Do patients with chronic low back pain have an altered level and/or pattern of physical activity compared to healthy individuals? A systematic review of the literature

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Systematic review

Do patients with chronic low back pain have an altered level and/or pattern of physical activity compared to healthy individuals? A systematic review of the literature

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Abstract

Background It is commonly assumed that patients with chronic low back pain are less active than healthy individuals. There has been a recent increase in the number of studies published comparing the physical activity levels of patients with chronic low back pain and healthy individuals.
Objectives The aim of this systematic review was to determine, based on the current body of evidence, if patients with chronic low back pain have a lower level and/or altered pattern of physical activity compared with asymptomatic, healthy individuals.
Data sources The electronic databases Embase, Medline, ISI Web of Knowledge, Cinahl, Sport Discus and Nursing and Allied Health were searched from the beginning of each database until the end of December 2009.
Review methods Studies which compared the level and/or pattern of physical activity of patients with chronic low back pain and healthy controls were included. The quality of the included studies was assessed using an assessment tool based on the Newcastle-Ottawa Scale. The scale was modified for the purposes of this study.
Results Seven studies were included in the final review. Four studies recruited adult patients (18–65 years), two studies examined older adults (≥65 years) and one study recruited adolescents (<18 years). Pooled data revealed no significant difference in the overall activity level of adults or adolescents with CLBP, however there is evidence that older adults with chronic low back pain are less active than controls. The results suggest that patients exhibit an altered pattern of physical activity over the course of a day compared to controls. Major methodological limitations were identified and are discussed.
Conclusion There is no conclusive evidence that patients with chronic low back pain are less active than healthy individuals. Based on a limited number of studies, there is some evidence that the distribution of activities over the course of a day is different between patients with chronic low back pain and controls.

Keywords: Low back pain; Physical activity; Measurement

Introduction

It is reported that as many as 80% of the population will experience an acute episode of low back pain during their lifetime [1]. Despite the favorable prognosis of acute low back pain, approximately 5% of patients will subsequently develop sub-acute and chronic low back pain (CLBP) [2]. CLBP remains a highly prevalent, global medical problem and is a source of high levels of disability and distress for patients [3]. To date, no treatment appears to be superior to another in the management of CLBP [4].

Physical inactivity has been described as ‘the greatest public health problem of the 21st century’ [5]. The common assumption that patients with CLBP are less active that comparable healthy individuals is in the most part due to the large body of literature supporting the fear-avoidance model (FAM). According to the FAM in chronic pain, disuse or a decreased level of physical activity results from fear of pain and subsequent fear and avoidance of activities that are known or believed to exacerbate pain [6,7]. The Avoidance-Endurance Model [8] suggests however, that in addition to

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patients who are fearful of their pain, a subgroup of patients exists who ignore their pain and therefore persist with activity despite pain. Therefore, the commonly held belief that all patients with CLBP are less active than healthy individuals is challenged by this model. A recent study [9] showed that both high and low levels of physical activity were associated with a greater prevalence of CLBP which suggests that not all patients with CLBP exhibit low levels of physical activity.

In a systematic review, van Weering *et al*. [10] examined the comparative activity levels of patients with chronic pain and asymptomatic individuals. The authors found that there was no conclusive evidence to suggest that patients with CLBP are less active than healthy individuals. These finding were based on only two cross-sectional studies that were available at the time. Since the publication of this review, the topic of physical activity in patients with CLBP has gained considerable attention and more, relevant studies have since been published. Therefore, the primary aim of this systematic review was to determine if a difference exists in the level and/or pattern of physical activity between patients with CLBP and healthy individuals based on the current body of evidence.

Methods

Overview

Considering the nature of the research question being addressed in this review, i.e. non-interventional, a non-experimental study design is most appropriate. Thus, this systematic review focused on non-experimental study designs. In addition, recent evidence highlights that the prevalence of low back pain amongst adolescents is high [11]. Therefore, the present review included studies irrespective of the age of the participants. This was to ensure that the review is both comprehensive and current.

Types of studies/intervention

All non-experimental studies comparing the level and/or pattern of free-living physical activity of patients with chronic low back pain with asymptomatic healthy individuals were included.

Type of participants

Patients with CLBP of all age groups were eligible for inclusion. CLBP was defined as pain located between the 12th rib and the gluteal fold with or without leg pain that was present for at least three months. Patients with or without a neuropathic pain component were included, provided that the results for patients with and without a neuropathic pain component were presented separately. Patients with 'red-flag' disorders were excluded (e.g. neoplasm, inflammatory disease, fracture).

Type of outcome measures

Studies using a self-report and/or objective measure of physical activity were included. Such measures include questionnaires, accelerometers, pedometers, heart rate monitors, calorimetry or doubly labeled water technique.

