Disorders of breathing and continence have a stronger association with back pain than obesity and physical activity

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Although obesity and physical activity have been argued to predict back pain, these factors are also related to incontinence and breathing difficulties. Breathing and continence mechanisms may interfere with the physiology of spinal control, and may provide a link to back pain. The aim of this study was to establish the association between back pain and disorders of continence and respiration in women. We conducted a cross-sectional analysis of self-report, postal survey data from the Australian Longitudinal Study on Women's Health. We used multinomial logistic regression to model four levels of back pain in relation to both the traditional risk factors of body mass index and activity level, and the potential risk factors of incontinence, breathing difficulties, and allergy. A total of 38 050 women were included from three age-cohorts. When incontinence and breathing difficulties were considered, obesity and physical activity were not consistently associated with back pain. In contrast, odds ratios (OR) for often having back pain were higher for women often having incontinence compared to women without incontinence (OR were 2.5, 2.3 and 2.3 for young, mid-age and older women, respectively). Similarly, mid-aged and older women had higher odds of having back pain often when they experienced breathing difficulties often compared to women with no brerathing problems (OR of 2.0 and 1.9, respectively). Unlike obesity and physical activity, disorders of continence and respiration were strongly related to frequent back pain. This relationship may be explained by physiological limitations of co-ordination of postural, respiratory and continence functions of trunk muscles. **[Smith MD, Russell A, and Hodges PW (2006): Disorders of breathing and continence have a stronger association with back pain than obesity and physical activity. *Australian Journal of Physiotherapy* 52: 11-16]**

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Introduction

Back pain is a prevalent and expensive problem in society (van Tulder et al 1995). The two-week prevalence of low back pain in western countries has been reported to vary between 2% and 33% (Walker 1999). Numerous studies have attempted to evaluate the relationship between back pain and different aspects of physical and mental health. Two commonly investigated factors have been body mass index (BMI) and activity level; however, the association between these factors and back pain remains controversial (Leboeuf-Yde 2000, Levangie 1999, Thomas et al 1999). Notably, BMI and activity level are also associated with other conditions such as incontinence (Brown and Miller 2001, Hannestad et al 2003, Parazzini et al 2003) and breathing disorders (Mannino et al 2003) for which there is preliminary evidence of a relationship to back pain (Finkelstein 2002, Hestbaek et al 2003, Koskimaki et al 2001). The relationship between disorders of continence and respiration, and back pain has not been researched extensively, and may therefore confound the proposed association between BMI, activity level and back pain.

Although the mechanism for the development of back pain is not well understood, it may be associated with changes in control of the trunk muscles (Hodges and Richardson 1996, Radebold et al 2000). Notably, control of the trunk is dependent on activity of muscles such as the diaphragm (Hodges et al 1997), transversus abdominis (Hodges et al 1999), and pelvic floor muscles (Hodges et al 2002), and reduced postural activity of these muscles has been argued to impair the mechanical support of the spine. A factor that complicates the contribution of these muscles to trunk control is their essential roles in respiration and continence.

In the absence of disease, the diaphragm and transversus abdominis simultaneously control both respiration and posture; however, in chronic respiratory disease (Hodges et al 2000), and during induced-hypercapnia (Hodges et al 2001) postural activation of these muscles is impaired. A similar compromise may present for the pelvic floor muscles in women with incontinence, in whom muscle activity is insufficient (Deindl et al 1994). In light of this physiological data it is possible that if a muscle's contribution to spinal control is compromised, back pain may develop. The aim of this study was to determine if disorders of continence and respiration are associated with a higher prevalence of back pain while considering confounding factors of BMI and physical activity.

Method

Participants Participants in the Australian Longitudinal Study on Women's Health (ALSWH) comprise three age cohorts of women who were recruited in 1996 from the National Medicare Health Insurance Database, recognised as the most complete register of people living in Australia. Women were selected randomly from the database, with over-sampling of women living in rural and remote areas.

Recruitment was by written invitation from a branch of the national government, and contact details of those agreeing to participate were forwarded to researchers. Encouragement to enrol was impossible as no direct access to the database was allowed. Enrolment rates were estimated to be 41%, 54% and 36% for the young, mid-age and older cohorts respectively, aged 18 to 23, 45 to 50 and 70 to 75 years at recruitment (Brown et al 1998). Participants complete mail surveys on a rolling triennial schedule. Surveys measure physical and

Table 1. Crude mean (95% CI) for the SF-36 bodily pain* subscale (assessed over the last four weeks) at each level of back pain (assessed over the last 12 months).

