Author's response to reviews

Title: Regional differences in lumbar spinal posture and the influence of low back pain

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Version: 3 Date: 7 August 2008

Author's response to reviews: see over
21/7/2008

Dr Melissa Norton

Editor

BMC Musculoskeletal

Dear Dr Norton,

Thank you for the opportunity to submit a revised version of our manuscript entitled “Regional differences in lumbar spinal posture and the influence of low back pain” for consideration for publication in BMC Musculoskeletal. The reviewer’s comments have been addressed, as outlined in the attached response document.

With regards to the following: “(1) Although you state that "ethical approval to conduct the study was granted from each institution involved", we require you to be more specific and document within your manuscript, the names of each of the committees which gave approval.” The names of the relevant committees have been documented in the revised manuscript (see Page 6, Line 3).

Yours Sincerely,

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Reviewer's report

Title: Regional differences in lumbar spinal posture and the influence of low back pain

Version: 1 Date: 16 April 2008

Reviewer: Jaap van Dieën

Reviewer's report:

general comments

The authors have studied the lower and upper sagittal plane angles in sitting and standing and a number of other postures and tasks in a large cohort of young female subjects. They provide relevant data, specifically regarding the lack of correlation between upper and lower lumbar angles. This finding clearly supports and extends previous literature that indicates that to make inferences on spinal tissue loading, upper and lower lumbar kinematics need to be regarded separately. In addition, the authors have studied the effect of low-back pain, with several case definitions, on these angles, on the relationship between upper and lower lumbar angles and on the relationship between lower lumbar angles across tasks/postures. While no group differences (effects of low-back pain) on the angles and on the relationship between upper and lower angles were found, a group difference in the relationship between the lower lumbar angle in sitting to the lower lumbar angle in other tasks was found.
Reviewer 1. Comment 1

From a comparison of the coefficients of correlation, it was concluded that this relationship is more consistent in the group without low-back pain than in the group with severe low-back pain or with low-back pain related to sitting. The latter conclusion is, in my view, not very convincing. The data presented in figure 3 indicate that the variance in angles is larger in the control group than among cases. Hence, the difference in the coefficient of correlation may reflect a difference in within-group variances of angles rather than a difference in consistency (the within-group covariance). It would appear that mean absolute residuals are not very different for example. An alternative interpretation could be that in the low-back pain group extreme angles are avoided. This doesn’t affect the mean, but does affect the within-group variance. The statistical analysis could be improved and perhaps expanded to provide a more thorough understanding of this interesting data set.

- We acknowledge that the variance in the no pain group of the measures presented is larger than the pain group. For this specific modelling of between-subject differences of within-subject task variances, a multilevel modelling approach would be the method of choice.

- As the reviewer rightly points out, the main finding of this paper is regional differences in lumbar spine kinematics over a large range of postures and tasks, and the variation in correlations between tasks across pain groups is a secondary finding.

- For this reason, this section of the analysis has been deleted, as it will be the subject of further more complex analysis which will be presented
in a separate publication.

Reviewer 1. Comment 2

The sitting and standing postures are defined as ‘usual’. It seems debatable whether subjects truly adopt their usual posture in the presence of a researcher whom they know to be interested in posture and low-back pain, certainly given the short measurement duration. The terminology needs to be adjusted and this point merits discussion.

- It is acknowledged that measuring true “usual” posture is difficult in the laboratory setting, and this is a weakness of any postural study.

However, subjects were not aware when the “usual” standing and sitting measures were being recorded, as they performed a number of tasks that involved sitting or standing as the starting position. These points have been addressed in the methods section (See page 8 / line 7) and the discussion section (See page 21 / line 8).

Reviewer 1. Comment 3

In the description of the functional tasks under point 3, ‘the box’ should be ‘the pillow’

- Change made (See page 10 / line 7).

Reviewer 1. Comment 4

ICC and SEM are reported for the lower lumbar angle. Please, add similar
information for the upper and total lumbar angle.

- Information provided as requested (See page 12 / line 3).

Reviewer 1. Comment 5

Why weren’t the tests performed in one ANOVA with low-back pain group, upper vs lower, and posture/task as factors? This would avoid some repeated testing and might give a more clear interpretation of the results. The differences in within-group variances may be a point of concern in the statistical analysis.