Search strategy

A comprehensive search of the following databases was conducted: Embase, Medline, ISI Web of Knowledge, Cinahl, Sport Discus and Nursing and Allied Health: Basic Edition. All databases were searched from the beginning of each database until the end of December 2009. In addition the '*European Journal of Pain*' and '*Pain*' were searched separately. This was mainly to ensure that articles 'in press' were not missed. These journals were chosen as there has been a recent increase in the number of articles on physical activity in CLBP published in these journals.

Keywords or phrases used during the search were: ('chronic low* back pain' OR 'persistent low* back pain') *and* ('physical activit*' OR 'daily activit*' OR 'daily living') *and* ('acceleromet*' OR 'pedomet*' OR 'activity monitor*' OR 'ambulat* monitor*' OR 'actigraph*' OR 'questionnaire' OR 'observation' OR 'diary' OR 'double labeled water technique' OR 'heart rate monitor*'). No language restriction was imposed.

Study selection

Each article obtained from the search was assessed for eligibility by the primary author (DG). The title, abstract and keywords of each article were assessed to determine if it fulfilled the inclusion criteria outlined above. Studies which met the inclusion criteria were included for full-text review. In cases where the abstract did not provide sufficient detail, the full article was obtained. Also, the reference lists of articles which met the inclusion criteria were manually searched to ensure other relevant articles were not omitted.

Data extraction

Data extraction was carried out by one reviewer (DG). For each article which met the inclusion criteria, the following information was documented: (1) inclusion/exclusion criteria, (2) setting(s) from which the patient population and controls were recruited, (3) number of participants, (4) age, gender and work status of patients and controls, (5) duration of symptoms, (6) type and name of outcome measure used, (7) statistical methods, (8) main results and (9) conclusions.

Quality assessment

The methodological tool used to assess the quality of studies included in the review was based on the *Newcastle-Ottawa Scale (NOS) for case–control studies* [12]. The

Newcastle-Ottawa Scale is recommended by the Cochrane Collaboration group to assess the quality of observational studies. The original scale assesses the quality of studies on three main areas: *Selection*, *Comparability and Outcome or Exposure*. For the purposes of this study, the scale was modified to include assessment of the validity and reliability of the measure of physical activity used in the study. The psychometric properties of the measure of physical activity were deemed essential in determining the overall external validity of the study. In addition, aspects of statistical analysis were also assessed (see the "results" section for detailed description of the quality assessment procedure). However, the authors did not feel it was appropriate to award an overall score to each study. Sanderson *et al*. [13] stated that 'summary scores involve inherent weighting of component items, some of which may not be directly related to the validity of a study's findings'. Also, some items are likely to be more important than others. Therefore an overall score may not truly reflect the quality of the study. The quality assessment procedure was carried out by two reviewers. In situations where consensus was not reached between the two reviewers, a third person made the final decision.

Data synthesis

For studies with sufficient data, we calculated the standardized mean difference (SMD) and its 95% confidence interval (CI) for continuous variables. Where appropriate, we pooled the data using a random-effects model. A random-effects model was chosen due to heterogeneity of outcome reporting across the individual studies. For pooled data, heterogeneity between studies was measured using I^2 statistics [14]. The analysis was carried out using RevMan Version 5 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2008).

Results

Study selection

The electronic search resulted in 1414 potentially relevant citations. 374 duplicates were removed and subsequently 1009 articles were excluded following screening of the title, abstract and keywords of each article. The excluded studies did not fit with the aims of this review. 29 articles were obtained in full-text for further review. An additional text was included following manual searching of the reference lists. Moreover, an additional text that the authors became aware of, published following the search strategy was also included. Therefore, 31 articles were included in the full-text review. Following full-text review, 24 articles were excluded. Seven articles were included in the final review [15–21]. The selection procedure is outlined in Fig. 1.