	Crude mean (95% CI)			
	Never	Rarely	Sometimes	Often
Young	83.0	75.6	70.0	57.3
	(82.4 to 83.5)	(75.0 to 76.2)	(69.4 to 70.6)	(56.4 to 58.3)
Mid-age	84.2	78.5	70.1	50.6
	(83.5 to 85.0)	(77.7 to 79.2)	(69.5 to 70.7)	(49.8 to 51.4)
Older	81.1	73.8	64.6	42.7
	(80.3 to 81.8)	(72.8 to 74.8)	63.9 to 65.4)	(41.8 to 43.6)

*Higher scores indicate better health or less bodily pain

Table 2. Prevalence (%) for four levels of back pain (weighted by area of residence).

Back pain in the last 12 months	Young (n = 14 060)	Mid-age (n = 13 004)	Older (n = 10 986)
Never	33.4	23.5	29.4
Rarely	28.7	24.2	17.9
Sometimes	25.6	33.9	30.1
Often	11.7	19.4	22.6

mental well-being, health behaviours, self-report diagnoses and symptoms, and social factors. Measures are not uniform for all cohorts, especially for diagnoses and symptoms. The ALSWH surveys were in accordance with ethical standards of the institutional Human Research Ethics Committees. This study is a cross-sectional analysis of 1996 self-report, postal survey responses.

Exclusion criteria We excluded women who were pregnant at the time of the survey (438 young, 103 mid-age) and women with fractures in the last 12 months (155 mid-age; 512 older). All women with a history of cancer (238 young, 792 mid-age; 1053 older) were excluded, as were women who did not provide data for back pain (58 young, 74 mid-age, 45 older). Data from 14 060 young, 13 004 mid-aged, and 10 986 older women were included.

Major outcomes and risk factors The major outcome in the analysis was frequency of self-reported back pain in the last 12 months, assessed as never, rarely, sometimes or often. The bodily pain subscale of the SF-36 was used as an indicator of generalised pain. The major risk factors assessed were incontinence, breathing difficulty (not young), asthma (young only), allergy (including the respiratory disorders hay fever and sinusitis), BMI, and physical activity level. Incontinence, breathing difficulty, asthma, and allergy were assessed as never, rarely, sometimes or often in the last 12 months. BMI was calculated from reported weight and height, and categorised as underweight (< 20), acceptable (≥ 20 to ≤ 25), overweight (> 25 to ≤ 30) and obese (> 30) (NHMRC 1997). A physical activity score (range 0–80) was obtained from two questions about vigorous and moderate activity which were modified from the 1980–1989 Australian National Health Foundation Risk Factor Prevalence Studies (Brown et al 2000). Physical activity was categorised as none/very low (< 5), low (5–15), moderate (15–25) or high (> 25) (Brown et al 2000).

Confounding factors Numerous variables possibly associated with back pain were included in multivariate analysis. Potential confounding factors considered were mental health (low if the mental health index of the SF-36 was 52 or less (Berwick et al 1991)); number of gastrointestinal symptoms (from constipation, haemorrhoids, other bowel problems); severe period pain (not older); number of pregnancies; pelvic surgery (not young); osteoporosis (not young); stiff or painful joints (not young); providing regular care for person with disability; stress; satisfaction with career/work/study; smoking status; education; and occupation (not older). Also included in the analysis were recent life events which may be associated with back pain: major personal illness, major personal injury, major surgery, involvement in a serious accident, and being pushed, grabbed, hit or kicked.

Statistical methods Analyses were conducted separately for each age cohort. To minimise missing observations, a category was created in the analyses when a characteristic had 200 or more observations missing. We used multinomial logistic regression to model the odds of each level of back pain compared with no back pain. We used a forward selection procedure and retained any variables significant at 0.005 in the model. Variables excluded in this way were added to the final multivariate model one at a time and estimates of the odds ratios for incontinence, breathing problems, allergy, BMI, and activity level were inspected for changes of more than 0.2. This was done as a conservative step to check for residual confounding, but no variables were included in this manner.

Table 5. Associations for BMI and recreational activity level with three levels of back pain, each compared with no back pain in the last 12 months.

