Academy of PHYSICAL MEDICINE

Research Paper Review

This review is published with the permission of Research Review Service (www.researchreviewservice.com)

Comparing lumbo-pelvic kinematics in people with & without back pain: a systematic review & meta-analysis

BMC Musculoskeletal Disorders 2014 Jul 10; 15:229

Laird RA, Gilbert J, Kent P, Keating JL

Reviewed by Dr. Jeff Muir DC (Research Review Service)

ABSTRACT

Background: *Clinicians commonly examine posture and movement in people with the belief that correcting dysfunctional movement may reduce pain. If dysfunctional movement is to be accurately identified, clinicians should know what constitutes normal movement and how this differs in people with low back pain (LBP). This systematic review examined studies that compared biomechanical aspects of lumbo-pelvic movement in people with and without LBP.*

Methods: *MEDLINE, Cochrane Central, EMBASE, AMI, CINAHL, Scopus, AMED, ISI Web of Science were searched from inception until January 2014 for relevant studies. Studies had to compare adults with and without LBP using skin surface measurement techniques to measure lumbo-pelvic posture or movement. Two reviewers independently applied inclusion and exclusion criteria, and identified and extracted data. Standardised mean differences and 95% confidence intervals were estimated for group differences between people with and without LBP, and where possible, meta-analyses were performed. Within-group variability in all measurements was also compared.*

Results: *The search identified 43 eligible studies. Compared to people without LBP, on average, people with LBP display: (i) no difference in lordosis angle (8 studies), (ii) reduced lumbar ROM (19 studies), (iii) no difference in lumbar relative to hip contribution to end-range flexion (4 studies), (iv) no difference in standing pelvic tilt angle (3 studies), (v) slower movement (8 studies), and (vi) reduced proprioception (17 studies). Movement variability appeared greater for people with LBP for flexion, lateral flexion and rotation ROM, and movement speed, but not for other movement characteristics. Considerable heterogeneity exists between studies, including a lack of detail or standardization between studies on the criteria used to define participants as people with LBP (cases) or without LBP (controls).*

Conclusions: *On average, people with LBP have reduced lumbar ROM and proprioception, and move more slowly compared to people without LBP. Whether these deficits exist prior to LBP onset is unknown.*

Keywords: *Low back pain; Movement disorders; Posture; Range of movement; Lordosis; Proprioception*

ANALYSIS

Author's Affiliations
Department of Physiotherapy, Monash University, Australia; Peak MSK Physiotherapy, Australia; Department of Sports Science and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark; Research Department, Spine Centre of Southern Denmark, Lillebaelt Hospital, Institute of Regional Health Services Research, University of Southern Denmark

Background Information
Lumbopelvic movement and posture are basic components of the physical examination of low back pain (LBP) sufferers, due in large part to the belief that identifying and correcting movement or postural aberration(s) can improve pain and activity limitation (1-3). Examination generally ranges from basic evaluation of range of motion (ROM) and posture to more complex variables such as proprioception, muscle activation patterns and postural sway. However, measurements of lumbopelvic kinematics vary widely in the published literature, owing to differences in instrumentation (4), biological differences in true ROM and human error.

Despite the importance of lumbopelvic mechanics in low back pain, there are no studies comparing movement kinematics in patients suffering from LBP to those without LBP. The following systematic review and meta-analysis was undertaken to investigate and compare typical lumbopelvic movement differences between people with and without LBP.

PERTINENT RESULTS

Initial searches yielded a total of 17,276 articles, of which 86 were retrieved for full review. Forty three studies were ultimately deemed eligible for this review.

Study Type
- Articles examining lumbar lordosis: 8
- Articles evaluating range of motion: 21
- Articles evaluating hip and lumbar contribution to trunk movement: 6
- Articles evaluating pelvic angle/relative position and ROM: 4
- Articles evaluating speed/acceleration of lumbar movement: 8
- Articles evaluating proprioception: 17

Definitions
The definition of LBP was variable among the included studies. 48% provided no diagnostic criteria; 37% defined LBP non-specifically; 15% used either a Quebec Task Force (5) or movement-based classification.

A defined control group was present in 60% of studies, although these definitions were varied and

vague, including “no current pain” (16%), varying periods of time since the last episode of LBP (35%) and “no LBP ever” (9%).

Study Quality

Several criteria were examined regarding potential areas of bias. No studies attempted blinding of assessors to group status, and only one study reported standardizing instructions to participants. There was no significant correlation observed between total quality assessment scores and the magnitude of SMDs in measurements for those with and without LBP (r = 0.03).

Movement Characteristics

- *Lordosis*: 8 studies compared lumbar lordosis in patients with and without LBP. Most reported small, non-significant differences. The pooled analysis also showed no significant difference. Women demonstrated a greater lordosis angle than men across the pooled results.
- *Range of motion*: 26 studies compared ROM in patients with and without LBP. Statistically significant decreases in all ranges of motion (flexion, extension, lateral flexion, rotation) were observed in patients with LBP versus those without LBP.
- *Lumbar spine versus hip contribution to flexion/extension*: 6 studies examined relative lumbar and hip contributions to lumbar flexion. No significant difference was noted between those with and without LBP. A non-significant decrease was noted in lumbar contribution to flexion in patients with LBP. 3 studies found significant differences in the “through-range” contribution of lumbar movement, noting significant differences in the mid-range of flexion.
- *Pelvic tilt angle, relative position and tilt range*: 3 studies examined pelvic tilt angle while standing and found no significant differences between patients with LBP and those without. One study compared differences between groups in full anterior and posterior tilt positions and found a significant difference for maximum anterior tilt angle, but not for maximum posterior tilt angle.
- *Speed/Acceleration*: 7 studies measured speed while one measured acceleration. Patients with LBP demonstrated a significantly slower movement than those without LBP.
- P*roprioception*: 15 studies measured position/reposition accuracy as a gauge of lumbar spine proprioception. 12 studies measured the absolute error in repositioning accuracy and were pooled in the meta-analysis. A consistent, large and significant reduction in the ability to accurately re-position the spine at pre-specified angles was observed in people with LBP compared to those without LBP.