Description of included studies

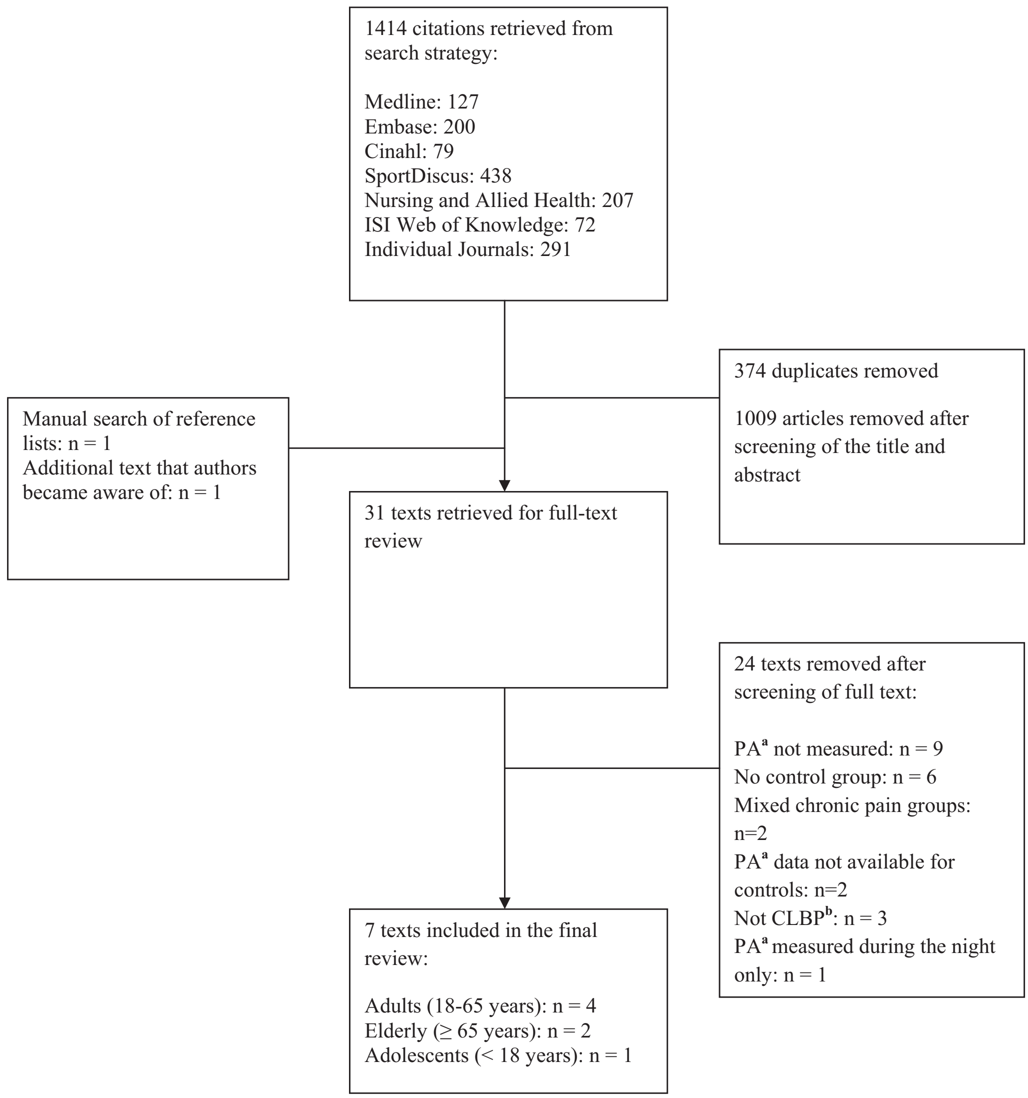
A detailed description of the included studies is presented in Table 1. Four studies included patients between 18 and 65 years [15–18], one study included patients aged 14–16 only [21] and two studies included patients ≥65 years [19,20]. The number of patients in the CLBP group ranged from 12 to 162 and the number of individuals in the asymptomatic control group ranged from 10 to 158. The mean age of patients with CLBP ranged from 36.6 years to 73.6 years and the mean age of controls ranged from 29.2 years to 73.5 years. The study by Astfalck *et al*. [21] recruited patients aged 14–16 and involved measuring many variables in addition to physical activity. However not all participants consented to take part in the physical activity component of the study. The age and gender breakdown of those who did participate in this component of the study was not presented separately. Five of the included studies measured physical activity occurring over seven days [17–21], one measured physical activity over a 24-hour period [16] and one study measured physical activity over two weeks [15].

Reporting of physical activity

Two studies reported on physical activity as the amount of time spent in various postures (i.e. time spent in standing, sitting, lying and walking) and using step frequency [16,17]. Three studies reported on physical activity in terms of 'volume' or overall level of physical activity [16,18,20] and two studies reported on physical activity in terms of overall energy expenditure [15,19] Astfalck *et al*. [21] reported on the amount of time spent at moderate or vigorous activity and total weekly step count. Three of the included studies examined the within- and between-group difference in physical activity level between different parts of the day [16–18]. Two of the included studies presented data on the within- and between group difference in physical activity level during work days and non-work days [17,18]. One of the included studies presented data on the within- and between-group difference in physical activity level during weekdays and the weekend [18].

Measurement of physical activity

Each of the included studies used a different measurement tool to assess free-living physical activity. The doubly labeled water technique (DLWT) which is considered the gold-standard measure of total energy expenditure, provides information on the overall volume of physical activity and was used only in one of the studies [15]. Three studies used an activity monitor/accelerometer to record physical activity [16–18] and one study used a pedometer [21]. Three studies used a self-report questionnaire to measure physical activity [19–21]. Physical activity was expressed in different ways across the different studies (e.g. 'volume' of physical activity or energy expenditure, time spent in different activities



Note: [a] PA: Physical activity; [b]CLBP: Chronic low back pain

Fig. 1. Flow chart of study selection procedure.

including walking, lying/sitting). (Please see Table 1 for how physical activity was reported in each of the included studies.)