- There are a number of multivariate analysis choices for this data, being i) repeated measures ANOVA ii) multivariate ANOVA or iii) likelihood based multi-level models, and these choices represent increasing levels of complexity in the interpretation of results.

- As the reviewer points out, the first choice of repeated measures ANOVA may provide a more clear interpretation of the results. However, we were reluctant to use this method as there are both violations of sphericity (as the correlations between task conditions by lumbar area are non-exchangeable) and non-constant within-group variances using these models. This analysis would require interpretation of main effects for the within-subject factors of task, region and the between subject factor of pain group, along with the twoway interaction effects for task*region, task*paingroup, region*paingroup and the threeway interaction effect for task*region*paingroup. In addition another reviewer has requested adjustment for BMI, making the interpretation even more complex.
To reduce complexity of interpretation and to partially overcome violations of an exchangeable correlation assumption, we have chosen to present the results as a series of repeated measures ANCOVAs for each posture or task, with the repeated measure being lumbar region, and the between-subject contrast being pain group, adjusted for BMI (As requested by reviewer 2).

Reviewer 1. Comment 6

In the results section: ‘The Lx sagittal’ should probably be ‘The TLx sagittal’.

- The reviewer is correct and the change has been made (See page 13 / line 22).

Reviewer 1. Comment 7

Please repeat briefly here how motion (better range of motion) was defined, between which tasks.

- Motion was changed to range of motion and was defined as:
  
  (difference between maximal forward and backward bending angles)

  (See page 13 / line 22).

Reviewer 1. Comment 8

figure 3: Please use same axes for left and right panels to facilitate comparison.

- Figure 3 has been removed as per response to Reviewer 1. Comment 1
Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: Yes, and I have assessed the statistics in my report.

Declaration of competing interests:

I declare that I have no competing interests
Reviewer's report

Title: Regional differences in lumbar spinal posture and the influence of low back pain

Version: 1 Date: 3 June 2008

Reviewer: Julie Fritz

Reviewer's report:

The authors of this manuscript report on lumbar spine position during various tasks or static postures in nursing students with or without LBP, and based on different regions of the spine. The manuscript extends research in this area and may present a contribution to the literature in the area of the relationship between posture and LBP. There are however substantial concerns about the manuscript that should be addressed. My primary concerns relate to two issues.

First is the validity of the categorization of subjects into the various LBP categories used in this study.
The second is the statistical analysis and the lack of accounting for potential confounding variables in examining the relationship between spinal posture/ROM and LBP category.

Details of these concerns are provided below along with additional recommendations. I have referenced the section of the manuscript because my copy did not have any page numbers.

Major Compulsory Revisions

**Reviewer 2. Comment 1**

1. Methods section

   (LBP characteristics) – The categorization of LBP categories requires clarification. In the previous section the authors state that individuals with pain >3/10 on a VAS were excluded, yet lifetime LBP severity >4/10 is one of the requirements for the category “significant LBP”. This appears contradictory.

   - *The exclusion criteria refers to pain on the day of testing, in order to exclude the influence of current / acute pain on the subjects posture and movement measures. The lifetime LBP severity >4/10 refers to the worst level of LBP ever experienced.*
   
   - *It was considered that defining these groups based on a number of criteria was more valid than using a single criteria.*
   
   - *The exclusion criteria and subject LBP classification have been reworded to assist clarification: (See page 6 / line 7 and page 6 / line*
Reviewer 2. Comment 2

In addition, how is “lifetime LBP severity” determined? The authors mention that this was determined as the “mean episodic LBP severity data”, but it is not clear what this means. How was this question presented to the participant?

- This has been clarified in the text. Subjects were asked to rate their worst ever LBP on a visual analogue pain scale (See page 7 / line 1).

Reviewer 2. Comment 3

Were subjects asked to rate the severity of LBP for every episode they have had? If this is the case it raises concerns about recall bias.

- No, it was a rating of their worst ever LBP severity (See page 7 / line 1).

Reviewer 2. Comment 4

2. Statistical Analysis section –

The authors do not adjust their between-group comparisons or their correlation coefficients related to ROM and spinal angles for the height and weight (or BMI) for the subjects. The literature recognizes the potential influence of these variables on posture and ROM (for example, Gilleard W, Smith T. Effect of obesity on posture and hip joint moments during a standing task, and trunk forward flexion motion. Int J Obes. 2007;31:267-71) Table 1 does not suggest substantial mean differences between the LBP categories,
however individual variation on these variables could confound the results and should be adjusted for.

