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Research

# After-hours or weekend rehabilitation improves outcomes and increases physical activity but does not affect length of stay: a systematic review

Katharine Scrivener [a], Taryn Jones [a], Karl Schurr [b], Petra L Graham [c], Catherine M Dean [a]

[a] Department of Health Professions, Macquarie University; [b] Physiotherapy Department, Bankstown-Lidcombe Hospital; [c] Department of Statistics, Macquarie University, Sydney, Australia

KEY WORDS

Rehabilitation
Physical activity
Outcome
After hours
Weekend

ABSTRACT

**Question:** In adults undergoing inpatient rehabilitation, does additional after-hours rehabilitation decrease length of stay and improve functional outcome, activities of daily living performance and physical activity? **Design:** Systematic review with meta-analysis of randomised trials. **Participants:** Adults participating in an inpatient rehabilitation program. **Intervention:** Additional rehabilitation provided after hours (evening or weekend). **Outcome measures:** Function was measured with tests such as the Motor Assessment Scale, 10-m walk test, the Timed Up and Go test, and Berg Balance Scale. Performance on activities of daily living was measured with the Barthel index or the Functional Independence Measure. Length of stay was measured in days. Physical activity levels were measured as number of steps or time spent upright. Standardised mean differences (SMD) or mean differences (MD) were used to combine these outcomes. Adverse events were summarised using relative risks (RR). Study quality was assessed using PEDro scores. **Results:** Seven trials were included in the review. All trials had strong methodological quality, scoring 8/10 on the PEDro scale. Among the measures of function, only balance showed a significant effect: the MD was 14 points better (95% CI 5 to 23) with additional after-hours rehabilitation on a 0-to-56-point scale. The improvement in activities of daily living performance with additional after-hours rehabilitation was of borderline statistical significance (SMD 0.10, 95% CI 0.00 to 0.21). Hospital length of stay did not differ significantly (MD –1.8 days, 95% CI –5.1 to 1.6). Those receiving additional rehabilitation had significantly higher step counts and spent significantly more time upright. Overall, the risk of adverse events was not increased by the provision of after-hours or weekend rehabilitation (RR 0.87, 95% CI 0.70 to 1.10). **Conclusion:** Additional after-hours rehabilitation can increase physical activity and may improve activities of daily living, but does not seem to affect the hospital length of stay. **Review registration:** PROSPERO CRD42014007648. **[Scrivener K, Jones T, Schurr K, Graham PL, Dean CM (2015) After-hours or weekend rehabilitation improves outcomes and increases physical activity but does not affect length of stay: a systematic review. *Journal of Physiotherapy* 61: 61–67]**


## Introduction

Inpatient rehabilitation programs are commonly required for people with poor mobility and functional performance as a result of many health conditions.[1–3] These rehabilitation programs should contain repetitive practice of functional tasks and exercise in order to improve fitness.[1,4,5] Increasing the intensity of rehabilitation programs elicits greater improvement in participants' mobility and functional outcomes, as well as a reduction in the length of hospital stay.[6–9] Despite this, inpatients undergoing rehabilitation programs are inactive for large amounts of time during the day.[10–12] During weekdays, the amount of therapy occurring in hospital varies greatly. In rehabilitation after hip fracture, for example, 2 hours of physiotherapy and occupational therapy have been observed to be completed each weekday,[13] whereas in stroke rehabilitation, as little as 16 minutes of therapy time has been observed each weekday.[14]

Inpatient rehabilitation participants are more inactive on the weekend than during the week.[15,16] Furthermore, less therapeutic activity is observed in the evenings and on the weekend.[17] In many rehabilitation hospital settings, therapists are rostered to work from Monday to Friday, within usual working hours. Consequently, little or no therapeutic activities occur in the evenings and on the weekend. In addition, therapy areas are usually closed when therapists are not present. Therefore, for rehabilitation, increasing physical activity opportunities out of traditional working hours is a major challenge. In 2006, a systematic review analysed trials of additional physiotherapy outside of traditional working hours provided to acute hospital inpatients but did not show a benefit from the additional therapy.[18]

Various strategies have been investigated to provide opportunities for exercise out of the typical therapy times and environment. For example, one of these strategies included the provision of supplementary arm exercise programs that the

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rehabilitation participant completes independently in the ward environment.[19] This program demonstrated a positive outcome with very minimal burden on therapy staff.

The aim of this systematic review was to summarise current evidence about the effect of additional in-hospital rehabilitation out of traditional working hours. This is in contrast to other reviews of more intensive therapy after stroke, which predominantly included studies of additional therapy during the working day.[6,7] Therefore, the research questions for this systematic review were:

1. Does additional rehabilitation occurring after hours or on weekends improve the functional outcomes of rehabilitation participants?
2. Does providing additional rehabilitation after hours or on weekends decrease the length of stay in rehabilitation?
3. Does providing additional rehabilitation after hours or on weekends increase daily physical activity among hospital inpatients?
4. Does providing additional rehabilitation after hours or on weekends increase the risk of adverse events?

