Title: Interventions to improve real world walking after stroke: a systematic review and meta-analysis

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Abstract:

Objective: This study aimed to determine effectiveness of current interventions to improve real world walking for people with stroke and specifically whether benefits are sustained. **Data sources:** EBSCO Megafile, AMED, Cochrane, Scopus, PEDRO, OTSeeker and Psychbite databases were searched to identify relevant studies. **Review methods**: Proximity searching with key words such as ambulat*, walk*, gait, mobility*, activit* was used. Randomised controlled trials that used measures of real world walking were included. Two reviewers independently assessed methodological quality using the Cochrane Risk of Bias Tool and extracted the data. **Results:** Nine studies fitting the inclusion criteria were identified, most of high quality. A positive effect overall was found indicating a small effect of interventions on real world walking (SMD 0.29 [0.17, 0.41]). Five studies provided follow-up data at > 3-6 months which demonstrated sustained benefits (SMD 0.32 [0.16, 0.48]). Sub group analysis revealed studies using exercise alone were not effective (SMD 0.19 [-0.11, 0.49]) but those incorporating behavioural change techniques (SMD 0.27 [0.12, 0.41]) were.

Conclusions: A small but significant effect was found for current interventions and benefits can be sustained. Interventions which include behaviour change techniques appear more effective at improving real world walking habits than exercise alone.

Introduction

Real world walking describes actual walking in usual settings as opposed to the walking that occurs in a clinic or standardised environment characteristic of rehabilitation settings (1). Usual walking behaviour can be measured with an activity monitor or retrospective self-reports of actual walking (2). Walking is the most popular form of physical activity (3) and walking regularly even 'around the block' can provide protection against future functional decline even for those already disabled (4). The majority of stroke survivors rate walking as important or very important (5) and difficulty with walking as one of their largest unmet needs (6). Moderate activity (including walking) for 20-30 minutes on most days following stroke can reduce the relative risk of premature death from a second stroke by 41% (7). However people with stroke walk less than virtually any other clinical population (8) and take 50% less steps each day than their age-matched peers (9).

Several randomised controlled trials have investigated the use of exercise-based interventions to improve walking for people with stroke (10–14). Most studies report similar findings with gains in the ability to walk further and/or faster in the indoor clinic setting (10,12–14). The size of the treatment effect in these studies is modest (e.g. 20-50m increase in the six-minute walk test- a measure of walking capacity) and gains in walking ability following exercise are seldom sustained once the intervention has ceased (15,16,10,12). Further, it is unclear if gains in walking ability as measured in a clinic setting extend to changes in a real world setting (12,14). Behaviour change techniques such as goal setting, action planning and self-monitoring can be very effective at improving physical activity for healthy people (17), are familiar to rehabilitation professionals (18) and may a help sustain gains once professionally-led exercise programs finish. The overall research question for the review was: how effective are current interventions to improve walking in the real world compared to usual care or no intervention for people with stroke?

Methods:

We aimed to include all published randomised controlled trials or quasi randomised controlled trials exploring the effectiveness of either a single intervention or combined interventions on real world walking following stroke. The primary outcome was a change in real world walking (as measured by an activity monitor such as an accelerometer or pedometer, and/or measured with self-report questionnaire). Our definition of real world walking behaviour was developed through an iterative process that involved reviewing existing definitions of related concepts (e.g. community ambulation, performance, capacity and capability), debate and consultation with the review team to reach a consensus on a definition. The primary outcome focus of this review is walking activity a person actually *does do* in real world settings (e.g. performance) versus what they *can do* (e.g. capacity or capability). The full definition of real world walking is found in Appendix One.

Studies were included if participants were ≥16 years of age with a stroke of any type, a randomised or quasi-randomised study design was used and there was a control group of usual care, no intervention or attention control. When screening for inclusion we looked carefully at the outcome measures in each study to ascertain whether it reflected real world walking behaviour as described in our definition (see Appendix One). For a self-report measure to be included the majority of items (i.e. >50%) needed to be consistent with our definition. If we were unable to obtain a copy of the outcome measure then we did not include it. Interventions were considered as long as an outcome measure that quantified real world walking was used. As such interventions were included whether delivered by a health professional or a lay person, and modes of delivery could include one on one, group or using some form of technology such as a computer or phone. Only studies published in English were included due to funding and resource limitations.

Search strategy

The following databases were searched; EBSCO Megafile (which includes Medline, CINAHL, Sports Discus), AMED, Scopus and the Cochrane Database of Systematic Reviews. A second search using key words of; 'walking and stroke', 'gait and stroke' and 'activity and stroke' was undertaken in PEDRO, OT Seeker & Psychbite. The reference lists of three Cochrane systematic reviews (19–21) which included interventions to improve walking after stroke were also hand searched for relevant studies that met our inclusion criteria. Databases were searched from their inception, the initial searching took place in February 2013 and was updated in November 2015. (See Appendix Two for the full search strategy).

Screening for inclusion

The initial screening process involved reviewing titles and abstracts to identify those papers possibly or probably meeting the inclusion criteria. Full text of papers were retrieved and reviewed in full by two independent reviewers (CS and SM) to determine eligibility for inclusion. If there was any uncertainty, a copy of the outcome measure(s) were obtained and closely scrutinized. Disagreements were initially resolved by discussion and consensus and, if necessary, a third reviewer acted as an adjudicator (NK).

Some of the studies also published a protocol or further information about the intervention (22–25). These papers were excluded from the meta-analysis but referred to during the data extraction process for additional information if needed.

The mobility subscale of the Nottingham Extended Activities of Daily Living, was identified as potentially containing items of relevance. Authors were contacted to request the raw data. Two of the authors contacted were able to provide this data (28,29) and these two studies were then able to be included following reanalysis of the data supplied. Reanalysis involved dichotomizing the raw data in Excel 2010 (into '0' for did not do and '1' for did do) and the scores summed for each item with means and standard deviations calculated. For example the first item on the mobility subscale is "In the last few weeks did you walk around outside?" There were four preselected answers and each response was given a '0' if the answer was 'Not at all' but a '1' if it was either 'with help', 'on your own with difficulty' or 'on your own'. This was necessary to ensure the outcome truly reflected what someone actually did do, regardless of whether they required assistance to do it.

Data extraction and analysis:

Data were extracted and level of bias assessed independently by two reviewers (CS and SM) using the Cochrane Risk of Bias Form which evaluates each study on different sources of potential bias (26). Extraction of information from each study included: a) study aims, b) design, c) description of participants including inclusion and exclusion criteria, d) study setting, e) description of intervention and control including duration, timing and who delivered it, f) outcomes that reflected the domain of interest, and g) potential for bias issues, including the presence of a blinded assessor and how missing data was handled i.e. whether there was intention to treat analysis.

Data were entered in RevMan 5 (27) and individual effect sizes using post-intervention outcomes calculated. Given the heterogeneity of the outcome measures, a standardised mean difference was used to calculate the overall effect size and measures of consistency using the I^2 statistic were also calculated (26). A random effects analysis was undertaken (26). Two of the studies (11,12) used the same outcome measure (StepWatch Activity monitor) so an additional analysis for these studies using a mean difference could be completed. Three studies (12,14,30) did a follow-up assessment at 3 months post intervention and two studies (29,31) at 6 months and so follow-up results could be included for five studies.

