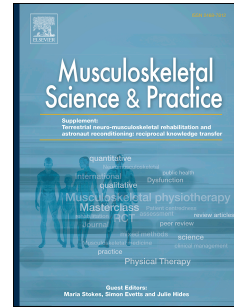


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What do physiotherapists and manual handling advisors consider the safest lifting posture, and do back beliefs influence their choice?

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Conflicts of interest:

Two authors (KOS, POS) receive income for providing continuing education courses on low back pain which include challenging prevailing beliefs regarding lifting and back pain.

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Abstract

Background: It is commonly believed lifting is dangerous and the back should be straight during lifting. These beliefs may arise from healthcare professionals, yet no study has evaluated the lifting and back beliefs of manual handling advisors (MHAs) and physiotherapists (PTs).

Objectives: To evaluate (i) what lifting technique MHAs and PTs perceive as safest, and why, and (ii) the back pain beliefs of MHAs and PTs.

Design: Data was collected via an electronic survey.

Method: Participants selected the safest lifting posture from four options: two with a straight back and two with a more rounded back, with justification. Back beliefs were collected via the Back-Pain Attitudes Questionnaire (Back-PAQ). Relationships were investigated using multiple linear and logistic regression models.

Results: 400 PTs and MHAs completed the survey. 75% of PTs and 91% of MHAs chose a straight lifting posture as safest, mostly on the basis that it avoided rounding of the back. MHAs scored significantly higher than PTs on the Back-PAQ instrument (mean difference = 33.9), indicating more negative back beliefs. Those who chose the straight back position had significantly more negative back beliefs (mean 81.9, SD 22.7) than those who chose a round back lift (mean 61.7, SD 21.1).

Conclusion: Avoiding rounding the back while lifting is a common belief in PTs and MHAs, despite the lack of evidence that any specific spinal posture is a risk factor for low back pain. MHAs, and those who perceived a straight back position as safest, had significantly more negative back beliefs.

Introduction

Low back pain (LBP) is a large and growing issue in Western societies (Deyo et al., 2009), and work absence due to back pain is socially and economically expensive (Maniadakis and Grey, 2000). The reasons for this increasing problem are much debated, but what is clear is that LBP, especially when it persists, is a complex disorder driven by a number of factors across a wide biopsychosocial spectrum (Pransky et al., 2011). In this regard, while there is evidence that physical demands of work are associated with LBP, they only account for a modest proportion of LBP in the workforce (Waddel and Burton, 2001).

In the prevention of LBP, employers commonly use manual handling training for their staff. This training often involves teaching people how to lift, as lifting is the main way of loading the spine and is often cited as provocative in those with LBP (Coenen et al., 2014). However, the evidence that lifting is a risk factor for LBP is debatable. Cumulative back loading has been associated with LBP (Coenen et al., 2013), yet there is no proven causal link between lifting and LBP (Wai et al., 2010). In fact, mechanical loading parameters in general have not been shown to be independently causative of LBP (Roffey et al. 2010; Roffey (b) et la., 2010; Roffey (c) et al., 2010; Roffey (d) et la., 2010; Roffey (e) et al., 2010; Wai (b) et al., 2010; Wai (c) et al., 2010). More specifically, there is no *in vivo* evidence that lifting with a round back is a predictor for LBP, nor that lifting with a straight back is safer, despite this being a widely held belief. This may help to explain why teaching people how to lift has not been shown to be effective in preventing LBP (Hignett, 2003; Maher, 2000; Bos et al., 2006; Matimo et al., 2008).

Back beliefs that are consistently held in those with LBP are that their spine is a vulnerable structure that is easily injured and in need of protection (Darlow et al., 2015). These beliefs have, in part, been shown to come from their treating healthcare professional (Darlow et al., 2013), and clinicians' beliefs affects their clinical management (Daykine and Richardson, 2004).

To date, the back pain beliefs of MHAs have not been assessed, an important consideration as they advise others regarding the risks of LBP.