	Odds ratio* (95% CI)		
	Rarely	Sometimes	Often
BMI			
Mid-age (n = 12 101)			
Underweight	0.8 (0.7 to 1.0)	0.8 (0.7 to 1.0)	0.8 (0.7 to 1.1)
Acceptable	1.0†	1.0†	1.0†
Overweight	1.0 (0.9 to 1.1)	1.0 (0.9 to 1.1)	1.3 (1.1 to 1.5)
Obese	1.0 (0.9 to 1.2)	1.1 (1.0 to 1.3)	1.4 (1.2 to 1.7)
Older (n = 10 531)			
Underweight	0.8 (0.6 to 1.0)	0.8 (0.6 to 1.0)	0.8 (0.6 to 1.0)
Acceptable	1.0†	1.0†	1.0†
Overweight	1.0 (0.9 to 1.1)	1.0 (0.9 to 1.1)	1.3 (1.1 to 1.5)
Obese	0.9 (0.8 to 1.2)	1.1 (0.9 to 1.3)	1.8 (1.5 to 2.2)
Missing	0.6 (0.5 to 0.8)	0.8 (0.7 to 1.0)	1.0 (0.8 to 1.3)
Physical Activity			
Older (n = 10 531)			
None/very low	1.0†	1.0†	1.0†
Low	1.1 (0.9 to 1.3)	1.1 (0.9 to 1.3)	0.8 (0.7 to 0.9)
Moderate	1.2 (1.0 to 1.4)	1.0 (0.9 to 1.1)	0.8 (0.7 to 0.9)
High	0.9 (0.7 to 1.1)	0.9 (0.7 to 1.0)	0.6 (0.5 to 0.7)

*Odds ratios and 95% confidence intervals adjusted for: Mid-age and Older: incontinence, breathing difficulties, allergy, gastrointestinal symptoms, stress, mental health, major injury, highest qualifications; major illness, osteoporosis, pelvic surgery; Mid-age: Severe period pain, smoking status, satisfaction with work/career/study. †Reference category.

Results

The reported levels of back pain were consistent with an independent measure of bodily pain; pain scores increased with frequency of back pain for all three age cohorts (Table 1). The incidence of often experiencing back pain increased with age (Table 2). The prevalence of incontinence, breathing difficulties (mid-age and older), asthma (younger), allergy, BMI, and physical activity are presented in Table 3 [e-addendum], and the frequency of back pain for each variable can be found in Table 4 [e-addendum].

BMI and physical activity were not consistently associated with incidence of back pain across age cohorts. After multivariate analysis, the association between BMI and back pain was only statistically significant among the mid-age and older women. The odds of experiencing back pain often (but not at other frequencies of back pain) were elevated among overweight and obese women compared to those in the acceptable weight range (Table 5). There was no significant association among younger women. Physical activity was only significantly associated with back pain among women from the older age cohort. Older women who participated in any level of recreational physical activity had lower odds of having back pain often than sedentary women (Table 5).

In contrast, incontinence and allergy were associated with back pain among the three age cohorts, and respiratory disorders were associated with back pain among mid-age and older women (Table 6). Among younger women, the association between back pain and asthma (the only respiratory symptom assessed in this cohort) was significant in univariate ($p < 0.001$) but not multivariate analysis. Univariate odds ratios and 95% confidence intervals for often experiencing back pain among women who reported having asthma sometimes and often in the last 12 months were 1.5 (1.3 to 1.8) and 2.0 (1.6 to 2.5) respectively.

Discussion

A number of factors that have been proposed to be associated with back pain were not associated in our data. Most notably, physical activity was significantly associated with back pain only among older women and the elevation in odds ratios was restricted to the most frequent category of back pain. Thus, a relationship was found in a small subpopulation of women who represent merely 9.2% of women with

Table 6. Associations for symptoms of incontinence, breathing problems and allergy with 3 levels of back pain, each compared with no back pain in the last 12 months.