In line with the review protocol for the review interventions were grouped as either a) primarily consisting of progressive exercise or b) explicitly including at least one or more of the 40 behaviour change techniques as outlined by the CALO-RE taxonomy for use in interventions to improve physical activity (32). This carefully developed and theory-linked taxonomy operationalises the content of common behavioural interventions by identifying the individual behaviour change techniques that make up the intervention. The presence of a specific behaviour change technique in included studies was identified either by using the taxonomy or if there was an explicit intent (documented in either the published paper or manual of procedures) to support behaviour change. Preplanned subgroup analysis was undertaken to compare progressive exercise alone to interventions including at least one behaviour change technique in conjunction with either exercise or escorted community walking. Overall standardised mean differences were calculated for these two subgroups using the final assessment point.

Results:

Description of studies

Figure 1 shows the flow of information through the study. Seven separate trials fully met the inclusion criteria (33,11,25,12,13,31,14). One of these trials had more than one treatment arm (11,34) and so both were included in our review: a) the early Locomotor Training Programme (LTP) on a treadmill ('Duncan 2011a LTP') (34) and b) the Home

Exercise Programme ('Duncan 2011b HEP') (34). For this study data was entered into RevMan 5(27) and the size of control group adjusted accordingly (i.e. the total number of the control group was divided by two). Following reanalysis of the raw outcome data, two more studies (28,29) were able to meet our criteria. This meant that the review included 9 separate studies with 10 treatment arms.

The trials included a variety of different interventions with four using primarily progressive task-oriented exercises either individually (31) or group based (12–14,33). The five remaining trials (33,35,28,29,34) included at least one behaviour change technique as defined by the CALO-RE taxonomy (32). Table 2 provides an overview of the studies included in the review.

Risk of bias in included studies

Blinding of participants and 'delivery' personnel is particularly difficult in rehabilitation interventions studies where activity components are observable though two of the studies in this review included an adequate attention control such as arm exercises or social/educational interventions to counter this source of bias (12,13) and ensured blinded outcome assessment. Overall there appeared a very low risk of bias influencing the findings of this review (see Table 1).

Measures of treatment effect

The standardised mean difference in favor of the intervention was small (SMD 0.29 [0.17, 0.41]) indicating the interventions had a small but positive effect on improving real world walking (see Figure 2).

A variety of self-report measures were used for the analysis (e.g. Rivermead Mobility Index, (33) dichotomized mobility subscale of the Nottingham Extended Activities of Daily Living (23,29) and the Physical Activity Scale for Individuals with Disabilities (13)). One study used a pedometer (33) but three studies used the StepWatch Activity Monitor (12,34). A mean difference was calculated for the studies which provided specific information about the size of the treatment effect. The overall mean difference for the StepWatch was 675 average steps per day [CI 137, 1213]. The study which had the highest average number of steps per day (983 mean step/day [CI 59, 1906]) was the home exercise arm of the LEAPS study (34). By contrast the early treadmill training arm (Duncan 2011a LTP) (34) and Mudge 2009 (12) had 566 (CI -290 and 1422.01) and 445 (CI -599 and 1489) average daily steps respectively. StepWatch outputs in people with stroke demonstrate considerable variability (9); however the mean increase of 983 steps/day for the Home Exercise group (Duncan 2011b HEP) in the LEAPS study (34) represents a proportional increase in daily step counts of between 4-70% compared to normative values for people with stroke who have not received any intervention (9).

Five studies included follow-up data at a second assessment point (12,14,23,29,31). The overall standardised mean difference of the effectiveness of the interventions at the follow-up assessment was SMD 0.32 [0.16, 0.48]). This indicates that changes in real world walking following interventions can potentially be sustained once the intervention has finished (See Figure 3).

Subgroup Analysis

Subgroup analysis of exercise interventions alone versus interventions that used at least one behaviour change technique showed there was a difference in effect sizes with an SMD of 0.19 [-0.11, 0.49] for exercise and 0.27 [0.12, 0.43] for those using behaviour change techniques indicating the likely effectiveness of techniques. For this analysis, the final assessment point was used to represent a sustained change in real world walking (see Figure 4).

Discussion

The main findings of this systematic review were that current interventions to improve real world walking after stroke are effective and able to lead to sustained change but some interventions appear to be more effective than others. For example interventions which include at least one behaviour change techniques-with exercise or real world practice were usually more effective than those that used exercise alone. Behaviour change techniques used in the studies with the largest effect sizes included goal setting, barrier identification and self-monitoring. However specific details regarding the optimum approach to, or combination of techniques, the influence of social or environmental contextual factors and mechanisms underlying these findings remains unclear. Further research is needed to answer these questions.

This review has some weaknesses reflective of research in the field. Both subjective and objective measures of real world walking were included in this review. The theoretical concept of real world walking has been variably defined in the literature and lacks conceptual development. As a consequence, electronic searching was challenging. Determining whether an outcome measure accurately reflected the construct of real walking was also difficult and led to considerable debate at times between team members before consensus. Only a reasonably small number of studies used the same self-reported measures of physical activity which meant overall mean differences could not be calculated. We also acknowledge that walking is often a subconscious activity which may lead to under reporting of activity levels by self-report measures (36). However several of the included studies were of very high quality and well powered. In addition the I^2 value of 14% indicates that there were low levels of heterogeneity for the review. Several processes including careful development of the search strategy, contacting authors and the methodical process consistent with the best-practice guidelines was undertaken suggesting our review is likely to have identified the majority of studies meeting the inclusion criteria and the findings are likely to be robust.

A number of systematic reviews exploring the effectiveness of interventions to improve walking competency after stroke have been published (20,21). In general the conclusions are that repetitive exercise programs are effective at improving walking ability using clinic-based tests such as walking speed or endurance. However this review shows that task-oriented exercise programme alone are usually not sufficient at changing walking habits or real world walking.

Recently a large meta regression of interventions to improve physical activity in healthy people highlighted interventions that included one of five self-regulatory theory techniques (particularly self-monitoring) were more effective than interventions drawing on other behaviour change techniques (17). However the operationalisation of these techniques for use in neurological rehabilitation needs further attention. There were some examples in this review of ways to operationalise change techniques that draw on a strong theoretical basis from health psychology. For example in the Home Exercise Programme arm of the LEAPS (22) study participants were explicitly encouraged to walk in the real world, and a plan was developed with the therapist to make the most of any gains. Specifically a barrier identification change technique was employed where each participant was asked '*what is limiting you from achieving your goal relative to walking?*' and a plan to address the barriers included as part of the treatment.

The finding that the Home Exercise Programme group of the LEAPS study walked more often also suggests that the use of these techniques in the home setting has a stronger mode of action than that of task-specific repetitive practice in a clinic setting. Many recent interventions to improve walking after stroke are primarily based on a theoretical rationale that focuses on activity dependent cortical plasticity (albeit this being largely implicit) (34,37). The findings of the LEAPS study indicate this focus should be reconsidered given the relative success of a low intensity home-based exercise program. This finding and the evidence from the trial of escorted outdoor walking (29) together lend support to the value of personally meaningful context-specific training on improving the amount of walking in the real world following stroke rehabilitation.

In conclusion, this review has demonstrated that interventions employing behaviour change techniques in addition to progressive exercise/ real world practice are likely to be more effective than physical training alone at improving real world walking after stroke. The underlying modes of action of these interventions and which approaches are most successful requires further study in order to extend current theoretical models of practice in physiotherapy and neurological rehabilitation.

Competing interests

None

Clinical Messages

- Current rehabilitation interventions can improve actual walking in usual settings and lead to sustained change
- The use of behaviour change techniques in addition to repetitive walking practice in usual settings is likely to promote sustained change in walking habits.

References

1. World Health Organisation. Towards a common language for functioning, disability and health-ICF [Internet]. Geneva: World Health Organisation; 2002 [cited 2013 Mar 26]. Available from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.123.1564&rep=rep1&type=pdf

2. Tudor-Locke CE, Myers AM. Challenges and opportunities for measuring physical activity in sedentary adults. Sports Med. 2001;31(2):91–100.