- The reviewer is correct on the issue of individual BMI variation confounding results. BMI has now been adjusted for in the analysis – with some very interesting findings which we believe strengthen the paper. These are reported in the results and discussion sections.

Minor Essential Revisions

Reviewer 2. Comment 5

1. The background section is somewhat confusing with respect to use of the term “posture”. At times the word is used to refer to a static position (sitting, standing), at other times it is used in conjunction with an activity (bending, lifting, twisting) and apparently refers to the position of the spine during these dynamic activities.

   It would be useful for the authors to clarify their definition of the term “posture” for this manuscript and/or clearly distinguish static posture from dynamic spinal position.

- The manuscript has been altered throughout, so “posture” only refers to static sitting and standing, and functional positions are referred to in terms of “position” or “angle” where appropriate, and not posture.
Reviewer 2. Comment 6

2. Background section (paragraph 3) – The authors refer to “specific health care populations”, but I think what is meant by this phrase is specific health care workers. Health care populations could be confused to types of patients therefore I would recommend changing the “populations” to “workers”.

- *With alterations to the background section, this sentence has been removed.*

Reviewer 2. Comment 7

3. Background section (paragraph 6) – The last sentence of this paragraph attempts to extend the results of a study on the lifting techniques of healthy individuals to identifying an optimal lifting strategy to reduce LBP. I recommend removing this sentence. The credibility of the authors’ supposition is tenuous at best and the issue is not central to the background for the current study.

- *This sentence has been removed as requested.*

Reviewer 2. Comment 8

4. Background section (paragraph 7) – The authors’ conclusions in this paragraph (based on the study by Gill and colleagues), also seem to require some clarification. The authors contend that a lack of variation in lower lumbar posture during lifting in healthy subjects leads to the conclusion that “specific regional spinal postures that an individual holds may be important in the
development or maintenance of LBP”. I am not certain how this conclusion is reached based on the results found by Gill et al. Are the authors simply attempting to say that different regions of the spine need to be examined separately? Please clarify.

- With alterations to the background section, this sentence has been removed

Reviewer 2. Comment 9

5. Methods section (LBP characteristics) – Please clarify how subjects with “minor LBP” were differentiated from “No LBP”.

- This issue has been clarified in the Methods (See page 7 / line 11).

Reviewer 2. Comment 10

6. Methods section (LLx, ULx, TLx angle measurement) – Please specify the ICC model used to calculate the inter-trial reliability coefficients.

- The ICC model used was ICC(3,1) (Portney and Watkins, 2000) was used and this information has been added in the text. (See page 12 / line 3).

Reviewer 2. Comment 11

7. Methods section – Can the authors provide any justification for the sample size that was used?

- As stated in the methods, this study was part of larger study into LBP in nursing students. Sample size calculations were not performed specifically for this paper.
• However on the primary hypothesis of this paper, that “regional (LLx / ULx) differences exist in spinal sagittal; static posture angles, range of motion and dynamic spinal angles during functional tasks”, a sample size calculation was conducted. It showed over 99% power to detect one half of one standard deviation in range of motion between the ULx and LLx spine in a sample size of 170 subjects using repeated measures. This was even assuming an unlikely strong correlation of 0.9 between ULx and LLx angles. (See page 12 / line 12).

Reviewer 2. Comment 12

8. Results section (effect of LBP on relationships) – the first sentence of this paragraph is not clear. Consider rewording the sentence to improve the clarity.
  • This paragraph has been reworded and clarified (See page 15 / line 10).

Reviewer 2. Comment 13

9. Results section (effect of LBP on relationships) – The authors state that all subjects were divided into either pain provoked by sitting or no pain in sitting based on the ODI. Were subjects in the “no LBP” category included in this? What threshold on the ODI scoring was used?
  • This part of the results has been removed as per the response to Reviewer 1. Comment 1.

Reviewer 2. Comment 14
10. Results section (effect of LBP on relationships) – The scatter plots are not necessary. These should be removed and the authors should report r values as they have for previous results in the manuscript.

- The scatter plots have been removed based on the change in analysis are per the response to Reviewer 1. Comment 1.