Description of results

Overall level of physical activity

Adults (18–65 years). Verbunt *et al*. [15] found no significant difference in the physical activity level (PAL, i.e. a measure of activity-related energy expenditure) of men (SMD = −0.34, 95% CI = −1.32 to 0.65) and women (SMD = 0.16, 95% CI = −1.23 to 1.55) with CLBP compared to healthy controls. van Weering *et al*. [18] found no significant difference in total accelerometer count between patients and controls. The pooled data from these two studies revealed no significant difference between the physical activity levels of patients and controls (SMD = −0.06, 95% CI = −0.52 to 0.41, P = 0.81) (see Fig. 2a).

Elderly (>65 years). Rudy *et al*. [20] found that patients with CLBP had a significant lower overall level of physical activity compared to controls (SMD = −0.29, CI = −0.51 to −0.07). Basler *et al*. [19] found no significant difference between patients with CLBP and healthy control regarding overall level of physical activity (SMD = −0.20, 95% CI = −0.52 to 0.12). The pooled data from these two studies indicate that elderly patients with chronic low back pain are less active than healthy controls (SMD = −0.26, CI = −0.44 to −0.08, P = 0.005) (see Fig. 2b).

Adolescents (<18 years). Astfalck *et al*. [21] found no statistically significant difference between patients with chronic low back pain and healthy controls for time spent at moderate–vigorous intensity per week (SMD = 0.44, 95% CI = −0.31 to 1.19, P = 0.25).

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Table 1
Description of the studies included in the review.

Citation	Participant characteristics	Age (years ± SD) and gender (male, female)	Measurement reference period	Measure of physical activity	Main results
Verbunt 2001 [15]	Patients with NSCLBP[a] (18–60 years)	Patients: 45.0 ± 3.0 (9M, 4F) Controls: 45.7 ± 2.93 (9M, 4F)	14 days	Doubly labeled water technique *Outcome:* (1) Physical activity level (PAL) (average daily metabolic rate divided by resting metabolic rate)	Physical activity level (PAL)[b] did not differ significantly between patients with NSCLBP[a] and healthy controls
Spenkelink 2002 [16]	Patients with NSCLBP[a] ≥6 months	Patients: 36.6 ± 9.0 (27M, 20F) Controls: 29.2 ± 4.3 (4M, 6F)	24 hours	Dynaport ADL Monitor (McRoberts BV, Netherlands) *Outcome:* (1) Time spent sitting, lying, standing, in locomotion (walking) (2) Physical activity level (PAL) (an overall level of physical activity that combines several parameters).	Patients with NSCLBP[a] spent significantly more time lying and had a significantly less walking frequency (steps/min) than controls during the day and the evening ($P < 0.01$) Patients spent significantly less time standing in the evening compared to controls ($P < 0.01$) and had a significantly lower physical activity level (PAL)[c] compared to controls. Patients and controls showed a high day to day variability in levels of physical activity.
van Weering 2009 [18]	Patients with NSCLBP[a] (18–65 years)	Patients: 44.41 ± 13.64 ($n = 29$; 55%M, 45%F) Controls: 40.63 ± 14.61 ($n = 20$; 45%M, 55%F)	7 days	MT9 sensor (Xsens Technologies BV, Netherlands) *Outcome:* (1) Mean acceleration per minute.	On average, over a 24 hour period there was no significant difference between patients and controls with regards to mean accelerations (0.75 vs 0.71 respectively). During weekdays, patients had a significantly higher activity level in the morning ($P < 0.001$) and a significantly lower activity level in the evening ($P < 0.05$) compared to controls. The physical activity less was not significantly different ($P > 0.05$) between patients who worked and those who were not working.
Ryan 2009 [17]	Patients with NSCLBP[a]	Patients: 39.0 ± 11.0 (3M, 12F) Controls: 40.0 ± 11.0 (3M, 12F)	7 days	ActivPAL™ activity monitor (PAL Technologies, Glasgow, UK) *Outcome:* (1) Time spent in standing, stepping (walking). (2) Step count. (3) Cadence.	Patients with NSCLBP[a] spent 0.7 fewer hours walking and took 3480 fewer steps ($P < 0.01$) than controls. Patient with chronic low back pain took 793 fewer steps per day during moderate walks (20–100 steps) and took 1214 fewer steps per day during long (100–499 steps) walks than healthy controls. Patients with NSCLBP[a] took 11 fewer steps per minute during extra-long walks (>500 steps) compared with controls.