3. Ministry of Health. Guidelines on Physical Activity for Older People (aged 65 years and over). Wellington; 2013.

4. Simonsick EM, Guralnik JM, Volpato S, Balfour J, Fried LP. Just get out the door! Importance of walking outside the home for maintaining mobility: findings from the women's health and aging study. J Am Geriatr Soc. 2005;53(2):198–203.

5. Lord SE, McPherson K, McNaughton HK, Rochester L, Weatherall M. Community ambulation after stroke: how important and obtainable is it and what measures appear predictive? Arch Phys Med Rehabil. 2004 Feb;85(2):234–9.

6. McKevitt C, Fudge N, Redfern J, Sheldenkar A, Crichton S, Rudd AR, et al. Self-Reported Long-Term Needs After Stroke. Stroke. 2011 Mar 24;42(5):1398–403.

7. Towfighi A, Markovic D, Ovbiagele B. Impact of a healthy lifestyle on all-cause and cardiovascular mortality after stroke in the USA. J Neurol Neurosurg Psychiatry. 2012 Feb 1;83(2):146–51.

8. Tudor-Locke C, Washington TL, Hart TL. Expected values for steps/day in special populations. Prev Med. 2009 Jul;49(1):3–11.

9. English C, Manns PJ, Tucak C, Bernhardt J. Physical Activity and Sedentary Behaviors in People With Stroke Living in the Community: A Systematic Review. Phys Ther. 2013 Sep 12;94(2):185–96.

10. Ada L, Dean CM, Lindley R. Randomized trial of treadmill training to improve walking in community-dwelling people after stroke: the AMBULATE trial: Clinical trial. Int J Stroke. 2013 Aug;8(6):436–44.

11. Duncan PW, Sullivan KJ, Behrman AL, Azen SP, Wu SS, Nadeau SE, et al. Body-weight–supported treadmill rehabilitation after stroke. N Engl J Med. 2011;364(21):2026–36.

12. Mudge S, Barber PA, Stott NS. Circuit-Based Rehabilitation Improves Gait Endurance but Not Usual Walking Activity in Chronic Stroke: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2009 Dec;90(12):1989–96.

13. Pang MYC, Eng JJ, Dawson AS, McKay HA, Harris JE. A Community-Based Fitness and Mobility Exercise Program for Older Adults with Chronic Stroke: A Randomized, Controlled Trial: FITNESS AND MOBILITY EXERCISE FOR STROKE. J Am Geriatr Soc. 2005 Oct;53(10):1667–74.

14. van de Port IGL, Wevers LEG, Lindeman E, Kwakkel G. Effects of circuit training as alternative to usual physiotherapy after stroke: randomised controlled trial. BMJ. 2012 May 10;344(may10 1):e2672–e2672.

15. Wade DT, Collen FM, Robb GF, Warlow CP. Physiotherapy intervention late after stroke and mobility. BMJ. 1992;304(6827):609–13.

16. Green J, Young J, Forster A, Collen F, Wade D. Combined analysis of two randomized trials of community physiotherapy for patients more than one year post stroke. Clin Rehabil. 2004 May 1;18(3):249–52.

17. Michie S, Abraham C, Whittington C, McAteer J, Gupta S. Effective Techniques in Healthy Eating and Physical Activity Interventions: A Meta-Regression. Health Psychol. 2009;28(6):690–701.

18. Sugavanam T, Mead G, Bulley C, Donaghy M, van Wijck F. The effects and experiences of goal setting in stroke rehabilitation – a systematic review. Disabil Rehabil. 2013 Feb;35(3):177–90.

19. Barclay RE, Stevenson TJ, Poluha W, Ripat J, Nett C, Srikesavan CS. Interventions for improving community ambulation in individuals with stroke. In: The Cochrane Collaboration, editor. Cochrane Database of Systematic Reviews [Internet]. Chichester, UK: John Wiley & Sons, Ltd; 2015 [cited 2015 Nov 11]. Available from: http://doi.wiley.com/10.1002/14651858.CD010200.pub2

20. Pollock A, Baer G, Campbell P, Choo PL, Forster A, Morris J, et al. Physical rehabilitation approaches for the recovery of function and mobility following stroke. Cochrane Database Syst Rev [Internet]. 2014 [cited 2015 Nov 11];4. Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD001920.pub3/epdf/standard

21. States RA, Pappas E, Salem Y. Overground physical therapy gait training for chronic stroke patients with mobility deficits. In: The Cochrane Collaboration, editor. Cochrane Database of Systematic Reviews [Internet]. Chichester, UK: John Wiley & Sons, Ltd; 2009 [cited 2015 Nov 11]. Available from: http://doi.wiley.com/10.1002/14651858.CD006075.pub2

22. Duncan PW, Sullivan KJ, Behrman AL, Azen SP, Wu SS, Nadeau SE, et al. Protocol for the Locomotor Experience Applied Post-Stroke (LEAPS) trial: a randomized controlled trial. BMC Neurol. 2007;7(1):39.

23. Galvin R, Cusack T, Stokes E. A randomised controlled trial evaluating family mediated exercise (FAME) therapy following stroke. BMC Neurol. 2008;8(1):22.

24. Logan PA, Walker MF, Gladman JRF. Description of an occupational therapy intervention aimed at improving outdoor mobility. Br J Occup Ther. 2006;69(1):2–6.

25. Mansfield A, Wong JS, Bayley M, Biasin L, Brooks D, Brunton K, et al. Using wireless technology in clinical practice: does feedback of daily walking activity improve walking outcomes of individuals receiving rehabilitation post-stroke? Study protocol for a randomized controlled trial. BMC Neurol. 2013;13(1):93.

26. Higgins JP., Green S. Handbook for Systematic Reviews of Interventions [Internet]. Cochrane Version 5.0.2 [updated September 2009}. Cochrane Collaboration; 2009. Available from: www.cochrane-handbook.org.

27. Review Manager (RevMan). Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration; 2012.

28. Galvin R, Cusack T, O'Grady E, Murphy TB, Stokes E. Family-Mediated Exercise Intervention (FAME): Evaluation of a Novel Form of Exercise Delivery After Stroke. Stroke. 2011 Mar 1;42(3):681–6.

29. Logan PA. Randomised controlled trial of an occupational therapy intervention to increase outdoor mobility after stroke. BMJ. 2004 Dec 11;329(7479):1372–5.

30. Galvin R, Stokes E, Cusack T. Family-Mediated Exercises (FAME): An Exploration of Participant's Involvement in a Novel Form of Exercise Delivery After Stroke. Top Stroke Rehabil. 2014 Jan 1;21(1):63–74.

31. Pohl M, Werner C, Holzgraefe M, Kroczek G, Wingendorf I, Hoolig G, et al. Repetitive locomotor training and physiotherapy improve walking and basic activities of daily living after stroke: a single-blind, randomized multicentre trial (DEutsche GAngtrainerStudie, DEGAS). Clin Rehabil. 2007 Jan 1;21(1):17–27.

32. Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. Psychol Health. 2011 Nov;26(11):1479–98.

33. Dean CM, Rissel C, Sherrington C, Sharkey M, Cumming RG, Lord SR, et al. Exercise to Enhance Mobility and Prevent Falls After Stroke: The Community Stroke Club Randomized Trial. Neurorehabil Neural Repair. 2012 Nov 1;26(9):1046–57.

