The effectiveness of walking as an intervention for low back pain: a systematic review

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Abstract As current low back pain (LBP) guidelines do not specifically advocate walking as an intervention, this review has explored for the effectiveness of walking in managing acute and chronic LBP. CINAHL, Medline, AMED, EMBASE, PubMed, Cochrane and Scopus databases, as well as a hand search of reference lists of retrieved articles, were searched. The search was restricted to studies in the English language. Studies were included when walking was identified as an intervention. Four studies met inclusion criteria, and were assessed with a quality checklist. Three lower ranked studies reported a reduction in LBP from a walking intervention, while the highest ranked study observed no effect. Heterogeneity of study design made it difficult to draw comparisons between studies. There is only low–moderate evidence for walking as an effective intervention strategy for LBP. Further investigation is required to investigate the strength of effect for walking as a primary intervention in the management of acute and chronic LBP.

Keywords Low back pain · Walking · Systematic review · Intervention

Introduction

Low back pain (LBP) is a costly and prevalent disorder, and effective clinical management can be elusive [24, 31, 35, 38, 50, 59, 60]. The New Zealand Accident

Compensation Corporation (ACC) [1] LBP guidelines describe acute LBP as best managed by maintaining normal function during the recovery process. A recent comparison of international clinical guidelines concluded that patients with either acute or sub-acute LBP should be advised to remain active and discouraged from bed rest, while patients with chronic LBP should be prescribed exercise therapy [28]. Although these modern treatment guidelines advocate a more active and patient-centred approach, resulting in significant improvements in pain and function as well as an earlier return to work, there has been little research exploring which activities are more effective [19, 65, 66].

Walking is a fundamental human activity, that is easy to perform, has a low risk of injury and is associated with many health benefits [12, 37, 45]. While much research has investigated exercise and advice to remain active as management strategies for LBP [19, 32, 33], few studies specifically target walking as the primary intervention. The American College of Sports Medicine (ACSM) [4] recommend 30 min of low intensity aerobic activity 3–5 times a week to maintain a healthy lifestyle. The positive role for increasing moderate physical activity in the management and prevention of many chronic health conditions is now well established [22, 27, 45]. However, the specific role of walking as an intervention in the management of LBP has not been established.

To our knowledge, there has been no systematic review evaluating the effectiveness of walking as an intervention for LBP. Therefore, the aim of this study was to review the literature and determine the strength of evidence for walking as an intervention in the management of LBP. The results will inform recommendations for researchers and clinicians in the management of primary care LBP. Specific questions include:

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- (a) What walking dosages have been employed (e.g. frequency, duration and intensity)?
- (b) What LBP populations have been investigated?
- (c) What is the evidence for effectiveness?

Methodology

Search strategy

The following databases were searched: Medline (1950–present), EMBASE (1947–present), AMED (1985–present), CINAHL, Cochrane, PEDro, PubMed and Scopus. MeSH terms included “walking” and/or “low back pain”. Additional studies were found using a hand search of relevant reference lists. These articles were screened against the following criteria:

Inclusion criteria

Types of studies Randomised and non-randomised trials published in English, measuring the effect of walking on pain levels and quality of life in LBP patients.

Types of participants Subjects with acute, sub-acute, or chronic LBP where acute LBP was defined as pain lasting less than 6 weeks, sub-acute 6 weeks until 3 months and chronic as lasting more than 3 months [62].

Types of interventions Walking as the main intervention or as an adjunct to other interventions. Both free-living walking, defined as independent walking without the use of equipment [67], and non-free living, walking on a treadmill, were included.

Types of outcome measures Validated measures of pain or disability [7].

Exclusion criteria

Studies that prescribed either activity or exercise, but did not specify walking as the intervention.

Studies using walking as the outcome measure not the intervention.

Studies that included pathologies such as fractures, osteoporosis, infections, systemic musculoskeletal disorders, cancer or pregnancy.

Review process

Four reviewers independently assessed the titles and abstracts using consensus to determine whether the studies met the inclusion and exclusion criteria described above. The full text of each included articles was then

retrieved, and independently reviewed by two reviewers to confirm eligibility and to extract relevant data. If consensus was not reached, a third reviewer (SM) was used. Reference lists of included articles were manually searched for additional articles. Relevant data from each article were independently extracted and tabulated. The tabulated checklists were then checked for consistency by PH.