There is an emerging view that certain advice to protect the back may not always be helpful in the treatment of LBP (O'Sullivan et al., 2016) and, in fact, may fuel a cycle of negative beliefs and thoughts leading to fear and protective behaviours that maintain the disorder (O'Sullivan, 2005). For example, it has been shown that those with LBP lift cautiously; they move slower when they bend, bend their back less, and co-activate the muscles supporting the spine – thereby bracing themselves (Ferguson et al., 2004; Rudy et al., 2003; Slaboda et al., 2008). This way of movement is less efficient and linked to greater spinal loading which may be pro-nociceptive (Marras et al., 2001). This cautious way of lifting also reflects commonly taught lifting strategies, where individuals are advised to keep the back straight and bend their knees. The theory that squat lifting in this manner is the safest way to lift comes from *in vitro* data suggesting that it is harder to injure certain elements of the spine when the natural lordotic curve of the spine is maintained, and bending is avoided (Callaghan and McGill, 2001). However, this has not been confirmed *in-vivo* (Dreischarf et al., 2016, Kingma et al., 2010). Indeed, lifting with a round back has actually been shown to be more efficient (Holder, 2013). It is plausible that teaching those with back pain to keep their back straight when they lift and the belief that the spine is vulnerable may in fact be unhelpful.

To date little is known about the beliefs of PTs and MHAs regarding lifting. O'Sullivan et al., (2012) showed that physiotherapists tended to prefer more upright sitting postures over flexed postures as best for the back and choosing this posture was associated with more negative beliefs about back pain. We hypothesise the same relationship will be observed for lifting, where those with more negative attitudes about back pain will believe straight back lifting is safest, and this will be associated with more negative back beliefs.

The aims of this study are therefore:

1. To determine which lifting posture PTs and MHAs think is the safest, and why.
2. To investigate factors (e.g. profession, sex, experience) associated with lifting posture beliefs.
3. To investigate factors associated with back pain beliefs.
4. To investigate the relationship between lifting posture beliefs and back pain beliefs.

Methods

Participants

Participants, either MHAs or PTs, were recruited in three ways: (i) using an email sent to all members of the National Back Exchange – an association set up to promote evidence-based practice among manual handling advisors; (ii) by advertisements placed on the Chartered Society of Physiotherapy web page; and (iii) via dissemination of Twitter links to the study. Those who did not work with individuals with back pain were asked not to participate.

Generating photographs

After consultation with professional colleagues, four sample lifting postures were chosen (Figure 1). These reflected common lifting techniques. A 37-year-old male with no history of LBP and adequate flexibility to assume these postures was used as a model.



Lift a)



Lift b)



Lift c)



Lift d)

Fig 1. Four lifting postures: a and d straight back, and b and c round back

Data collection

Demographic, health and employment data of participants was collected via an electronic survey, including: age, sex, occupation (PTs or MHAs), main country of work, years of experience, whether or not specific qualifications in manual handling (MH) had been obtained, whether or not the participant taught MH techniques to others, and whether or not the participant had LBP within the last 12 months.

Information on whether participants taught MH techniques to others was elicited only from those who reported that they had obtained specific qualifications in MH: other information was collected from all participants.

The back pain beliefs for each participant were collected via the Back-PAQ survey (Darlow et al., 2014). This survey comprises 34 Likert-style items, each with 5 possible responses. The survey has been designed to highlight beliefs that are thought to be unhelpful for recovery from an episode of back pain; for example, beliefs about the vulnerability of the back, relationship between pain and injury, prognosis of back pain, activity and back pain, and psychological influences on back pain. Scores from these items were summed to give an overall score of back pain beliefs. A range of scores from 34 to 170 is possible, with higher scores indicating more unhelpful beliefs – for instance, that the back is easily injured and in need of protection. This outcome measure has been shown to have adequate internal consistency, construct validity and test-retest reliability (Rushworth, 2015).