34. Nadeau SE, Wu SS, Dobkin BH, Azen SP, Rose DK, Tilson JK, et al. Effects of Task-Specific and Impairment-Based Training Compared With Usual Care on Functional Walking Ability After Inpatient Stroke Rehabilitation: LEAPS Trial. Neurorehabil Neural Repair. 2013 May 1;27(4):370–80.

35. Mansfield A, Wong JS, Bryce J, Brunton K, Inness EL, Knorr S, et al. Use of Accelerometer-Based Feedback of Walking Activity for Appraising Progress With Walking-Related Goals in Inpatient Stroke Rehabilitation A Randomized Controlled Trial. Neurorehabil Neural Repair. 2015;29(9):847–57.

36. Scott EJ, Eves FF, French DP, Hoppé R. The theory of planned behaviour predicts self-reports of walking, but does not predict step count. Br J Health Psychol. 2007 Nov;12(4):601–20.

37. Kreisel SH, Hennerici MG, Bäzner H. Pathophysiology of Stroke Rehabilitation: The Natural Course of Clinical Recovery, Use-Dependent Plasticity and Rehabilitative Outcome. Cerebrovasc Dis. 2007;23(4):243–55.

38. Ada L, Dean CM, Hall JM, Bampton J, Crompton S. A treadmill and overground walking program improves walking in persons residing in the community after stroke: a placebo-controlled, randomized trial. Arch Phys Med Rehabil. 2003;84(10):1486–91.

39. Batchelor FA, Hill KD, Mackintosh SF, Said CM, Whitehead CH. Effects of a Multifactorial Falls Prevention Program for People With Stroke Returning Home After Rehabilitation: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2012 Sep;93(9):1648–55.

40. Boysen G, Krarup L-H, Zeng X, Oskedra A, Korv J, Andersen G, et al. ExStroke Pilot Trial of the effect of repeated instructions to improve physical activity after

ischaemic stroke: a multinational randomised controlled clinical trial. BMJ. 2009 Jul 22;339(jul20 3):b2810–b2810.

41. Cooke EV, Tallis RC, Clark A, Pomeroy VM. Efficacy of Functional Strength Training on Restoration of Lower-Limb Motor Function Early After Stroke: Phase I Randomized Controlled Trial. Neurorehabil Neural Repair. 2010 Jan 1;24(1):88–96.

42. Cramp MC, Greenwood RJ, Gill M, Lehmann A, Rothwell JC, Scott OM. Effectiveness of a community-based low intensity exercise programme for ambulatory stroke survivors. Disabil Rehabil. 2010 Jan;32(3):239–47.

43. Cumming TB, Thrift AG, Collier JM, Churilov L, Dewey HM, Donnan GA, et al. Very Early Mobilization After Stroke Fast-Tracks Return to Walking: Further Results From the Phase II AVERT Randomized Controlled Trial. Stroke. 2011 Jan 1;42(1):153–8.

44. Dean CM, Ada L, Bampton J, Morris ME, Katrak PH, Potts S. Treadmill walking with body weight support in subacute non-ambulatory stroke improves walking capacity more than overground walking: a randomised trial. J Physiother. 2010;56(2):97–103.

45. Desrosiers J, Noreau L, Rochette A, Carbonneau H, Fontaine L, Viscogliosi C, et al. Effect of a Home Leisure Education Program After Stroke: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2007 Sep;88(9):1095–100.

46. Dickstein R, Deutsch JE, Yoeli Y, Kafri M, Falash F, Dunsky A, et al. Effects of Integrated Motor Imagery Practice on Gait of Individuals With Chronic Stroke: A Half-Crossover Randomized Study. Arch Phys Med Rehabil. 2013 Nov;94(11):2119–25.

47. Dobkin BH, Plummer-D'Amato P, Elashoff R, Lee J, the SIRROWS Group. International Randomized Clinical Trial, Stroke Inpatient Rehabilitation With Reinforcement of Walking Speed (SIRROWS), Improves Outcomes. Neurorehabil Neural Repair. 2010 Mar 1;24(3):235–42.

48. Elsworth C, Winward C, Sackley C, Meek C, Freebody J, Esser P, et al. Supported community exercise in people with long-term neurological conditions: a phase II randomized controlled trial. Clin Rehabil. 2011 Jul 1;25(7):588–98.

49. English C, Bernhardt J, Hillier S. Circuit Class Therapy and 7-Day-Week Therapy Increase Physiotherapy Time, But Not Patient Activity: Early Results From the CIRCIT Trial. Stroke. 2014 Oct 1;45(10):3002–7.

50. Gillham S, Endacott R. Impact of enhanced secondary prevention on health behaviour in patients following minor stroke and transient ischaemic attack: a randomized controlled trial. Clin Rehabil. 2010 Sep 1;24(9):822–30.

51. Green J, Forster A, Bogle S, Young J. Physiotherapy for patients with mobility problems more than 1 year after stroke: a randomised controlled trial. The Lancet. 2002;359(9302):199–203.

52. Harwood M, Weatherall M, Talemaitoga A, Barber PA, Gommans J, Taylor W, et al. Taking charge after stroke: promoting self-directed rehabilitation to improve quality of life–a randomized controlled trial. Clin Rehabil. 2012;26(6):493–501.

53. Holmgren E, Lindström B, Gosman-Hedström G, Nyberg L, Wester P. What is the benefit of a high intensive exercise program? A randomized controlled trial. Adv Physiother. 2010 Sep;12(3):115–24.

54. Hwang S, Jeon HS, Yi C h., Kwon O y., Cho S h., You S h. Locomotor imagery training improves gait performance in people with chronic hemiparetic stroke: a controlled clinical trial. Clin Rehabil. 2010 Jun 1;24(6):514–22.

55. Johnston M, Bonetti D, Joice S, Pollard B, Morrison V, Francis JJ, et al. Recovery from disability after stroke as a target for a behavioural intervention: Results of a randomized controlled trial. Disabil Rehabil. 2007 Jan;29(14):1117–27.

56. Kirk H, Kersten P, Crawford P, Keens A, Ashburn A, Conway J. The cardiac model of rehabilitation for reducing cardiovascular risk factors post transient ischaemic attack and stroke: a randomized controlled trial. Clin Rehabil. 2013;0269215513502211.

57. Kono Y, Yamada S, Yamaguchi J, Hagiwara Y, Iritani N, Ishida S, et al. Secondary Prevention of New Vascular Events with Lifestyle Intervention in Patients with Noncardioembolic Mild Ischaemic Stroke: A Single-Center Randomized Controlled Trial. Cerebrovasc Dis. 2013;36:88–97.

58. Kwakkel G, Kollen BJ, Wagenaar RC. Long term effects of intensity of upper and lower limb training after stroke: a randomised trial. J Neurol Neurosurg Psychiatry. 2002;72(4):473–9.

59. Lennon O, Carey A, Gaffney N, Stephenson J, Blake C. A pilot randomized controlled trial to evaluate the benefit of the cardiac rehabilitation paradigm for the non-acute ischaemic stroke population. Clin Rehabil. 2008 Feb 1;22(2):125–33.

60. Lord S, McPherson KM, McNaughton HK, Rochester L, Weatherall M. How feasible is the attainment of community ambulation after stroke? A pilot randomized controlled trial to evaluate community-based physiotherapy in subacute stroke. Clin Rehabil. 2007 Dec 5;22(3):215–25.

61. Lund A, Michelet M, Sandvik L, Wyller TB, Sveen U. A lifestyle intervention as supplement to a physical activity programme in rehabilitation after stroke: a randomized controlled trial. Clin Rehabil. 2012;26(6):502–12.