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Table 1 (*Continued*)

Citation	Participant characteristics	Age (years ± SD) and gender (male, female)	Measurement reference period	Measure of physical activity	Main results
Astfalck 2010 [21]	Patients with NSCLBP[a] (14–16 years)	Patients: $n = 12$ Controls: $n = 17$	7 days (self-report questionnaire) At least three weekdays and one weekend day (pedometer)	Multimedia activity recall for children and adolescents	No significant difference was found with regard to time spent in moderate or vigorous activity (minutes/week) between patients with NSCLBP[a] (1158) and controls (919).
		Age and gender breakdown for patients who participated in the physical activity arm of the study is not presented		*Outcome:* (1) Number of minutes at moderate/vigorous activity intensity per week. Yamax Digiwalker SW200 Pedometer (Yamasa Tokei Keiki Co, Tokyo, Japan) *Outcome:* (1) Weekly step count	Although patients had a lower weekly step count compared to controls (80707 versus 89010 respectively), this difference was not significant.
Rudy 2007 [20]	Patients with CLBP[d] (65–84 years)	Patients: 73.6 ± 5.2 (94M, 66F) Controls: 73.5 ± 4.8 (83M, 80F)	7 days	Physical Activity Scale (PASE) *Outcome:* (1) Total physical activity score (measure of volume of physical activity over one week)	Elderly patients with CLBP[d] had a significantly lower volume of physical activity ($P < 0.05$) compared with healthy controls (124.42 PASE points versus 105.76 PASE points).
Basler 2008 [19]	Patients with CLBP[d] due to osteoporosis or degenerative spine disorders (≥65 years)	Patients: 71.41 ± 5.2 Controls: 71.19 ± 4.73	7 days	Activity Diary and Freiburg Activity Questionnaire *Outcome:* MET hours (metabolic equivalent) per week.	No difference between patients and controls was detected in regard to energy expenditure (MET hour/week) measured using the activity diary (14.55 versus 14.26 respectively; $P = 0.819$) and the questionnaire (39.95 versus 33.0 respectively; $P = 0.213$).

[a] NSCLBP: non-specific chronic low back pain.
[b] Physical activity level (PAL): daily metabolic rate divided by resting metabolic rate.
[c] Physical activity level (PAL): represents an overall level of activity by combining several parameters.
[d] CLBP: chronic low back pain.

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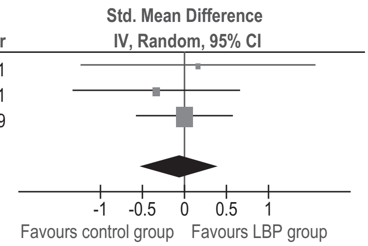
a.

Study or Subgroup	LBP group Mean	LBP group SD	LBP group Total	Control group Mean	Control group SD	Control group Total	Weight	Std. Mean Difference IV, Random, 95% CI	Year
Verbunt et al (Females)	1.77	0.21	4	1.73	0.22	4	11.2%	0.16 [-1.23, 1.55]	2001
Verbunt et al (Males)	1.66	0.3	8	1.77	0.32	8	22.1%	-0.34 [-1.32, 0.65]	2001
van Weering et al	0.74	0.44	29	0.74	0.46	20	66.7%	0.00 [-0.57, 0.57]	2009
Total (95% CI)			**41**			**32**	**100.0%**	**-0.06 [-0.52, 0.41]**	

Heterogeneity: Tau² = 0.00; Chi² = 0.44, df = 2 (P = 0.80); I² = 0%
Test for overall effect: Z = 0.24 (P = 0.81)



b.

Study or Subgroup	LBP group Mean	LBP group SD	LBP group Total	Control group Mean	Control group SD	Control group Total	Weight	Std. Mean Difference IV, Random, 95% CI	Year
Rudy et al	105.76	64.38	162	124.42	65.02	158	68.0%	-0.29 [-0.51, -0.07]	2007
Basler et al	39.95	27.58	103	46.01	33	59	32.0%	-0.20 [-0.52, 0.12]	2008
Total (95% CI)			**265**			**217**	**100.0%**	**-0.26 [-0.44, -0.08]**	

Heterogeneity: Tau² = 0.00; Chi² = 0.18, df = 1 (P = 0.67); I² = 0%
Test for overall effect: Z = 2.81 (P = 0.005)

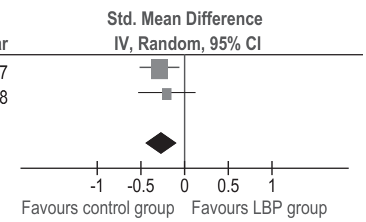


Fig. 2. (a) Comparison of the overall physical activity level of adults (18–65 years) with chronic low back pain and healthy controls. (b) Comparison of the overall physical activity level of older adults (>65 years) with chronic low back pain and healthy controls.