Data relating to participants' opinions on safe back lifting posture, and responses to the Back-PAQ survey, was also collected via the electronic survey. When selecting an optimum posture from four possible options (figure 1), participants were asked: "Assume the load in the box is a weight that the subject finds heavy, but possible to lift. Which lift do you consider to be the safest?" Two of the postures corresponded to different versions of a straight back lifting and

answers were combined to form a “straight” group; the remaining two corresponded to varying degrees of a rounded back of lifting posture and were combined to form a “rounded” group. In addition, a comment box was provided asking: “Why have you chosen this technique?”

Data Analysis

The sample was summarised descriptively. A series of χ^2 tests for association and uncontrolled logistic and linear regression analyses were conducted as screening procedures for the lifting position and Back-PAQ outcomes; considering the association between the appropriate outcome and each of the predictor variables in turn. Any variable that appeared to show some substantive relationship with the outcome measure was carried forward for inclusion in a multiple model. Automated modelling strategies were not utilised. Model goodness-of-fit, discrimination and calibration, collinearity between predictors and linearity of the logit were assessed using standard procedures.

The significance of the difference in Back-PAQ score between those choosing a straight or rounded back lifting posture, controlling for other covariates, was also assessed as a secondary analysis using an independent samples t-test.

The qualitative comments of each participant justifying their choice of safest lift (393/400) were first grouped into the same “straight” and “rounded” categories. Thereafter, words were grouped together into common themes and the frequency of these themes compared descriptively between the “straight” and “rounded” categories.

Ethics

Approvals were attained from South West Yorkshire Partnership NHS Foundation Trust, UK, who sponsored the study. The electronic questionnaire included an information page

informing participants of the purpose of the study and providing assurances of anonymity.

Consent was assumed by completion of the questionnaire.

Results

Descriptive summary of participants

Data was obtained on 471 individuals; of which 400 completed the survey – 71 completed demographic information only. The sample is summarised descriptively in Table 1 below.

Table 1: Descriptive summary of sample

| Categorical variable | Frequency (valid %) |
|---|----------------------------|
| Sex | |
| Male | 216 (45.9%) |
| Female | 255 (54.1%) |
| Main country of work | |
| United Kingdom and dependencies | 306 (65.0%) |
| Ireland | 23 (4.9%) |
| Australia and New Zealand | 34 (7.2%) |
| Europe (non UK/Ireland) | 60 (12.7%) |
| North America | 25 (5.3%) |
| Others | 23 (4.9%) |
| Occupation | |
| Manual Handling Advisor | 160 (34.0%) |
| Physiotherapist | 311 (66.0%) |
| Low back pain within previous 12 months | |
| Yes | 80 (17.1%) |
| No | 389 (82.9%) |
| Specific qualifications in manual handling | |
| Yes | 254 (54.2%) |
| No | 215 (45.8%) |
| Manual handling techniques taught to others | |
| Yes | 213 (83.9%) |
| No | 41 (16.1%) |
| Preferred back position when lifting | |
| a | 210 (52.5%) |
| b | 13 (3.3%) |
| c | 64 (16.0%) |
| d | 113 (28.2%) |
| a&d combined - Straight | 323 (80.7%) |

| | |
|----------------------------|-------------------------|
| b&c combined - Rounded | 77 (19.3%) |
| Numerical variable | Mean (SD; range) |
| Age (years) | 40.4 (11.3; 20-66) |
| Experience in role (years) | 10.9 (8.17; 1-40) |
| BACK-PAQ summed score | 78.0 (23.8; 34-134) |

Back lifting posture outcome

Only 65 PTs (24.4%) and 12 MHAs (9.1%) selected one of the two rounded back lifting postures (in preference to the alternative two straight back lifting postures). Nine respondents who had reported having LBP within the previous 12 months (13.8%) and 68 respondents who had not reported having LBP within the previous 12 months (20.4%) selected a rounded back lifting posture. 24 respondents who had specific qualifications in moving and handling with teaching experience (13.0%), three respondents who had specific qualifications in moving and handling but no teaching experience (9.7%), and 50 respondents who did not have specific qualifications in moving and handling (27.5%) selected a rounded back lifting posture. The screening tests revealed choice of lifting posture to be substantively associated with *Occupation, LBP, Qualifications-Teaching* and *Experience*, which were all carried forward for inclusion in a multiple logistic regression model.