Reviewer's report

Title: Regional differences in lumbar spinal posture and the influence of low back
pain

**Version:** 1  **Date:** 26 May 2008

**Reviewer:** Martin Descarreaux

**Reviewer's report:**

**Title:** Regional differences in lumbar spinal posture and the influence of low back pain

**General comments**

This paper presents new data related to the possible link between lumbar spine posture and the development of low back pain. By dividing the lumbar spine into two functional “sub region” the authors investigated the possible link between changes in the lower and upper part of the lumbar spine and low back pain in a very specific population i.e. 170 undergraduate nursing students. These new results add up to the tremendous amount of data available on the topic of spinal posture vs pain, spinal posture vs spinal degeneration and will certainly help to better understand the possible influence of spinal posture on low back conditions.

My main concerns with the paper relate to the generalization of the results, the selection and the sub classification of the subjects.

*Page and line numbering would have been helpful in the revision of the manuscript.*

**Major Compulsory Revisions**
Reviewer 3. Comment 1

In the introduction, the authors have presented a very limited overview of the current knowledge related to posture and pain. This particular topic is very controversial and data for and against such relation (between posture and pain) are abundant. Other research group have dedicated their work to this possible relationship (Harrison DD, Harrison DE) and other to the absence of a relationship. The introduction should focus on the manuscript objectives and present data and the current body of knowledge pertaining to low back pain in nurses and the relation with posture. Otherwise it will remain a vague introduction, not serving the purpose of the article.

- **Given the change in analysis as per Reviewer one’s comments and direction from this comment to focus on the objectives, the introduction has been changed accordingly, with the emphasis on regional differences. Posture and LBP, and LBP in nurses are introduced as important issues in the introduction, however it is not in the scope of the paper to provide an expansive review of the literature on these issues.**

Reviewer 3. Comment 2

The authors have chosen to include subjects with low level of LBP ((pain less than 3 out of 10 on a VAS at the time of testing). They also state that only one subject was excluded from the study because of low back pain higher than “3/10” at the time of testing. Therefore, one could argue that the sample of subjects
chosen for this experimentation was relatively free of disabling low back pain. However the authors also performed a sub classification of their sample based on LBP intensity! On the basis of 4 criteria, one of them being “…LBP disability levels at the time of testing measured by the Oswestry Disability Index (ODI), (>20% based on mean ODI score for primary LBP of 26%” Pain and disability are at least partially correlated and it is difficult to understand how a group of patient could score under 3/10 on the VAS and at the same time present with significant disability.

- The exclusion criteria and subject LBP classification has been reworded to assist clarification as per Reviewer 2 Comment 1 (See page 6 / line 7 and page 6 / line 17).
- Exclusion criteria was based on pain intensity at the time of testing, while the sub-classification uses history of pain intensity to help classify subjects.
- Subjects with significant pain intensity at the time of testing (as opposed to significant pain intensity in the past) are likely to adopt postures and move in response to their current pain, and were excluded, as the study was not looking at the effect of acute / current pain on posture.
- The mean ODI for the significant LBP group was 21.2% ± 9.2. A review article by Fairbank (Fairbank and Pynsent, 2000) cites the mean ODI for Primary LBP as 27% across 21 studies, and the mean ODI for Chronic LBP as 43.3% across 25 studies. We agree with the reviewer’s
comments that the sample chosen was relatively free from disabling LBP. This is reflected in that they are otherwise a young, healthy, female university population.

- **Given their mean ODI was not particularly high, and the lack of strong correlation between pain and disability (Waddell, 2004; Chiu et al., 2005), it is quite likely that this group will present with a VAS score below 3/10 at the time of testing, as indeed was the case.**

**Reviewer 3. Comment 3**

The author should reconsider their sub classification and perhaps present only the date from a No LBP and LBP perspective. Sub classification of a very specific population is a major drawback to the possible generalization of the results. I think this issue has to be addressed by the authors.

- **Firstly, the authors believe that a very specific population strengthens the findings of this study, as it limits the number of potential confounding variables. This is particularly important given the somewhat novel findings in this study. The lack of generalization of these results across other populations is however already acknowledged in the limitations (See page 20 / line 20).**

- **Secondly, sub-classification has been shown to be a important to identifying differences between LBP subgroups and controls (Dankaerts et al., 2006; O'Sullivan et al., 2006), and is supported as a counter to the pain patient homogeneity assumption (Turk, 2005).**

**Reviewer 3. Comment 4**
The authors have discussed the reliability of the 3-Space Fastrak device but have not discussed its validity in the measurements of segmental spinal angles.