Methodological quality assessment

The articles were assessed using the Downs and Black checklist for methodological quality of health care intervention studies that included randomised and non-randomised design [11]. Each article was independently scored by two of the authors and majority consensus used for non-agreement. The checklist included 27 items covering five different aspects of methodological quality: reporting, external validity, bias, confounding and power giving a possible total score of 31. The test–re-test reliability for this quality index is considered to be high ($r = 0.88$), inter-rater reliability good ($r = 0.75$), while sub-scale reliability varies from good to poor [11].

Results

Study selection

The electronic database search resulted in 543 titles. After reviewing the titles, 25 were considered appropriate. Abstracts were then reviewed leaving 15 full text articles for review. Following full review, four articles met the final inclusion criteria.

Study characteristics

Two RCT's [36, 55], one case–control [54] and one cohort study [25] were found. While three laboratory-based studies used a treadmill [25, 36, 54], only one study evaluated walking in free living [55]. One reported the effect of walking on acute LBP [54], two reported on chronic LBP [36, 55] and one reported on mixed sample of LBP participants [25]. Sample sizes ranged from 11 to 208. Two studies used treadmill walking as an adjunct to traction [25, 36], one used increased walking speed on a treadmill [55] and the last used free-living walking as one of three interventions [55]. Three trials used the Visual Analogue Scale (VAS) to assess pain, while the other used the Brief Pain Inventory (BPI). Two articles used the Roland-Morris Questionnaire (RMQ) (Table 1).

Table 1 Study characteristics

Study	Participants and pathology	Interventions	Outcomes
RCTs			
Mirovsky et al. [34]	76 participants with chronic mechanical LBP. Randomised into two groups Control group 1 41 participants Vertical ambulatory traction device (VATD) Intervention group 2 35 participants Traction and treadmill walking	Both groups have daily sessions of VATD for 20 min over 12 days with eight more sessions on alternating days for 30 min Group 2: were also instructed to walk on a treadmill for 15 min per session after the third session at 3 kmph	VAS evaluated at baseline, 1 month post-completion of programme, 6 months and 1 year In both groups pain intensity significantly decreased after treatment; however, Group 2 VAS score improved more at all follow-up points ($P < 0.001$)
Torstensen et al. [52]	208 participants with chronic non-specific LBP sub-classified into LBP and buttock, and lower extremity pain with or without radiation. 103 men, 105 women and age range 20–65. Participants were divided into three groups 71-medical exercise therapy (MET) 67-conventional therapy (C) 70-self exercise (SE) group	Medical exercise therapy (MET). Individual-based exercise regime specific to patients' symptoms, e.g. mobilising and stabilisation of lumbar spine Conventional therapy—use of heat, cold, massage, stretches, traction and electrotherapy Self exercise (SE) group—walking as an intervention. 1 h, three times per week for 12 weeks	VAS, Oswestry, return to work; measured at termination of treatment and at 1 year Pain was significantly reduced in the back and buttock ($P = 0.01$) and lower extremity ($P = 0.003$) in the MET and C groups compared to the SE group. At 1 year, there was no difference in back and buttock pain between all three groups. Lower extremity pain was significantly reduced in the MET and C groups. Significant difference in Oswestry score for MET and C groups at both time intervals ($P = 0.01$ and $P = 0.005$)
Cohort			
Joffe et al. [24]	11 subjects started—only 6 subjects completed study (LBP and leg pain). Duration of LBP 1–6 months	Participants went through an exercise regime that consisted of three phases: A1, B and A2 Phase A1: lumbar stabilisation exercises two times daily. Specific flexibility exercises for lower extremity. Soft tissue mobilisation (if indicated). Education on good posture and self unloading of spine. Continued until symptoms were stable or until 3 weeks Phase B: treadmill with partial body weight support (20–40% body weight). Walking speed of 1.4–3.2 kmph. 2–3 times weekly as well as doing A1 exercises. Maximum of 3 weeks for 30–40 min Phase A2: same as A1 with addition of exercises as patients improved. This continued until patients were discharged	VAS, RMQ—completed at baseline and cessation of treatment Three out of six subjects showed a significant change in pain score after PBWS intervention Five out of six subjects had a significant improvement in function (RMQ) after PBWS
Case-control			
Taylor et al. [51]	Patients met the Quebec task force classification where pain did not radiate down the knee, less than 7 days post-injury, no neurological signs, no history of spinal surgery, no history of spinal stenosis 16 participants: 8 acute for LBP and 8 matched controls	Walking on a treadmill at a self-selected speed for 10 min Followed by a period of fast walking for further 5 min (fast speed 40% more than self-selected speed) Video analysis done	VAS baseline testing, following intervention and follow-up at 6 weeks. RMQ at baseline and 6 weeks Significant reduction ($P = 0.02$) in pain immediately after self-selected walking and no change after fast walking ($P = 0.62$) At 6 weeks, all eight participants had resolution of LBP