Postural physical activity and step count

Adults (18–65 years). Ryan *et al.* [17] reported that patients with CLBP spent significantly less time walking (SMD = −1.14, 95% CI = −1.91 to −0.36, P = 0.004) and took significantly fewer number of steps (SMD = −1.47, 95% CI = −2.29 to −0.65, P = 0.0004) over a 24-hour period compared to healthy controls. There was no statistically significant difference in time spent standing between the two groups (SMD = −0.30, 95% CI = −1.02 to P = 0.42).

Adolescents (<18 years). Astfalck *et al.* [21] reported that adolescents with CLBP took 8303 less steps per week but this difference was not statistically significant (SMD = −0.16, 95% CI = −0.90 to 0.58, P = 0.67).

Pattern of physical activity

Adults (18–65 years). van Weering *et al.* [18] showed that patients with CLBP has a significantly lower overall level of physical activity in the morning (SMD = 0.74, 95% CI = 0.15 to 1.33, P = 0.01) (see Fig. 3a). Pooled data from two studies show that patients with CLBP are significantly less active than healthy controls during the evening (SMD = −0.49, 95% CI = −0.94 to −0.04, P = 0.03) (see Fig. 3b). Spenkelink *et al.* [16] found that patients spent significantly more time lying during the daytime (SMD = 0.80, 95% CI = 0.08 to 1.51, P = 0.03) and evening (SMD = 0.97, 95% CI = 0.25 to 1.70, P = 0.009) compared to controls.

Spenkelink *et al.* [16] found no significant difference in time spent walking during the daytime (SMD = 0.36, 95% CI = −0.34 to −1.06, P = 0.31) or evening (SMD = 0.07, 95% CI = −0.63 to 0.76, P = 0.85) between patients with CLBP and healthy controls. Ryan *et al.* [17] reported that patients with CLBP spent less time walking during the daytime on working (SMD = −0.55, 95% CI = −1.28 to 0.18, P = 0.14) and non-working days (SMD = −0.64, 95% CI = −1.38 to 0.09, P = 0.09). A similar pattern was reported during the evening time.

Spenkelink *et al.* [16] reported that patients with CLBP had a significantly slower cadence during the day (SMD = −1.14, 95% CI = −1.87 to −0.40, P = 0.002) and evening time (SMD = −0.87, 95% CI = −1.59 to −0.15., P = 0.02) compared to controls. Similarly, Ryan *et al.* [17] reported that during extra-long walks (>500 steps), patients with CLBP had a reduced cadence compared to controls (SMD = −0.84, 95% CI = −1.59 to −0.09, P = 0.03).

Methodological study quality

A detailed analysis of the quality of included studies is provided in Fig. 4. The majority the studies provided sufficient information on the inclusion and exclusion criteria. Five of the included studies [16–19,21] included controls without a recent history of low back pain. The remaining two studies [15,20] reported that controls were 'healthy' or 'asymptomatic' which was considered inadequate information. This is due to the high prevalence rate of low back pain in the general population. Only two studies adequately controlled for work status (in terms of physical demand) in addition to age and sex [17,18]. Although, most studies used a reliable and objective measure of physical activity in a healthy population, only two of the included studies [15,17] used an assessment tool valid for measuring physical activity