62. Michael K, Goldberg AP, Treuth MS, Beans J, Normandt P, Macko RF. Progressive Adaptive Physical Activity in Stroke Improves Balance, Gait, and Fitness: Preliminary Results. Top Stroke Rehabil. 2009 Jan 1;16(2):133–9.

63. Moore JL, Roth EJ, Killian C, Hornby TG. Locomotor Training Improves Daily Stepping Activity and Gait Efficiency in Individuals Poststroke Who Have Reached a 'Plateau' in Recovery. Stroke. 2010 Jan 1;41(1):129–35.

64. Olney SJ, Nymark J, Brouwer B, Culham E, Day A, Heard J, et al. A Randomized Controlled Trial of Supervised Versus Unsupervised Exercise Programs for Ambulatory Stroke Survivors. Stroke. 2006 Feb 1;37(2):476–81.

65. Park H-J, Oh D-W, Kim S-Y, Choi J-D. Effectiveness of community-based ambulation training for walking function of post-stroke hemiparesis: a randomized controlled pilot trial. Clin Rehabil. 2011 May 1;25(5):451–9.

66. Pundik S, Holcomb J, McCabe J, Daly JJ. Enhanced life-role participation in response to comprehensive gait training in chronic-stroke survivors. Disabil Rehabil. 2012 Sep;34(18):1535–9.

67. Smith J, Forster A, Young J. A randomized trial to evaluate an education programme for patients and carers after stroke. Clin Rehabil. 2004 Oct 1;18(7):726–36.

68. Teixeira-Salmela LF, Olney SJ, Nadeau SE, Brouwer BE. Muscle strengthening and physical conditioning to reduce impairment and disability in chronic stroke survivors. Arch Phys Med Rehabil. 1999;80:1211–8.

69. Torres-Arreola L del P, Doubova Dubova SV, Hernandez SF, Torres-Valdez LE, Constantino-Casas NP, Garcia-Contreras F, et al. Effectiveness of two rehabilitation strategies provided by nurses for stroke patients in Mexico: *Effectiveness of rehabilitation in stroke*. J Clin Nurs. 2009 Nov;18(21):2993–3002.

70. van der Ploeg HP. Counselling increases physical activity behaviour nine weeks after rehabilitation. Br J Sports Med. 2006 Mar 1;40(3):223–9.

71. Yang Y-R, Tsai M-P, Chuang T-Y, Sung W-H, Wang R-Y. Virtual reality-based training improves community ambulation in individuals with stroke: A randomized controlled trial. Gait Posture. 2008 Aug;28(2):201–6.

72. Zedlitz AMEE, Rietveld TCM, Geurts AC, Fasotti L. Cognitive and Graded Activity Training Can Alleviate Persistent Fatigue After Stroke: A Randomized, Controlled Trial. Stroke. 2012 Apr 1;43(4):1046–51.

Figure 1. Flow of information through the study

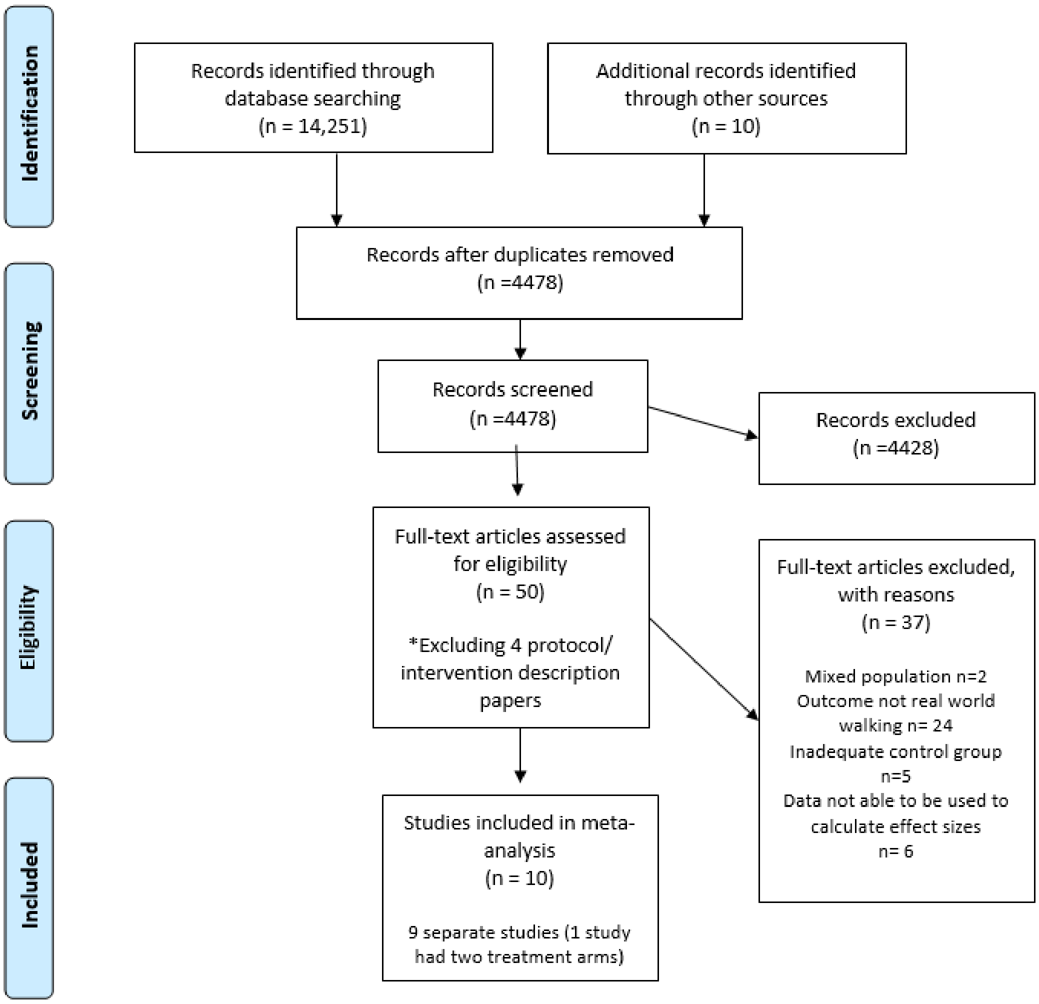
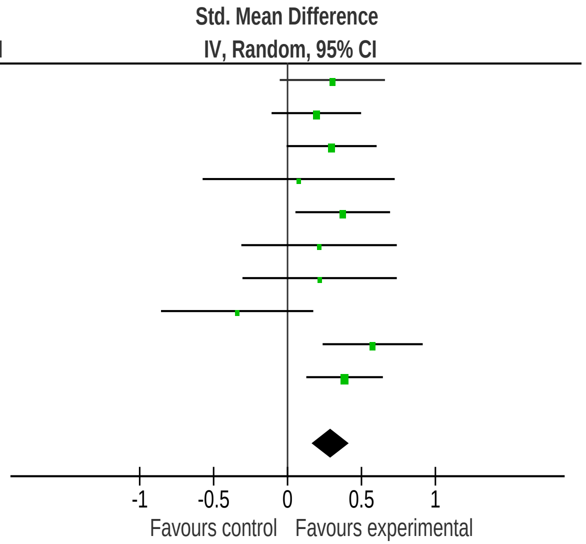


Figure 2. Effect of current interventions on real world walking at post-intervention assessment