VAS Visual Analogue Scale; RMQ Roland Morris Questionnaire

Methodological quality

The article scores (Table 2) ranged from 14 to 27 out of a possible 31 (Table 2). While all scored reasonably well in the bias and reporting aspects, measurement and reporting of confounding showed considerable variability. The highest ranked study [55] found that walking did not have a statistically significant affect on LBP, while conversely the three lowest ranked studies [25, 36, 54] found walking combined with traction had a positive effect.

Study analysis

Due to heterogeneity of study design and differences in types of participants, walking interventions, outcome measures and statistical methods, a meta-analysis could not be performed [15], and thus each study was individually analysed.

Randomised controlled trials

Torstensen et al. [55] used free-living walking in a prospective design in comparison to medical exercise therapy and conventional physiotherapy. Following a 12-week intervention, there was a greater reduction in pain in the two non-walking groups at the completion of the interventions. Although there was no difference in LBP intensity between the three groups at 12 months, there was a significant reduction in total costs for the two non-walking groups. Mirovsky et al. [36] found that the effects of treadmill walking and traction had a significantly greater reduction in pain at all follow-up points. However, at 1-year, there was no difference in the satisfaction with treatment between the two groups.

Participants Although both studies recruited chronic LBP subjects, only Torstensen et al. [55] described their recruitment from 22 social security offices in Oslo, sick-listed for 8–52 weeks.

Walking intervention Mirovsky et al. [36] compared standardised treadmill walking intervention with a vertical ambulatory traction device (VATD) alone (see Table 1), while Torstensen et al. [55] instructed the walking group to walk in free-living for 1 h three times weekly for 12 weeks. This was deemed to be self-directed; however,

subjects were telephoned every second week to determine compliance.

Outcomes and follow-up The studies differed in the number of follow-ups between baseline and 1 year; Mirovsky et al. [36] had a follow-up at 1, 6 and 12 months, while Torstensen et al. [55] had a follow-up at 3 and 12 months. Mirovsky et al. [36] lost 8 (10%) subjects to follow up, while Torstensen et al. [55] lost 33 (16%). However, only Torstensen et al. [55] used an intention to treat analysis to compensate for this loss.

Cohort studies

Joffe et al. [25] employed a three-phase intervention which included stability and flexibility exercises prior to and following sessions of treadmill walking with partial body weight support (PBWS) (Table 1). They showed a decrease in pain and disability in five out of the six subjects who completed the study during the PBWS phase of the intervention (Table 1).

Participants Five of the six subjects (who completed the trial) had herniated discs that were clinically diagnosed with MRI. Moreover, five of the six subjects (who completed the trial) reported gait limitations prior to the onset of the trial.

Walking intervention The intervention was divided into three phases: Phase A1 was an exercise regime including lumbar stabilisation and flexibility exercises twice daily. Phase B involved walking on a treadmill with partial body weight support (20–40% body weight), at a speed of 1.4–3.2 kmph (Table 1). The amount of unloading applied was determined as the least amount necessary to relieve back and leg pain during ambulation. Phase A2 was the same as A1 with the addition of endurance exercise progression continued until discharge. There was no control group with subjects acting as their own control.

Outcome measures and follow-up Five subjects were lost to follow-up from the initial 11 due to unrelated events and medical complications. No data were presented on those participants lost to follow-up.

Case-control studies

Taylor et al. [54] investigated the effect of treadmill walking speeds on measures of LBP and differences in gait

Table 2 Methodological quality assessment (Downs and Black [11])

	Reporting/11	External validity/3	Bias/7	Confounding/6	Power/5	Total/31
Mirovsky et al. [34]	8	0	5	1	0	14
Torstensen et al. [52]	7	3	6	6	5	27
Joffe et al. [24]	10	2	4	1	0	18
Taylor et al. [51]	10	0	5	3	0	18

parameters between a cohort of LBP ($n = 8$) and matched controls ($n = 8$). They found a significant reduction in pain levels in acute LBP participants after a single session of treadmill walking for 10 min at the participant's self-selected speed. A further 5 min walking at a faster speed did not lead to any further significant reduction in pain.