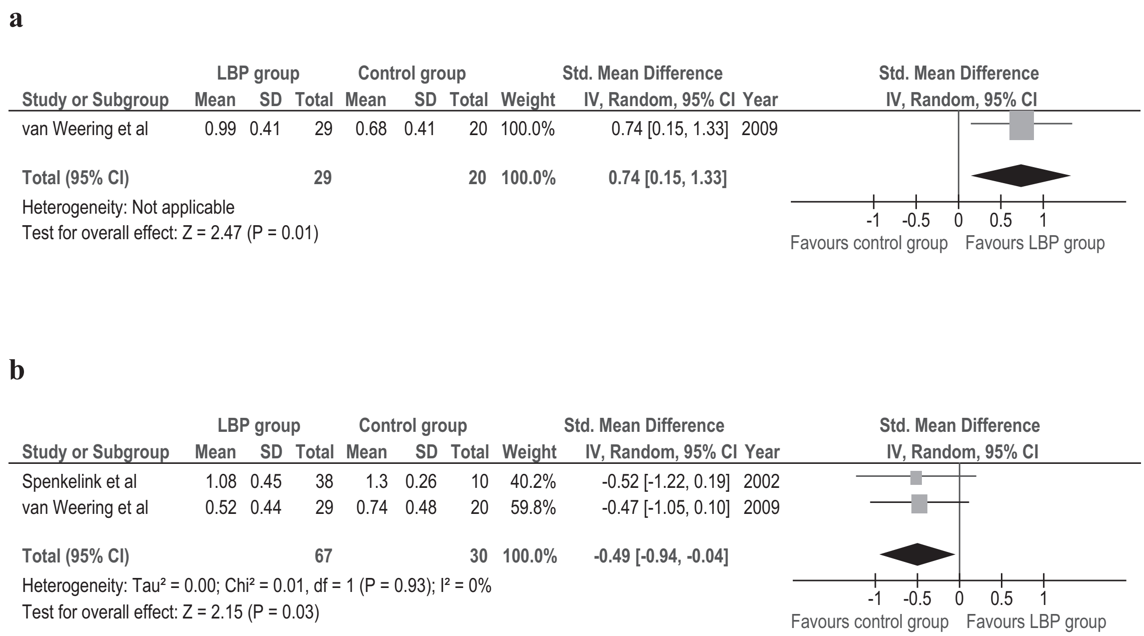


Fig. 3. (a) A comparison of the overall physical activity level of patients with chronic low back pain and healthy controls during the morning. (b) A comparison of the overall physical activity level of patients with chronic low back pain and healthy controls during the evening.

in a chronic low back pain population. The other measures have not been validated in a pain population. Two studies adequately reported on the sampling procedure [20,21]. It is unclear from the remaining studies whether consecutive or random sampling was used or not. Only one study justified the sample size used [19]. Although Astfalck *et al.* [21] did justify the sample size, this was based on detecting a difference in usual sitting posture which was another main aim of the study in addition to measuring physical activity.

Discussion

Main findings

This review did not find any consistent or conclusive evidence that adults or adolescents with CLBP are less active than their healthy counterparts. However, based on the pooled data from a limited number of studies, there is evidence that older adults are less active than controls. There is considerable evidence that physical activity declines with advancing

	Selection				Comparability		Outcome Measurement		Statistical Analysis	
	Patient Definition[a]	Representativeness of patients[b]	Selection of controls[c]	Definition of controls[d]	Age & Gender[e]	Work demand[f]	Reliability of outcome measure[g]	Validity of outcome measure[h]	Sample Size[i]	Statistical Method[j]
Verbunt et al (2001)	MET	UNCLEAR	MET	UNCLEAR	MET	NOT MET	MET	MET	NOT MET	MET
Spenkelink et al (2002)	MET	UNCLEAR	MET	MET	NOT MET	UNCLEAR	UNCLEAR	MET	NOT MET	MET
van Weering et al (2009)	MET	UNCLEAR	MET	MET	MET	MET	UNCLEAR	UNCLEAR	NOT MET	MET
Ryan et al (2009)	MET	UNCLEAR	MET	MET	MET	MET	MET	MET	NOT MET	MET
Rudy et al (2007)	MET	UNCLEAR	MET	UNCLEAR	MET	NOT MET	MET	MET	NOT MET	MET
Basler et al (2008)	MET	UNCLEAR	MET	MET	MET	NOT MET	MET	MET	MET	MET
Astfalck et al (2010)	MET	UNCLEAR	MET	MET	UNCLEAR	MET	MET	MET	NOT MET	MET

a. The inclusion/exclusion criteria are well defined.
b. Consecutive or obvious representative series of patients (e.g. random sample).
c. Controls were derived from the same community as patients.
d. Controls defined as 'healthy' with no history of low back pain in the previous 6 months.
e. The patient group and control group were adequately matched for age *and* gender.
f. The patient group and control group were adequately matched for work status (in term of work demand).
g. The measure of physical activity has documented reliability.
h. The measure of physical activity has documented validity.
i. The sample size was justified (or sample size calculation described).
j. The statistical analysis was clearly described and was appropriate.

Fig. 4. Methodological quality appraisal using a modified version of the Newcastle-Ottawa Scale.

age in healthy individuals [22]. Any additional factor including musculoskeletal pain which negatively impacts on the physical activity level of this group may have adverse consequences for overall health. Although the pooled standardized mean difference was small, the difference is therefore likely to still be clinically important [19,20]. Caution is needed however, as both of these studies measured physical activity using a self-report measure. van Weering and colleagues [18] found that patients with CLBP had a significantly higher overall level of physical activity in the morning compared to controls. In contrast, pooled data from two studies showed that patients with CLBP are significantly less active than controls during the evening. These results suggest that the distribution of physical activity over a 24-hour period is different between patients with CLBP and healthy individuals. Finally, there is evidence from two studies that patients with CLBP move at a slower cadence compared to healthy controls. This finding is in agreement with the results of a study by van den Berg-Emons *et al.* [23] who found that patients with chronic pain were active at a significantly less intensity compared to healthy controls.

The finding that patients with CLBP are not less active than controls is not wholly consistent with the fear-avoidance model. It is possible that patients fear and avoid specific movements or activities without reducing their overall activity levels [7]. There is a growing body of evidence which suggests that the level of fear-avoidance beliefs may not be associated with objectively-measured free-living physical activity [24–26]. Hasenbring *et al*. [8] proposed that, in addition to patients who fear their pain and avoid activity (‘avoiders’), a sub-group of patients exists who ignore their pain and suppress pain-related thoughts. The latter group have been termed ‘persisters’ and persist with physical activity despite pain [8]. There is empirical evidence to support this concept [27,28]. The concept of persisting with physical activity despite pain may also explain why patients become progressively less active over the course of a day [29]. Patients may attempt to complete various activities during the earlier part of the day when pain levels may be lower [18].