		Odds ratio* (95% CI)	
Symptom in the last 12 months	Rarely	Sometimes	Often
Incontinence			
Young (n = 13 633)			
Never	1.0†	1.0†	1.0†
Rarely	2.1 (1.8 to 2.6)	2.2 (1.8 to 2.7)	2.4 (1.9 to 2.9)
Sometimes	1.1 (0.9 to 1.5)	1.6 (1.2 to 2.1)	1.4 (1.0 to 1.9)
Often	1.6 (0.9 to 2.9)	2.3 (1.3 to 4.1)	2.5 (1.4 to 4.7)
Mid-age (n = 12 101)			
Never	1.0†	1.0†	1.0†
Rarely	1.9 (1.6 to 2.2)	1.5 (1.3 to 1.8)	1.7 (1.4 to 2.0)
Sometimes	1.3 (1.1 to 1.5)	1.6 (1.4 to 1.9)	1.6 (1.3 to 1.9)
Often	1.5 (1.1 to 2.1)	1.8 (1.3 to 2.3)	2.3 (1.7 to 3.1)
Older (n = 10 531)			
Never	1.0†	1.0†	1.0†
Rarely	1.9 (1.6 to 2.3)	1.6 (1.4 to 2.0)	1.7 (1.4 to 2.0)
Sometimes	1.6 (1.3 to 2.0)	2.0 (1.7 to 2.4)	2.1 (1.7 to 2.5)
Often	1.3 (1.0 to 1.7)	1.3 (1.0 to 1.7)	2.3 (1.7 to 2.9)
Breathing difficulty			
Mid-age (n = 12 101)			
Never	1.0†	1.0†	1.0†
Rarely	1.6 (1.4 to 2.0)	1.6 (1.4 to 1.9)	1.9 (1.6 to 2.3)
Sometimes	1.3 (1.0 to 1.5)	1.4 (1.2 to 1.7)	1.7 (1.4 to 2.1)
Often	1.3 (0.9 to 1.9)	1.1 (0.8 to 1.6)	2.0 (1.4 to 2.9)
Older (n = 10 531)			
Never	1.0†	1.0†	1.0†
Rarely	2.2 (1.8 to 2.6)	1.8 (1.5 to 2.2)	2.1 (1.7 to 2.6)
Sometimes	1.7 (1.4 to 2.1)	2.0 (1.6 to 2.3)	2.3 (1.9 to 2.7)
Often	1.5 (1.1 to 2.0)	1.0 (0.8 to 1.4)	1.9 (1.4 to 2.4)
Missing	2.5 (1.6 to 3.7)	2.1 (1.5 to 3.1)	2.6 (1.8 to 3.9)
Allergy			
Young (n = 13 633)			
Never	1.0†	1.0†	1.0†
Rarely	1.3 (1.2 to 1.5)	1.2 (1.0 to 1.3)	1.3 (1.1 to 1.5)
Sometimes	1.4 (1.3 to 1.6)	1.5 (1.3 to 1.7)	1.5 (1.3 to 1.7)
Often	1.3 (1.1 to 1.5)	1.4 (1.2 to 1.6)	1.8 (1.6 to 2.2)
Mid-age (n = 12 101)			
Never	1.0†	1.0†	1.0†
Rarely	1.4 (1.2 to 1.7)	1.3 (1.2 to 1.5)	1.4 (1.2 to 1.7)
Sometimes	1.2 (1.0 to 1.3)	1.4 (1.2 to 1.6)	1.5 (1.3 to 1.8)
Often	1.2 (1.0 to 1.5)	1.6 (1.3 to 1.9)	2.0 (1.7 to 2.4)
Older (n = 10 531)			
Never	1.0†	1.0†	1.0†
Rarely	2.0 (1.7 to 2.3)	1.6 (1.3 to 1.8)	1.7 (1.4 to 2.0)
Sometimes	1.6 (1.4 to 1.9)	1.9 (1.6 to 2.2)	1.8 (1.6 to 2.1)
Often	1.9 (1.5 to 2.4)	2.0 (1.6 to 2.5)	3.3 (2.6 to 4.1)
Missing	1.3 (0.8 to 2.0)	1.5 (1.0 to 2.3)	1.5 (1.0 to 2.4)

*Odds ratios and 95% confidence intervals adjusted for: Young, Mid-age and Older: gastrointestinal symptoms, stress, mental health, major injury, highest qualifications; Young and Mid-age: severe period pain, smoking status, satisfaction with work/career/study; Mid-age and Older: major illness, BMI, osteoporosis, pelvic surgery; Young only: number of pregnancies, serious accident; Older only: physical activity. †Reference category.

back pain. Similarly, mid-age and older women who were overweight and obese had higher odds of often experiencing back pain, but no association was found between BMI and other levels of back pain, or between BMI and back pain in younger women. These data suggest that the association between back pain, obesity (Leboeuf-Yde 2000, Leboeuf-Yde et al 1999) and physical activity (Macfarlane et al 1999, Nourbakhsh et al 2001, Thomas et al 1999) in women is less convincing than previously thought. Unfortunately, it is not possible to directly compare odds ratios for one exposure with another since each has its own scale and reference category. However, in contrast to BMI and activity level, after multivariate analysis the data show consistency in the relationship between back pain and disorders of continence and respiration across age cohorts.