The multiple logistic regression model revealed evidence that, controlling for other factors and covariates, the odds of PTs choosing a *rounded* back posture were about two and a half times the odds of MHAs choosing a *rounded* back posture (OR=2.44; 95% CI 1.19 to 5.00; $p=0.015$).

The model also revealed evidence that, controlling for other factors and covariates, the odds of choosing a *rounded* back posture were about four times less in those with specific MH qualifications than those without (OR=0.278; 95% CI 0.080 to 0.964; $p=0.044$); and about two times less in those with specific MH qualifications with teaching experience than those without

(OR=0.519; 95% CI 0.285 to 0.945; $p=0.032$). Experience of LBP was not significantly associated with choice of back lifting posture.

No evidence was revealed for collinearity between included variables in the multiple model; or for non-linearity of the logit with respect to numerical predictors.

Odds ratios, associated 95% confidence intervals and p -values of all tested parameters are summarised in Table 2.

Table 2: Multiple logistic regression parameters (choice of back lifting position outcome)

| Variable | Parameter estimate | 95% CI | p -value |
|---|--------------------|----------------------------------|----------------|
| Occupation MHA (reference) Physiotherapist | 2.44 | (1.19, 5.00) | 0.015 |
| LBP No recent back pain (reference) Recent back pain | 0.723 | (0.333, 1.57) | 0.413 |
| Qualifications-teaching No specific MH qualifications or teaching experience (reference) Qualifications but no teaching experience Qualifications with teaching experience | 0.278 0.519 | (0.080, 0.964) (0.285, 0.945) | 0.044 0.032 |
| Experience in role (years) | 1.025 | (0.995, 1.056) | 0.105 |

The model was found to classify 80.6% of cases correctly. The Nagelkerke pseudo- R^2 statistic of 0.102 suggested that the data was an adequate fit to the model. The Hosmer and Lemeshow test revealed no evidence that the model was not adequately calibrated ($\chi^2_{(8)}=2.59$, $p=0.958$); i.e. the observed and predicted probabilities agreed well over the entire range of probability values.

Back-PAQ score outcome

The uncontrolled linear regression screening models revealed that occupation, recent LBP and specific qualifications in manual handling with teaching experience were substantively

associated with Back-PAQ score; all of which were all carried forward for inclusion in a multiple linear regression model. The screening models revealed no evidence that length of experience was associated with the Back-PAQ score.

PTs scored a mean of 67.4 points (SD 18.6) on the Back-PAQ survey, whereas MHAs scored a mean of 101.3 points (SD 15.9). Those with back pain within the last 12 months scored a mean of 81.8 points (SD 26.0) on the Back-PAQ survey; those without back pain within the last 12 months scored a mean of 77.2 points (SD 23.3). Those with specific MH qualifications with teaching experience scored a mean of 88.6 points (SD 22.1) on the Back-PAQ survey; those with specific MH qualifications but no teaching experience scoring a mean of 68.5 points (SD 15.0), those without specific MH qualifications scored a mean of 68.9 points (SD 22.1).

The multiple linear regression model revealed that, after controlling for other factors and covariates, MHAs scored 30.7 points more than PTs on the Back-PAQ scale (95% CI: -35.1 to 26.3). Consequently, occupation was significantly associated with Back-PAQ score ($p < 0.001$).

The model also revealed evidence that, controlling for other factors and covariates, those who had both specific qualifications in MH, and teaching experience, scored 6.33 points more on the Back-PAQ scale (95% CI: 2.20 to 10.5) compared to those who had no teaching experience (regardless of specific qualifications). Thus, qualifications in MH with teaching experience was significantly associated with Back-PAQ score ($p = 0.003$).