Methodological considerations

The primary limitation of the included studies is their small sample size. Only one study appears to have been adequately powered. Therefore there is a high possibility of Type-II errors occurring. Only two of the studies included in this review used an objective measure of physical activity previously validated in a CLBP population. Verbunt *et al*. [15] measured total energy expenditure using the doubly labeled water method. Ryan *et al*. [17] used the ActivPAL™ activity monitor which has documented validity in a CLBP population and has good test-retest and inter-instrument reliability. Although the need for validation within specific clinical populations is debated in the literature [30], patients with CLBP may exhibit altered movement patterns or antalgic postures which may directly influence the output of the measurement device [31]. Both studies which measured physical activity in older adults used self-report measures. Self-report measures, although providing important contextual information, are less accurate compared to more objective measures [32]. The sampling procedure is unclear in the majority of the studies. Apart from one study, it is not clear if consecutive or random sampling was used. Therefore the possibility of selection bias cannot completely be ruled out.

Clinical implications

The clinical implications of this review need to be considered within the context of the broader literature in this area. As previously discussed, there is evidence that cognitive-behavioral subgroups of patients with CLBP exist, who exhibit maladaptive physical activity patterns including ‘avoidance’ and ‘persistence’. Although exercise and increasing a patient’s level of physical activity is integral to the management of low back pain, physiotherapists need to be aware that both these subgroups will require a different approach to achieve this. ‘Avoiders’ may benefit from a graded exercise intervention or exposure interventions that target specific feared movements or activities. There is evidence that patients with a high level of fear-avoidance beliefs regain physical fitness using a graded activity intervention [33]. In contrast, ‘persisters’ may benefit from pacing strategies designed to alternate period of activity with adequate rest. Such an approach, targeting specific maladaptive activity patterns has recently been shown to be successful in patients with fibromyalgia [34]. The avoidance-endurance questionnaire [35] and the Patterns of Activity Measure in Pain [36] are relatively new validated, self-report measures that may help physiotherapists determine the activity pattern of patients with CLBP.

Research implications

Measuring physical activity using accelerometers is often based on the assumption that there is a linear relationship between accelerometer counts and volume of physical activity and energy expenditure [37]. Also within many studies, there is an implied assumption that this relationship is similar for patients with CLBP and healthy controls. Few studies have examined the validity of accelerometers specifically in a low back pain population. There is consensus in the literature that more studies are needed to examine the validity of accelerometers for measuring physical activity in patients with CLBP [38]. Additionally, in the future, studies examining physical activity or exercise-based interventions for patients with CLBP should determine if tailored treatment, targeting specific maladaptive physical activity patterns is more effective, compared to a more generic intervention.

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Limitations

The primary limitation of this review is that all of the included studies were cross-sectional. However this review did not seek to determine the effectiveness of an intervention, for which a randomized-controlled design would be more appropriate. Instead the primary aim of this study was to determine if patients with CLBP had an altered level and/or pattern of physical activity compared to healthy individuals. Studies using a cross-sectional design were appropriate to address this question. Also we did not search for any unpublished literature in this area and so it is possible that relevant studies may have been missed. The lack of a consensus in the literature on how best to examine the methodological quality of observational studies is another limitation of this review. In this review we chose to use a modified version of the Newcastle-Ottawa Scale. We did not give an overall score to each of the included studies. We have outlined the reasons for this in the results section. In an attempt to make the study quality appraisal more comprehensive, we modified the scale to address essential elements of the study that would impact on its overall external validity (e.g. sample size, reliability/validity of measurement tools). Considering the limitations of assessing observational study quality, we have identified the major methodological limitations of the studies included in this review which we have discussed above. Finally the findings of this review are based on a limited number of studies, the majority of which used a small sample size. Although this is not a limitation of this review per se, the findings must be interpreted with caution and more studies using a larger sample size are needed to confirm the findings. However the finding of this review, considered together with the broader literature in this area may have important implications for the physiotherapy management of patients with CLBP and we have outlined these above.

Conclusion

There is no conclusive evidence that adults or adolescents with CLBP are less active than healthy, age-matched individuals. Based on a limited number of studies there is some evidence that elderly patients with CLBP are less active than healthy controls. However more studies, using objective measures of physical activity are necessary to confirm these findings. Finally there is some evidence that the distribution of physical activity over the course of the day is different between patients with CLBP and controls. Due to the small sample size used in the majority of the studies, the findings must be interpreted with caution and need to be replicated in future studies using a large sample size. Finally, further work is needed to determine the validity of objective physical activity measures such as accelerometers in patients with CLBP.

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