Previous studies investigating factors related to back pain have not considered disorders of continence or respiration in multivariate analysis. People who are incontinent are also more likely to be obese (Hannestad et al 2003, Parazzini et al 2003) and less physically active (Brown and Miller 2001, Hannestad et al 2003). People with respiratory problems are less able to exercise due to breathing difficulties and are therefore more sedentary than age-matched healthy individuals (Mannino et al 2003). It is therefore possible that the association between incontinence, respiratory disease, and back pain may contribute to the relationship previously reported for back pain, obesity, and physical activity.

Our data are consistent with previous data suggesting that disorders of respiration and continence may be associated with back pain. Clinical observations linking urinary urgency and low back pain have been reported (Eisenstein et al 1994), and two previous studies have suggested an association between incontinence and back pain. A study of 3143 Finnish men aged 50 to 70 found an increased prevalence of low back pain in men with lower urinary tract symptoms (Koskimaki et al 2001). However, this association was not significant after adjustment for other diseases. A study of the 1996–97 Canadian National Population Health Survey involving 54 920 male and female subjects found a significant association between incontinence and back problems (Finkelstein 2002), and a recent review of the literature identified a weak positive association between back pain and respiratory problems (Hestbaek et al 2003). However, none of these studies performed multivariate analysis and included confounding factors of obesity and physical activity.

This study provides initial evidence for the association between back pain and disorders of continence and respiration. However, the ALSWH survey relied on self-report and asked only about frequency of symptoms which may limit the interpretation of the data. To relate frequency of back pain to severity, we compared reported frequency to the bodily pain domain of the SF-36 questionnaire. Although we acknowledge that this is not specific to back pain, women who never experienced back pain scored higher (indicative of better health or less bodily pain) and those with more frequent back pain scored lower on the bodily pain domain, which increases confidence in the back pain responses. Future studies of severity and duration of symptoms are warranted to expand on these findings.

A limitation to this data set is that specific diagnoses of respiratory and continence disorders are not available, as these would have required medical consultation or an understanding of medical terminology. However, inclusion of all types of incontinence in the ALSWH surveys would, if anything, make it less likely that an association with back pain would be detected. Finally, to account for the variations in terminology used to classify different respiratory diseases, and the fact that many people are known to report specific respiratory diseases (such as asthma) inappropriately (LindenSmith et al 2004), the general measure of breathing difficulty was used for analysis. Although this does not allow inference to specific respiratory diseases, it does establish the basis for further studies to look at the relationship between particular respiratory conditions and back pain.

One further issue to consider is the use of the acceptable or healthy weight range (BMI $\geq$ 20 to $\leq$ 25), rather than underweight (BMI < 20), as the reference category for analysis of obesity data. This is consistent with previous studies (Leboeuf-Yde et al 1999) and accounts for the fact that being underweight has also been shown to be associated with back pain (Kerr et al 2001).

This study has shown that women with disorders of continence and respiration have a significantly higher prevalence of back pain than women who do not have these disorders. Notably this relationship persists after multivariate analysis inclusive of physical activity and BMI. The impetus for the present study was physiological data that indicate that the postural function of the diaphragm, abdominal, and pelvic floor muscles is reduced by incontinence (Deindl et al 1994) or respiratory disease (Hodges et al 2000). Our findings provide initial support for the hypothesis that compromised postural control of these muscles, secondary to disease-specific challenges, may contribute to the development of back pain. Prospective longitudinal studies are now required to investigate the predictive value of incontinence and respiratory disorders in the occurrence/recurrence of back pain, and physiological studies are warranted to investigate the mechanism for this association.

eAddenda Tables 3 and 4 can be found on the journal website at www.physiotherapy.asn.au/AJP

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