Participants Sixteen participants were included: 8 acute LBP subjects and 8 gender-, age- and height-matched controls recruited from an unspecified population (Table 1).

Walking intervention Treadmill walking performed at a self-selected speed for 10 min followed by a period of fast walking for further 5 min at baseline (Table 1).

Outcome measures and follow-up Participants were asked to mark their estimated levels of pain “at that moment” before and after the self-selected walking speed and after the period of fast walking.

Discussion

Three of four studies investigating walking as an intervention in LBP report a reduction in pain either measured immediately post-treadmill walking [54], after a 3-week period of PBWS [25] or recorded at three time points following sessions of VATD [36]. However, small sample size, poor methodological quality and the inclusion of traction in the intervention strategy considerably weaken the arguments for this effect. One higher quality study that investigated the effects of walking in a chronic LBP population compared to exercise and physiotherapy treatment [55] reported a significant difference in pain reduction in favour of the two interventions when compared to walking instruction alone.

Torstensen et al. [55] used a single-blinded design with the same independent assessor performing the outcome measures at each follow-up to avoid measurement bias. A lack of blinding and the use of VATD (with little evidence for efficacy) reduce the validity of the Mirovsky et al.'s [36] results. Torstensen et al. [55] used a free-living walking group instructed to walk for 1 h three times per week [55]. Although telephone monitoring was carried out, there was no direct measurement of walking duration or intensity by use of pedometer [56] activity diaries [6] or activity monitor [41]. Previous research has shown that the use of such devices improves compliance and adherence to a walking programme and also allows walking intervention to be objectively measured [9].

A loss to follow-up, lack of a control group and small sample size [25, 36] coupled with the complex three-phase methodology made it difficult to attribute change in pain status to the walking intervention alone and also to determine whether such changes are clinically significant [25].

There is currently little research evidence supporting the use of mechanical traction [8], and further studies are required within specific LBP populations to assess the efficacy of traction and walking compared to accepted and recommended treatment approaches for LBP.

Although Taylor et al. [54] showed a significant reduction in pain levels in a small group of ALBP participants after 10 min of walking at a self-selected speed (single session), it was not possible to determine whether this effect was maintained. Similarly as no control group was used, it was not possible to determine the actual effect size of the intervention. Participants walked on the treadmill at pre-selected speed, and were observed to have decreased pain levels immediately post-session. These effects may be due to the neurophysiological effects from exercise that include endorphin release [10]; however, further powered research with appropriate control and intervention groups is required to clarify these results.

A number of potential confounding factors for the relationship between walking and LBP outcomes were not assessed. These included previous levels of activity, where either inactivity or high activity prior to the trial is likely to influence results [39, 40]. Participant's activity levels were not monitored during the intervention, and thus other activities during the intervention period and/or the period between intervention and follow up could have had some influence. Although the age of the subjects was described within each study, it was not included in the statistical modelling as a potential confounding factor. The general age range used (18–65) did not take into account or at least describe the natural degenerative aspect of ageing [17] and its effect on the capacity to walk with LBP. Therefore, either a sub-group analysis needs to be performed for the differing age brackets or age-related changes need to be explored and addressed as a potential co-variate. Similarly only two of the four studies [36, 55] reported the number of males and females participating in the trial.

Due to significant differences in joint kinematics and temporal variables, including hip joint range of motion, cadence and stance time, comparison of results between over-ground and treadmill walking [4, 42, 49] cannot easily be made. Such differences include shorter step lengths, higher cadence and a shorter swing phase on treadmill compared to over-ground walking and subjects not receiving the same visual stimulation possibly altering balance strategies [26, 39]. Although these differences may affect walking outcomes for LBP, this requires further research.

Studies that have investigated whether walking parameters are altered in LBP populations report differences in muscle activity [20] and gait parameters compared to healthy normal's [25]. Various models have been developed to explain the role of pain on motor control strategies [48] and pain-related fear and disability on gait [2] and

consequent physical activity levels in LBP populations [52]. There is also some evidence that LBP populations differ in their walking parameters when compared to healthy controls [43]. Whether walking interventions would be more effective by targeting these observed differences are unknown and a potential direction for future research.

Previous research has found that the increased levels of recreational activity that included walking decreased the likelihood of future chronic LBP. Research has also demonstrated reduced variability in daily activities [63] and also lower fitness levels in patients with chronic LBP. Walking, as an intervention, potentially offers a relatively cheap and cost-effective way to target these impairments and thereby lower risks for the development of the disabling effects of chronic LBP.