Their measurement is not a direct measure of spinal posture and various limitations are associated with the use of external markers to calculate spinal angles. Skin movements, markers movements, vibration, interference with magnetic fields, etc… have to be discussed and taken into consideration in the both the methods and discussion section of the manuscript.

- This study does not measure segmental spinal angles, it measures angles of spinal regions, across 3-4 spinal segments.
- Further evidence of reliability and validity of the 3-Space Fastrak system has been added to the methods, and its limitations acknowledged (See page 11 / line 6).
- This issue is also discussed in the limitations section (See page 21 / line 1).

Reviewer 3. Comment 5

Many paragraphs of the discussion section are barely repetitions of the results section. The authors have only compared their results with a few studies (to often their own work). The discussion should be shortened and targeted to the main results with more explicit interpretations of the data and not only results presentation.

- Given the change in analysis as per Reviewer 1. Comment 1, the
discussion has been changed accordingly, and Reviewer 3. Comment 5. has also been taken into consideration.

Minor Essential Revisions

Reviewer 3. Comment 6

Paragraph 1 “opinion remains divided regarding optimal LBP management” a reference should be used to support this part of the sentence.

- A reference has been added as suggested. (See page 3 / line 6).

Reviewer 3. Comment 7

Abstract section

Data should be presented in the same fashion throughout the results section of the abstract. Changes should be done according to the different comments and changes performed throughout the manuscript.

- Given the change in analysis as per Reviewer 1. Comment 1, the abstract has been changed accordingly, and Reviewer 3. Comment 7 has also been taken into consideration.

Reviewer 3. Comment 8

Background section

I suggest the authors use more recent references regarding the two following topics:

A. Low back pain and lumbar posture for and against

B. Low back pain in nurses (here are a few examples)


- The authors acknowledge the listing of current references by the reviewer.

- Some of the references suggested by reviewer 3 are not of specific relevance to the background of this paper, so have not been included. However, the background has been revised following the recommendations of reviewers one and three and the authors feel that appropriate literature has been referenced.

**Reviewer 3. Comment 9**

When stating that “…the notion of the lumbar spine as a homogenous region may not provide a true reflection of pain and function in this region”… the author should be more convincing about their potentially new sub division of the lumbar spine. There are at least functional and anatomical reasons for the classification of the lumbar spine as being one of the spine main regions. If otherwise the reader as to be convinced!

- The division of the Lx spine into ULx and LLx is not new, as indicated
by a reference to Burton’s study from 1987 (Burton, 1987). The introduction includes reference to more pain reported in the LLx spine than the ULx spine as well as greater degenerative changes in the LLx spine, which the authors believe does provide reasoning for considering the lumbar spine in separate regions.

- The introduction then discusses the regional differences found in lifting styles using the same sub-division of ULx and LLx regions as used in this paper (Gill et al., 2007), which the authors feel provides strong rationale for further investigation of regional lumbar spine differences.

- However, a reference to importance of considering spinal regions has been added to strengthen this argument (van Dieen et al., 1996) (See page 4 / line 2).

Reviewer 3. Comment 10

“This may help explain why previous research has been unable to identify an optimal lifting style for reducing LBP [21], as regional lumbar posture rather than whole spine or body position (eg. stoop v squat lift technique), may be a more important factor” This is really only an assumption and it should not be included in the background section of the manuscript.

- This sentence has been deleted as suggested by the reviewer.

Reviewer 3. Comment 11

“This may expose these segments to increased end range tissue stress for longer periods, and possibly increase risk of injury [23, 24]”. The work done by
Cholewicki and McGill relating to spine stability and the roentgenographic study conducted by Itoi are of completely different nature and I am not sure how these two references serve the authors comment. This whole paragraph needs to be clarified.

- *The introduction has been adjusted as described above, and this paragraph has been removed.*

**Reviewer 3. Comment 12**

Please state a clear hypothesis based on previous work, current knowledge and publications so that it will justify the objectives of the study.