CLINICAL APPLICATION & CONCLUSIONS

After evaluating 43 studies and 6 movement characteristics: lordosis, ROM, lumbar versus hip contribution, pelvic tilt, speed and proprioception, the results indicate that patients with low back pain, when considered collectively, have reduced lumbar ROM, move more slowly and have reduced proprioception than people without low back pain. No differences between patients with and without low back pain were noted in lumbar lordosis angle, lumbar contribution to flexion or pelvic tilt angle. This information, while not surprising to experienced clinicians, is nevertheless valuable in assisting with the diagnosis and management of low back pain and adds to our clinical knowledge base currently available for this chronic and often disabling condition.

STUDY METHODS

Study selection

To be included in this review, studies had to:

- assess adults > 17 years of age,
- use non-invasive measurement systems (i.e. did not use measurements such as X-rays, CT scans),
- apply the same procedures to measure people with low back +/- leg pain (LBP group) and people without LBP (No LBP group),
- measure at least one of: lumbar lordosis, lumbar range of motion (ROM), speed/acceleration/timing of lumbar +/- hip movement, pelvic tilt angle (as measured by a line drawn from anterior to posterior superior iliac spines with an angle formed relative to horizontal, measured in sitting or standing), pelvic tilt ROM (defined as a range from maximum anterior tilt to maximum posterior tilt), usual sitting pelvic tilt position (i.e. relative to full anterior tilt), lumbar compared with hip contributions to ROM, lumbopelvic proprioceptive position/re-position accuracy, and
- report appropriate measurement means (or other point estimates) and variance estimates or data that enable estimation of these values.

No specific definition of LBP was required by study authors. Studies were excluded if they:

- included people who had lumbar surgery in the previous 12 months,
- reported that subjects had fracture, neurological conditions, metabolic disease, neoplasm, or scoliosis,
- measured only whole body movement such as distance from finger-tip-to-floor, or
- reported insufficient data, e.g. did not report measures of variability.

Literature Search Strategy

Eight electronic databases (MEDLINE, Cochrane Central Register of Controlled Trials (Central), EMBASE, AMI, CINAHL, Scopus, AMED, ISI Web of Science) were searched from inception until January 2014. A comprehensive search strategy was utilized, in an attempt to identify all studies involving low back pain and movement evaluation (6).

Study Quality

A quality assessment tool, using a similar approach to Mieritz (7), was constructed to determine how each study accounted for possible sources of bias, and if the study provided details on:

- study population (age, sex, BMI, source),
- participants' LBP (chronicity, +/- leg pain, specific versus non-specific, pain intensity and activity limitation scores),
- measurement procedures (i.e. detail that would enable accurate replication of the experiment, instrument description, standardized movement instructions, movement process descriptions such as fixed or free pelvis),
- blinding of assessors to the presence of back pain (yes/no), and
- whether the same assessment procedures were applied to participants with and without back pain.

Data Synthesis and Analysis

For each comparison, standardized mean differences (SMD) between groups with and without LBP were calculated using Revman software (8). Pooled analysis of overall differences between groups was

performed where study methodology was sufficiently similar to allow comparison. Within-group variability was measured for each movement characteristic. A coefficient of variation (CoV) (9) was calculated for each movement parameter using those studies included in the relevant meta-analysis.

STUDY STRENGTHS / WEAKNESSES

Strengths

- A comprehensive search strategy was employed.
- A broad range of movement characteristics were evaluated.
- Screening and data extraction were independently performed by two reviewers.
- Only studies comparing patients with and without LBP were evaluated.

Limitations

- The heterogeneity of patients with LBP is a lingering problem in all research on this topic (i.e. no sub-grouping based on pain, testing or other measures was performed).
- The authors limited their search to English-only articles, which may have excluded important data.

Additional References

1. Sahrmann S: Diagnosis and treatment of movement impairment syndromes. St Louis: Mosby Inc; 2002.
2. O'Sullivan PB. Diagnosis and classification of chronic low back pain disorders: Maladaptive movement and motor control impairments as underlying mechanism. Man Ther 2005; 10: 242–255.
3. Ikeda K, McGill S. Can altering motions, postures, and loads provide immediate low back pain relief: A study of 4 cases investigating spine load, posture, and stability. Spine 2012; 37(23): E1469–E1475.
4. Mannion A, Troke M. A comparison of two motion analysis devices used in the measurement of lumbar spinal mobility. Clin Biomech 1999; 4(9): 612–619.
5. Spitzer WO et al. Quebec Task Force on spinal disorders - Scientific approach to the assessment and management of activity-related spinal disorders - a monograph for clinicians. Spine 1987; 12(7): 1–59.
6. Additional file 1: 3254663351295239_add1.docx, 37K http://www.biomedcentral.com/imedia/4800244591353727/supp1.docx
7. Mieritz R, Bronfort G, Kawchuk G et al. Reliability and measurement error of 3-dimensional regional lumbar motion measures: a systematic review. J Manipulative Physiol Ther 2012; 35(8): 645–656.
8. The Cochrane Collaboration: Review Manager (RevMan) (computer program). Version 5.2. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration; 2012.
9. Koopmans L, Owen D, Rosenblatt J. Confidence intervals for the coefficient of variation for the normal and log normal distributions. Biometrika 1964; 51: 25–32.