Nutrition of the lumbar disc is dependant upon convective transport, arising from load-induced fluid movement in and out of the disc [58], and it is recognised that age-related disc maturation affects the ability of the disc to adapt and withstand load [29]. Although walking provides a low compression cyclical load that may enhance disc nutrition and the ability to adapt to spinal loading, further research is required to investigate these effects.

Based on the hierarchy of evidence [13, 21], poor methodological quality and heterogeneity of study design, the outcome of this review has only found low–moderate evidence that free-living walking did not improve LBP outcomes and only low level evidence for walking combined with various traction-type interventions improving LBP outcomes.

A number of studies investigated walking interventions within LBP cohorts, but did not meet the inclusion criteria of this review [14, 44, 57]. Ferrell et al. [14] included a mixed cohort of subjects with chronic back, hip, knee and foot pain, and although the results showed that walking helped to improve the participants' pain, no sub-group analysis determined the effect on the LBP group specifically. Sculco et al. [44] employed walking or cycling as the main intervention, which meant that participants may have performed either as an intervention. Turner et al. [57] used fast walking/slow jogging, progressing from 10 to 20 min and from 60 to 70% estimated maximum heart rate five times a week as the primary intervention. They found no significant differences compared to a specific exercise group or a behavioural/exercise intervention in a chronic LBP cohort. Since this group was exercising at a higher intensity than walking, it was not included in the review.

Role of exercise, activity and walking in LBP management

Current literature suggests that exercise therapy aimed at improving return to work and normal activities is more

effective for chronic LBP than bed rest [16, 18, 34, 61, 64]. However, research also suggests that individuals with chronic LBP should perform non-specific physical activity to reduce pain as opposed to specific back exercises [24]. Systematic reviews on the effect of exercise therapy on chronic LBP found that it was effective in decreasing pain and improving function [19, 61] and also effectively reducing recurrences in episodes of LBP [60]. Although this review did not find such evidence, we still consider it possible that walking may play a role in decreasing both acute and chronic LBP [5, 23, 47].

Research limitations

A potential fault with any systematic review is the risk of an incomplete literature search. Although a thorough search of the English language literature was conducted, the use of a limited keyword search may have resulted in some relevant studies being missed. A broad search strategy was used to encompass a larger selection of studies as a more defined search lead to a limited amount of results. However, the broader approach led to a larger selection, and the considerable title and abstract search may have resulted in some relevant studies being missed.

Further research direction

The findings of this review are inconclusive with little evidence to support walking having a positive effect on LBP. Thus, future research needs to include walking interventions which are effectively documented (time, intensity and duration) and compliance and adherence measured. Walking interventions need to be compared as sole interventions and against standard treatments for LBP within specific cohorts in an RCT design. Previous studies have shown the potentially positive effects for free-living walking in other chronic pathologies such as osteoarthritis [30, 40, 51, 53]; the use of pedometers has resulted in more structured interventions [53]. Such a research design could be adapted for LBP populations to allow effective assessment of walking in the management of LBP.

Although fear avoidance does not appear to be an important mediator of difference in fitness levels observed in chronic LBP populations [46], high fear avoidance levels have been identified as a poor prognostic factor in active intervention trials [3]. Future walking trials should assess the potential mediating effect of this variable in LBP outcomes.

Trial design will need to consider randomisation and specifically assess the addition of a walking programme intervention to standard treatment as well as including a third group which receives walking intervention only. Specific populations should include acute and chronic

populations as well as looking at the effects of a walking intervention in relatively in-active or elderly populations in comparison to a more active working population. Outcome measures should include measures of disability, self-reported health and functional status, objective measures of activity, performance-based measures of functional status and include comparisons of cost-effectiveness between the intervention groups. Outcomes of such interventions need to be assessed in the short term (6–12 weeks), and issues of compliance and adherence to such programmes assessed for potential long-term effects (>1 year).

Conclusion

This review found low–moderate evidence that free-living walking does not have a positive effect in the management of LBP and poor evidence for treadmill walking as an effective management strategy for LBP. Although the evidence for this review does not support walking, the methodological quality and lack of research in this area mean that it would be prudent to continue advising patients with LBP to remain active and encourage walking as an important component of the management programme. However, further research is required to clarify the potential role for walking in LBP management.

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