The model revealed no evidence that a participant experiencing LBP within the last 12 months was associated with Back-PAQ score, controlling for other factors and covariates ($p = 0.696$).

Residual analysis indicated no violations of regression assumptions. No evidence was revealed for collinearity between included variables in the multiple model.

Parameter estimates, associated 95% confidence intervals and p -values of all tested parameters are summarised in Table 3.

Table 3: Multiple linear regression parameters (BACK-PAQ score outcome)

| Variable | Parameter coefficient | 95% CI | p -value |
|---|-----------------------|----------------|------------|
| Occupation | | | |
| Manual handling advisor (reference) | | | |
| Physiotherapist | -30.7 | (-35.1, -26.3) | <0.001 |
| Back pain within 12 months | | | |
| No pain (reference) | | | |
| Pain | 0.978 | (-3.95, 5.91) | 0.696 |
| Qualifications and teaching | | | |
| No teaching experience ¹ (reference) | | | |
| Both qualifications and teaching experience | 6.33 | (2.20, 10.5) | 0.003 |

¹With or without specific MH qualifications

Analysis of relationship between outcome measures

The mean Back-PAC score amongst participants who selected a *rounded* back lifting posture was 61.7 (SD 21.1). The mean Back-PAC score amongst participants who selected a *straight* back lifting posture was 81.9 (SD 22.7). An independent samples t-test found this difference of 20.1 to be statistically significant ($p < 0.001$; 95% CI: 14.5 to 25.7).

Qualitative appraisal of lift choice

The main reason given by participants for choosing a straight back lift as safest ($n=319$) was because it was either 'neutral' or 'straight' ($n=143$). Other reasons were that the posture allowed 'good use of the legs' ($n=118$), 'got the load in close' ($n=107$), involved 'proper head posture' ($n=61$), looked the 'most efficient' ($n=28$), involved 'good back posture' (but not specifically what posture) ($n=19$), and it 'protects the back' ($n=15$).

The main reason for why the rounded group ($n=74$) chose that lift as safest was the fact it looked the 'most efficient' way of lifting ($n=21$). Other reasons that emerged were that it looked the 'most natural' position ($n=19$), looked the 'most relaxed' ($n=18$), allowed 'good use

of the legs' (n=14), involved 'moderate back flexion' (n=12), had the 'load in close' (n=7) and looked the 'most comfortable' (n=6).

Discussion

This is the first study to investigate the perceptions of PTs and MHAs on safe lifting posture. The results of this study show that the majority of PTs (76%) and MHAs (91%) perceive that a straight back lifting posture is safer than a more rounded one. However, the results do find a significant difference – PTs are 2.5 times more likely than MHAs to choose a more rounded lifting position.

Those who chose a straight lifting posture justified their choice mainly based on a biomechanical description such as the straight posture involving a "neutral spine", "straight back", "good posture" (51%) or "head posture" (20%). Conversely, the rounded group used more global terms to justify their choice; such as, these postures looking "efficient" (28%) and "relaxed" or "comfortable" (32%). The fact that the rounded postures involved a specific back posture, "moderate flexion", was mentioned less commonly (16%). Both groups reported their choice involved efficient use of the legs (37% straight *versus* 19% rounded). The straight group report keeping the load close as important (34%), whereas it was used much less for justification in the rounded group (9%).

The more biomechanical terms used by those selecting the straight postures could explain the difference in back pain beliefs between groups, as measured by the Back-PAQ. Those who chose a straight lifting posture, justifying it in biomechanical terms, scored higher than those who chose a rounded lifting posture, suggesting that their beliefs were associated with greater caution about the back.