- *A hypothesis has been added to the end of the introduction. (See page 5 / line 4).*

**Reviewer 3. Comment 13**

**Methods**

Defining the standing and sitting position (ex: standing posture they would usually adopt during habitual unsupported standing) must be defined as instructions to subjects. Stating that no direction of how to sit or stand was given is false as the usually adapted posture is a precise indication and might greatly impact the subject’s posture during testing. the definition of usual is not a defined position

- *The authors acknowledge this is a difficult issue in measuring “usual”*
spinal posture, and this has been addressed according to reviewer
Reviewer 1. Comment 2

- Subjects were instructed to stand on a mark facing a certain direction. They had been covertly observed in stand and sit prior to measurement, and there were a range of tests done with standing and sitting as the start position. Further, subjects did not know exactly when data was being recorded. Unreported ICC’s between usual stand prior to measurement of forward bending, sway, extension, and all functional tasks were extremely high (eg 0.98) – supporting that subjects reproduced a very consistent standing posture which was as close to “usual” standing as possible in the confines of this laboratory study.

Reviewer 3. Comment 14

The author should comment and present data regarding the standardization and variability of the functional tasks”.

- Further ICC and SEM data has been provided and commented on as per the request of Reviewer 1. Comment 4 (See page 12 / line 3).

Reviewer 3. Comment 14

Results

No need to include the obvious significant difference between LLx and ULx. Not include in the initial objective of the study.

- The authors are unsure of the meaning of this comment. The authors
contend that difference between LLx and ULx spinal posture and motion is the key aim of this study, and has not, to the authors knowledge, been reported previously across a range of postures and functional tasks. Also, reviewer 1 states “This finding clearly supports and extends previous literature that indicates that to make inferences on spinal tissue loading, upper and lower lumbar kinematics need to be regarded separately.”

Reviewer 3. Comment 15
The sample of subjects was hardly divided into two groups, stating that 53.4% of the subjects reported that sitting was the most common source of back pain is probably an overstatement. The author might have chosen this position for subsequent analyses instead of the other causes of low back pain but they it is more of an “editorial choice” than anything. The author should better justify this choice or performed statistical analyses on other sub group of patients.

- As per reviewer Reviewer 1. Comment 1, this analysis has been removed.

Reviewer 3. Comment 16
Discussion
Once again I am not sure how we can consider that 30% of the subjects presented with clinically significant low back pain base on the previously stated exclusion criteria.
• The variability in LBP definitions is acknowledged (Marras et al., 2007). Previous research has included “requiring medical attention” as a criteria for “serious LBP” (Adams et al., 1999). Our definition includes this, plus requires 2 of 3 other criteria based on LBP duration, disability and pain ratings, to be fulfilled.

• In this instance, the authors believe that our definition of “Significant LBP” is very robust given it considers measures of LBP across a range of domains. 53 out of 170 subjects (31.1%) were defined as having “Significant LBP”. It is specifically stated in the discussion that there is no suggestion that they are highly disabled (See page 18 / line 19).

Reviewer 3. Comment 17

Results are compared with MRI studies that can be considered a direct measure of lumbar posture or as some might say, gold standard measures. The author should acknowledge this fact and avoid simple conclusions like “Given our study found no difference in total ULx and LLx sagittal motion between LBP and control subjects, these hypotheses are not supported by our data” when in fact the two measures are very different in nature.

• The paragraph has been adjusted and the differences between types of posture measures has been acknowledged. (See page 20 / line 5).
Reviewer 3. Comment 18

Alternatively, other factors such as spinal motor control [3, 42], habitual posturing of the spine [11, 12], patterns of spinal loading [43], neurophysiological [44], psycho-social [45, 46], and genetic factors [47] may be more important mediating factors of LBP experience than spinal range of motion.

This is a useless sentence without further explanations. Considering that the discussion needs to be shortened I would delete it.

• This sentence was written to highlight that in the opinion of the authors, spinal ROM is less important in explaining LBP than a range of documented other factors. The authors believe that this is an important point, and would prefer to keep it in the discussion.

Reviewer 3. Comment 19

The last paragraph of the same section is also of little help for the reader. Could be deleted.

• The discussion has been rewritten according to reviewers comments, and this issue has been addressed.

Discretionary Revisions

Reviewer 3. Comment 20

Results

Please refer to table 2 in the functional tasks results (section: Regional lumbar static posture, range of movement and functional task postures)
• The results section has changed somewhat, and the authors have ensured tables are appropriately referred to.

REFERENCES


Dankaerts, W., O'Sullivan, P., Burnett, A.Straker, L. 2006. Differences in sitting postures are associated with nonspecific chronic low back pain disorders when patients are subclassified. Spine. 31(6), 698-704.