	Experimental			Control				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Dean 2012	4,365	3,350	64	3,357	3,256	62	10.6%	0.30 [-0.05, 0.65]
Duncan 2011a LTP (1)	3,926	2,913	120	3,360	2,857	68	13.9%	0.19 [-0.10, 0.49]
Duncan 2011b HEP (2)	4,343	3,501	120	3,360	2,857	68	13.8%	0.30 [-0.00, 0.60]
Galvin 2011	3.7	1.69	18	3.55	2.16	19	3.5%	0.08 [-0.57, 0.72]
Logan 2004	4.02	2	84	3.21	2.32	74	12.7%	0.37 [0.06, 0.69]
Mansfield 2015	6,195	2,918	29	5,604	2,524	28	5.3%	0.21 [-0.31, 0.73]
Mudge 2009	5,804	2,019	31	5,359	2,027	27	5.3%	0.22 [-0.30, 0.73]
Pang 2005	13.7	10.9	30	18.6	16.8	30	5.5%	-0.34 [-0.85, 0.17]
Pohl 2007	8.5	3.9	72	6.3	3.7	72	11.6%	0.58 [0.24, 0.91]
Van de Port 2012	13.47	1.44	125	12.82	1.9	117	17.8%	0.39 [0.13, 0.64]
Total (95% CI)			**693**			**565**	**100.0%**	**0.29 [0.17, 0.41]**

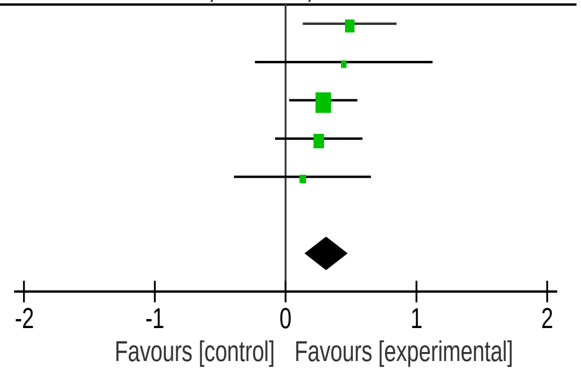
Heterogeneity: Tau² = 0.01; Chi² = 10.50, df = 9 (P = 0.31); I² = 14%
Test for overall effect: Z = 4.58 (P < 0.00001)



Footnotes
(1) Duncan 2011 has two treatment arms so 'n' of control group is divided by 2
(2) Duncan 2011 has two treatment arms so 'n' of control group is divided by 2

Figure 3. Effect of current interventions on real world walking at follow-up assessment

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI	Std. Mean Difference IV, Random, 95% CI
Pohl 2007	10	4.1	64	7.8	4.8	64	20.7%	0.49 [0.14, 0.84]	
Galvin 2011	4.95	1.79	18	4.05	2.16	17	5.7%	0.44 [-0.23, 1.12]	
Van de Port 2012	13.5	1.42	125	13.03	1.82	117	40.0%	0.29 [0.03, 0.54]	
Logan 2004	3.55	2.18	76	2.98	2.3	69	24.0%	0.25 [-0.07, 0.58]	
Mudge 2009	5,559	1,517.2	31	5,360	1,521.9	27	9.6%	0.13 [-0.39, 0.65]	
Total (95% CI)			**314**			**294**	**100.0%**	**0.32 [0.16, 0.48]**	



Heterogeneity: Tau² = 0.00; Chi² = 1.77, df = 4 (P = 0.78); I² = 0%

Test for overall effect: Z = 3.86 (P = 0.0001)

Figure 4. Subgroup analysis of exercise vs. behaviour change techniques + exercise on improving real world walking at final assessment

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
2.1.1 Exercise								
Pang 2005	13.7	10.9	30	18.6	16.8	30	5.0%	-0.34 [-0.85, 0.17]
Mudge 2009	5,559	1,517	31	5,360	1,521	27	4.9%	0.13 [-0.39, 0.65]
Van de Port 2012	13.5	1.42	125	13.03	1.82	117	20.2%	0.29 [0.03, 0.54]
Pohl 2007	10	4.1	64	7.8	4.8	64	10.5%	0.49 [0.14, 0.84]
Subtotal (95% CI)			**250**			**238**	**40.6%**	**0.19 [-0.11, 0.49]**
Heterogeneity: Tau² = 0.05; Chi² = 7.25, df = 3 (P = 0.06); I² = 59%								
Test for overall effect: Z = 1.23 (P = 0.22)								
2.1.2 BCT								
Duncan 2011a LTP	3,926	2,913	120	3,360	2,857	68	14.6%	0.19 [-0.10, 0.49]
Mansfield 2015	6,195	2,918	29	5,604	2,524	28	4.8%	0.21 [-0.31, 0.73]
Logan 2004	3.67	2.11	76	3.1	2.24	69	12.1%	0.26 [-0.07, 0.59]
Duncan 2011b HEP	4,343	3,501	120	3,360	2,857	68	14.5%	0.30 [-0.00, 0.60]
Dean 2012	4,365	3,350	64	3,357	3,256	62	10.5%	0.30 [-0.05, 0.65]
Galvin 2011	4.95	1.79	18	4.05	2.16	17	2.9%	0.44 [-0.23, 1.12]
Subtotal (95% CI)			**427**			**312**	**59.4%**	**0.27 [0.12, 0.41]**
Heterogeneity: Tau² = 0.00; Chi² = 0.62, df = 5 (P = 0.99); I² = 0%								
Test for overall effect: Z = 3.53 (P = 0.0004)								
Total (95% CI)			**677**			**550**	**100.0%**	**0.26 [0.14, 0.37]**
Heterogeneity: Tau² = 0.00; Chi² = 7.90, df = 9 (P = 0.54); I² = 0%								
Test for overall effect: Z = 4.42 (P < 0.00001)								
Test for subgroup differences: Chi² = 0.20, df = 1 (P = 0.66), I² = 0%								

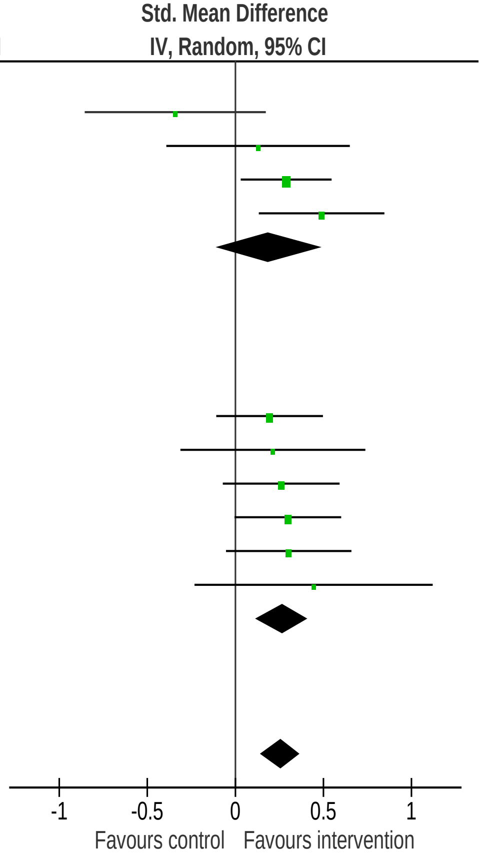


Table 1. Risk of bias table for each included study using Cochrane Risk of Bias Tool (26)

Study	Random Sequence Generation	Allocation Conceal-ment	Blinding Participants and Personnel	Blinding of Outcome Assessment	Incomplete Data	Selective Reporting	Other Bias and Notes
Dean 2012 (33)	Low	Low	High	Low	Low	Low	Outcome measure (pedometer) not valid this population
Duncan 2011 (11)	Low	Low	Low	Low	Low	Low	High quality study
Galvin 2011 (28)	Low	Unclear	High	Low	Low	Low	
Logan 2004 (29)	Low	Unclear	High	Low	Low	Unclear	
Mansfield 2015 (35)	Low	Low	High	Low	Low	Low	
Mudge 2009 (33)	Low	Low	Low	Low	Low	Low	High quality study
Pang 2005 (13)	Low	Unclear	Unclear	Low	Low	Unclear	
Pohl 2007 (31)	High	High	High	Unclear	Low	Low	
Van der Port 2012 (14)	Low	Low	High	Low	Low	Low	