There was a significant difference in back beliefs between PTs and MHAs, with MHAs having more negative beliefs about the back. This could be explained by differences in training and continuing professional education. It has been widely reported in the physiotherapy literature that attitudes and beliefs are important in the recovery from an episode of back pain (Linton, 2000) and that advice to protect the back can be detrimental (Darlow et al., 2013). This may have led to physiotherapists, in the sample we collected, having less cautious beliefs to lifting than MHAs. However, most physiotherapists still advised people to avoid bending the back when lifting which suggests physiotherapists appear to be quite cautious.

Most PTs and MHAs advise people to avoid rounding the back with lifting, adopting a squat style. This appraisal supports that they consider this lift to be the safest, and that this technique is the one they would teach someone for the prevention or management of LBP. Interestingly, it has been shown that those with self-reported disabling LBP already use the squat technique to lift (Damkot et al., 1983), and this has been confirmed by kinematic studies that show those with LBP lift differently to those that do not; in that they bend the back less, bend the knees more and co-contrast the muscles around the trunk (Fergauson et al., 2004, Marras et al., 2001, Rudy et al., 2003, Slaboda et al., 2008). There is also evidence to suggest that in people with LBP, those with higher levels of pain-related fear tense their back muscles more and flex their back less during forward bending activities (Geisser et al., 2004). This data suggests that people with LBP tend to bend and lift in the manner commonly advised by healthcare professionals (straight back), as an attempt to avoid stressing painful structures in the back. However, biomechanical modelling data suggests that lifting with the back straight and with trunk muscle co-contraction in fact results in *greater* biomechanical loads on the back (Marras et al., 2001). In contrast, when not instructed, pain-free individuals use a more rounded style of lifting (Straker and Duncan, 2000), which has been shown to be more efficient (Holder, 2013).

Optimal lifting technique is an area of professional uncertainty. Some researchers advise the avoidance of flexion due to, in part, *in vitro* studies that show spinal discs are harder to injure when the spine is in a 'neutral' position (Gunning et al., 2001). It has even been speculated that the back has a limited number of flexion cycles (Callaghan and McGill, 2001) and that flexion should be avoided to spare the spine. However, the transferability of these studies, and their related assumptions, have been challenged by in-vivo modelling that has failed to show that back posture is a major determinant of spinal load (Dreischarf et al., 2016), and studies showing that lifting is not independently causative of LBP (Wai et al., 2010). There is also a lack of clear evidence regarding the relationship between injury, tissue damage and back pain (Brinjikji et al., 2015, Jarvik et al., 2005). Common justifications in both groups for the choice of straight versus rounded back lifting posture were that their choice was the most efficient. However, it has been shown that squat lifting (straighter back and deeper knee bend) is less efficient than a more rounded style (Holder, 2013).

Currently there is no *in vivo* evidence to support the superiority of one lifting technique as being safer than another. In spite of this, there is an overwhelming belief amongst MHAs and PTs, surveyed in this study, that straight back lifting is safer than round back lifting. Interestingly this belief was associated with more negative back pain beliefs regarding the vulnerability of the back. This belief also contradicts emerging evidence that straight back lifting is less efficient than round back lifting and people with LBP should adopt more of a straight back lifting style. There is an urgent need to clarify these issues, as advice regarding lifting is central to the ergonomic industry and advice to 'protect' the back might actually have negative consequences for people with LBP (Bunzli et al., 2013).

Limitations to this study include the electronic nature, and the fact it was advertised on social media; this could have biased the sample to those active on the internet. These views may not

be fully representative of the professions. Also, the survey is a snapshot in time, and beliefs may be fluid. Finally, we did not ask if participants' view of the safest lift would have changed if the lift was painful to perform.

Conclusion

Most PTs and MHAs, perceive straight back lifting as safest, as it avoids rounding the back. Those who preferred a more straight back lifting position were more likely to be MHAs, and to have more negative beliefs about the back. Straight lifting positions were praised for the alignment of the spine, whereas the rounded postures were praised for their efficiency and comfort. Further work is required to evaluate whether lifting advice, and any specific lifting postures, are linked to LBP incidence and disability.

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