Table 2. Overview of studies included in the review*

Study ID	Participants	Intervention	Control	Outcomes	Key Findings and Comments
Dean 2012 (33)	People with chronic stroke (n= 151) who could attend exercise classes. Average age since stroke 5.9 years	1x week exercise programme in a circuit delivered by physiotherapist. 2x week individual home exercise programme for 40 weeks; progressed regularly- focused on lower limb.	Attention control: Exercises for arms and cognitive abilities 1x week and Home Ex. Prog. 2 x week for 40 weeks	Real world walking; Pedometer (steps/day) at 12 months follow up	• Real world walking measured using pedometer with positive point estimate but wide confidence intervals (SMD 0.30 [-0.5, 0.65]) • Small increase in six-minute walk test (+34m) and gait speed (0.07m/s) • Pedometer not valid for people with slow walking speed of less than 0.8m/s- Intervention group baseline gait speed was 0.72m/s and control group mean 0.67 m/s • Given Home Ex. Prog. + diary to record but no goals or plan to address individual barriers • Intervention workbook available online lists adherence strategies but not clearly operationalised • Recruitment was difficult, adherence to home exercise programme low especially as time went on

Duncan 2011a LTP (11,22,34)	People with stroke- within 30 days – with gait speed <0.8m/s	90 minutes, 3x week, progressive treadmill training and over ground walking in clinic; 30-36 sessions over 12-16 weeks	Usual care	Real world walking: StepWatch Activity Monitor: number steps per day at 6 months follow-up	• No statistically significant difference between usual care and LTP* on StepWatch • Significant improvements in gait speed compared to control group and Home Exercise Programme group presumably due to specificity of training • Real world walking (number steps per day) SMD 0.19 [-0.10' 0.49]) • Very intensive programme with 1-2 assistants and expensive equipment (treadmill) • Participants in trial had low levels physical functioning • Large, well-controlled study
Duncan 2011b HEP (11,22,34)	People with stroke- within 30 days – with gait speed <0.8m/s	90 minutes, 3x week, home-based low intensity exercises; 36 sessions over 12-16 weeks with goal oriented walking programme and	Usual care	Real world walking: StepWatch Activity Monitor: Number steps per day at 6 months follow up	• Statistically significant difference between usual care and Home Ex. Prog. group on StepWatch • Originally intended as an attention control group with exercise intensity sufficiently low to not provide physiological overload • Explicitly encouraged to walk in usual settings

		encouragement to walk			• Similar results to LTP overall but more real world walking SMD 0.30 [0.00,0.60] • Exercise delivered in home setting • Large well-controlled study
Galvin 2011 (23,28)	People with acute stroke in hospital (within 2 weeks onset) (n=40)	Actively involved family in partnership with physiotherapist to increase exercise time over 8 week period during inpatient stay Family-centred goal setting, progressive exercises and exercise diary	Usual care	Self-report physical activity: Nottingham Extended Self report: Activities Daily Living (NEADL) – mobility subscale (dichotomised) at post intervention and 3 month follow-up	• Overall although small study with only 20 in each group, the intervention group showed statistically significant improvements in all outcomes and improvements in patient-reported outcomes persisted at the 3-month follow-up. • NEADL at post-intervention (which reported activity preceding week) was administered while 23/40 participants still in hospital/inpatient rehabilitation so may explain negligible SMD at post assessment for dichotomised mobility subscale. (SMD 0.08 [-0.57, 0.72]). Three month follow up had much higher point estimate but still wide CI (SMD 0.44[-0.23,1.12]) • Participants in the intervention group were also significantly more

					integrated into their community at follow-up. and overall results of other outcomes showed results sustained/increased even though intervention delivered during inpatient stay • Family members in intervention group reported a significant decrease in their levels of caregiver strain at the follow-up when compared with those in the control group despite increased time commitments for family
Logan 2004 (24)	People with stroke at home within 3 years N= 168	Goal setting by OT and home visits and practice in real world settings to increase confidence	Information leaflets	Self-report physical activity: NEADL-mobility subscales at 4 months and 12 months follow-up	• Information returned by post and blinded outcome assessors checked missing data
Mansfield 2015 (25,35)	People with stroke in inpatient rehabilitation	Daily activity recorded with activity monitors and results given	Usual care	Real world waking; average number of	• Feedback generated by accelerometer from Gulf Data Concepts with a custom-written step detection algorithm.

	N=60	to physiotherapist who gave feedback to the participants		daily steps in last three days of rehabilitation	• Information provided to physiotherapist who chose to discuss it with participant in way they chose • RMI used as outcome
Mudge 2009 (12)	People with stroke >6months; residual gait problems but able walk independently N= 58	Group based circuit based exercise training, 1 hour, 3x week for 4 weeks= 12 sessions	Attention based control; social group	Real world walking: Stepwatch Activity Monitor (mean steps per day, peak activity index, Max 1, % time inactive). Assessed post intervention and 3 months follow-up	• No statistically significant difference in real world walking (SMD 0.22[-0.30,0.73]) on StepWatch or self-report physical activity (PADS) • Quite short intervention 4 weeks • Significant change in 6 minute walk test post intervention but not sustained at 3 months
Pang 2005 (13)	Community dwelling people with stroke. N=63	Task oriented mobility programme 19 weeks, 3 x week i.e. Up to 57 sessions	Attention based control: Seated Upper extremity exercises	Self-report physical Activity: Physical activity scale for individuals with physical	• Most intensive intervention in study in terms of number of session provided by health professionals but no home exercise programme provided • Lowest point estimate for activity (SMD -0.34[-0.85,0.17])

				disabilities at post-intervention	• Intervention group improved in 6MWT* cardiorespiratory fitness and bone density paretic leg • Did not included any behaviour change techniques
Pohl 2007 (31)	People with stroke in inpatient facility with stroke< 60 days who could not work independently N=155	Received 45 mins daily physiotherapy for 4 weeks which included 20 mins of repetitive locomotor therapy and 25 mins usual physiotherapy	45 mins usual physiotherapy (usual care)	Rivermead Mobility Index	• Lower quality study • Very dependent population
Van der Port 2012 (14)	People with stroke recently discharged from hospital. N=250	Attended task oriented circuit training for 12 weeks, 3x per week- worked in pairs	Usual care	Rivermead Mobility Index	• High quality, well powered study • Range outcome measures but original trial showed change in walking capacity and no change in self-report measures of ADL or participation

*SMD=Standardised Mean Difference, HEP= Home Exercise Programme, LTP= Locomotor Training Programme NEADL= Nottingham Extended Activities of Daily Living, RMI= Rivermead Mobility Index, 6MWT= 6 Minute Walk Test, ADL=Activities Daily Living

Appendix One: Definition of Real World Walking Behaviour

Real world walking behaviour describes actual walking in usual settings. Real world walking behaviour is a subset of physical activity behaviour. It refers to walking a person actually does do rather than has the physical capacity to do. It involves locomotor movement of the legs; is a largely habitual activity and occurs in a person's usual environmental settings. In addition it has the following features:

- Real world walking occurs in a specific environmental context. Such settings include walking that occurs in the place that they live (e.g. own home or residential setting) but also out and about in other community venues and settings. The term has a broader focus than does the concept of community ambulation as described by Lord et al (5) which focuses primarily on the ability of the individual and the destination of the walking activity.

- Real world walking behaviours include a range of walking patterns for a variety of purposes. These include turns and transitions, walking for exercise or leisure; and walking for transport purposes. It does include running or stair climbing because these are locomotor activities that occur in usual settings. It does not include forms of physical activity behaviour that include primarily stationary activities (e.g. Tai Chi). It does not activities which depends primarily on another object for transport (e.g. biking or using a wheelchair) or require both arms and legs (e.g. swimming).

- Real world walking behaviour can be measured through the use of activity monitors or self-report measures. Appropriate measures focus on real world walking activities that record walking that has actually occurred and commonly has the stem ‘how often do you?’ in the self-report question. Outcome measures that ask 'can you' or how 'how difficult' or 'how much assistance' are not considered a measure of real world walking behaviour.

Appendix Two: Search Strategy

(completed Feb 2013 and updated Nov 2015)

Ebsco

("free living" N8 walk*) OR ("free-living" N8 walk*) OR ("real world" N8 walk*) OR ("real-world" N8 walk*) OR (usual N8 walk*) OR (functional N3 walk*) OR ("free living" N8 ambulat*) OR ("free-living" N8 ambulat*) OR ("real world" N8 ambulat*) OR ("real-world" N8 ambulat*) OR (usual N8 ambulat*) OR (functional N3 ambulation*) OR ("free living" N8 gait) OR ("free-living" N8 gait) OR ("real world" N8 gait) OR ("real-world" N8 gait) OR (usual N8 gait*) OR (functional N3 gait*) OR ("free living" N8 locomotion) OR ("free-living" N8 locomotion) OR ("real world" N8 locomotion) OR ("real-world" N8 locomotion) OR (usual N8 locomotion*) OR (functional N3 locomotion*) OR ("community ambulat*") OR (community N8 walk*) OR (community N8 pedometer) OR (community N8 accelerometer) OR (community N8 "activity monitor") OR (physical N8 pedometer) OR (physical N8 accelerometer) OR (physical N8 "activity monitor")

AND

RCT OR "random* control* trial*" OR "random allocation" OR "clinical trial*" OR "control* clinical trial*" OR "control group" OR "single-blind method" OR (controlled N5 trial*) OR (controlled N5 stud*) OR (clinical* N5 trial*) OR "quasi-random*" or "quasi random*" or "pseudo-random*" or "pseudo random*"

Scopus

("free living" W/8 walk*) OR ("free-living" W/8 walk*) OR ("real world" W/8 walk*) OR ("real-world" W/8 walk*) OR (usual W/8 walk*) OR (functional W/3 walk*) OR ("free living" W/8 ambulat*) OR ("free-living" W/8 ambulat*) OR ("real world" W/8 ambulat*)

OR

("real-world" W/8 ambulat*) OR (usual W/8 ambulat*) OR (functional W/3 ambulation*) OR ("free living" W/8 gait) OR ("free-living" W/8 gait) OR ("real world" W/8 gait) OR ("real-world" W/8 gait) OR (usual W/8 gait*) OR (functional W/3 gait*)

OR

("free living" W/8 locomotion) OR ("free-living" W/8 locomotion) OR ("real world" W/8 locomotion) OR ("real-world" W/8 locomotion) OR (usual W/8 locomotion*) OR (functional W/3 locomotion*) OR "community ambulat*" OR (community W/8 walk*)

OR

(community W/8 pedometer) OR (community W/8 accelerometer) OR (community W/8 "activity monitor") OR (physical W/8 pedometer) OR (physical W/8 accelerometer) OR (physical W/8 "activity monitor")

AND

RCT OR "random* control* trial*" OR "random allocation" OR "control group" OR "single-blind method" OR (control* W/5 trial*) OR (control* W/5 stud*) OR (clinical* W/5 trial*) OR "quasi random*" OR "pseudo random*"

AMED (and Cochrane)

("free living" ADJ8 walk*) OR ("free-living" ADJ8 walk*) OR ("real world" ADJ8 walk*) OR ("real-world" ADJ8 walk*) OR (usual ADJ8 walk*) OR (functional ADJ3 walk*) OR ("free living" ADJ8 ambulat*) OR ("free-living" ADJ8 ambulat*) OR ("real world" ADJ8 ambulat*) OR ("real-world" ADJ8 ambulat*) OR (usual ADJ8 ambulat*) OR (functional ADJ3 ambulation*) OR ("free living" ADJ8 gait) OR ("free-living" ADJ8 gait) OR ("real world" ADJ8 gait) OR ("real-world" ADJ8 gait) OR (usual ADJ8 gait*) OR (functional ADJ3 gait*) OR ("free living" ADJ8 locomotion) OR ("free-living" ADJ8 locomotion) OR ("real world" ADJ8 locomotion) OR ("real-world" ADJ8 locomotion) OR (usual ADJ8 locomotion*) OR (functional ADJ3 locomotion*) OR "community ambulat*" OR (community ADJ8 walk*) OR (community ADJ8 pedometer) OR (community ADJ8 accelerometer) OR (community ADJ8"activity monitor") OR (physical ADJ8 pedometer) OR (physical ADJ8 accelerometer) OR (physical ADJ8 "activity monitor")

AND

RCT OR "random* control* trial*" OR "random allocation" OR "clinical trial*" OR "control* clinical trial*" OR "control group" OR "single-blind method" OR (controlled ADJ5 trial*) OR (controlled ADJ5 stud*) OR (clinical* ADJ5 trial*) OR "quasi-random*" or "quasi random*" or "pseudo-random*" or "pseudo random*"

PEDRO; OT Seeker: PsychBite

(Walk* AND Stroke)

(Gait AND Stroke)

Appendix Three: Studies excluded from review and reasons*

Papers	Reasons for exclusion				Additional Comments
	Outcome not real world waking behaviour #	**Inadequate control group**	**Mixed population**	**Unable calculate effect sizes with data provided**	
Ada 2003 (38)	○				
Ada 2013 (10)	○				
Batchelor 2012 (39)	○				
Boysen 2009 (40)				○	RMI but medians
Cooke 2010 (41)	○				Modified RMI
Cramp 2010 (42)		○			
Cumming 2011 (43)	○				
Dean 2010 (44)	○				
Desrosiers 2007 (45)	○				

Dicksten 2013 (46)				○	Number steps reported in text but authors contacted and not able provide data
Dobkin 2010 (47)	○				
Elsworth 2011 (48)			○		
English 2014 (49)				○	
Gilham 2010 (50)	○				
Green 2002 (51,16)				○	RMI but medians
Harwood 2011 (52)	○				
Holmgren 2006 (53)	○				
Hwang 2010 (54)	○				
Johnston 2007 (55)	○				
Kirk 2013 (56)				○	
Kono 2013 (57)		○			
Kwakkel 2002 (58)		○			

Lennon 2008 (59)	○				
Lord 2007 (60)	○				
Lund 2012 (61)	○				
Michael 2009 (62)		○			
Moore 2010 (63)				○	
Olney 2006 (64)		○			
Park 2011 (65)	○				
Pundik 2012 (66)	○				
Smith 2004 (67)	○				
Teixeira-Salmela 1999 (68)	○				
Torres-Arreola 2009 (69)	○				
Van der Ploeg (70)			○		
Wade 1992 (15)	○				Early version RMI- unable determine if met criteria
Yang 2008 (71)	○				

Zedlitz 2012 (72)	○				

*RMI=Rivermead Mobility Index
This category includes measures assessed and not considered to reflect real world walking or if not enough information available to make assessment