## Methods

### *Identification and selection of studies*

This systematic literature review was conducted according to a protocol that was registered *a priori* and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[20] An electronic search for relevant articles was conducted in July 2014. The following databases were searched: Ovid MEDLINE, Embase, AMED, CINAHL, Scopus and PEDro. The search terms included those related to rehabilitation (*physiotherapy*, *occupational therapy*, *exercise*), additional rehabilitation (*weekend*, *after-hours*, *supplementary*, *six day*, *seven day*, *Saturday*, *Sunday*), inpatient (*patient*, *hospital*) and randomised controlled trial (*controlled*, *intervention group*, *random*). Full details of the search strategy used for each database are in Appendix 1 on the eAddenda.

Titles and abstracts were examined for relevance by one author (KS). Where appropriate, the full text of articles was sought to determine their relevance to the review. Where there was doubt, a second author (TJ) reviewed the full-text article to determine its relevance to the review. The criteria for inclusion of studies in the review are presented in Box 1.

### *Assessment of characteristics of studies*

*Quality*

Two authors independently examined the full-text version of the trial reports included in the review to assess the risk of bias. Risk of bias was assessed using the PEDro scale[21] and the Cochrane Collaboration's Risk of Bias tool.[22] All included trial reports were located on the PEDro database to confirm their PEDro scale score. If a disagreement arose between the authors about the risk of bias scores, the trial was discussed with a third author in order to reach consensus.

**Box 1.** Inclusion criteria.

**Design**
- Randomised trial
- Published in English

**Participants**
- Adult inpatients in a subacute or rehabilitation setting

**Intervention**
- Additional after-hours physical rehabilitation

**Outcome measures**
- Functional outcome
- Activities of daily living
- Length of hospital stay
- Physical activity levels
- Adverse events

*Participants, interventions, outcomes*

Two authors independently examined the full-text version of the trial reports included in the review to extract data. Where necessary, authors of articles included in the review were contacted to provide additional data to allow the comparison of results. Participants in the included studies could have any clinical condition, provided they were receiving rehabilitation as inpatients. The after-hours physical rehabilitation could occur in any form (eg, arm exercise, mobility training) and could be unsupervised (ie, self-monitored programs) or supervised by anyone (eg, therapists, families, assistants, nursing staff). Trials examining additional therapy during regular working hours were ineligible. Data were extracted for the following outcomes: functional outcomes (eg, Motor Assessment Scale, Berg Balance Scale, 10-m walk test); activities of daily living (eg, Barthel index, Functional Independence Measure); length of hospital stay; physical activity (eg, activity monitors, behavioural mapping data); and adverse events.

### *Data analysis*

To obtain pooled estimates of the effect of the intervention, DerSimonian and Laird random-effects meta-analyses were used. The effect of additional after-hours rehabilitation was estimated using: standardised mean differences (SMD) with 95% CI for the functional outcomes and activities of daily living; mean differences (MD) with 95% CI for the Timed Up and Go test, the 10-m walk test, and length of hospital stay; and relative risk (RR) with 95% CI for adverse events. Heterogeneity between studies was assessed using Cochrane's Q, with $p$-values less than 0.05 indicating significant heterogeneity. Where results were reported as medians and interquartile ranges or ranges, the methods of Hozo and colleagues[23] were used to convert results into means and standard deviations. While reporting of medians may indicate non-normality, the sizes of the studies where this occurred suggested that it might be reasonable to assume that means would be normally distributed. Subgroup and sensitivity analyses were not undertaken due to the small number of studies providing data for any outcome. R statistical software[24] with the *meta* package[25] was used for all analyses.

## Results

### *Flow of studies through the review*

The search identified 2559 papers, of which 25 were retrieved in full text and screened for eligibility. Of these, seven trials were included in the review (Figure 1).

A systematic review[6] of augmented therapy time after stroke was identified by the search. Screening of the reference list identified 10 papers that were possibly relevant. Based on the abstracts, two papers were obtained in full text, but neither was eligible because the participants were outpatients.[26,27] Another systematic review,[18] investigating the effect of additional physiotherapy for hospital inpatients (in all phases of care) provided outside of regular business hours, was identified by the search. Screening of the reference list identified five papers that were possibly relevant. However, screening the abstracts indicated that none was eligible: two were not randomised, controlled trials;[28,29] one assessed additional therapy that was not delivered after hours;[30] and two were conducted in the acute setting.[31,32] A more recent systematic review investigating the

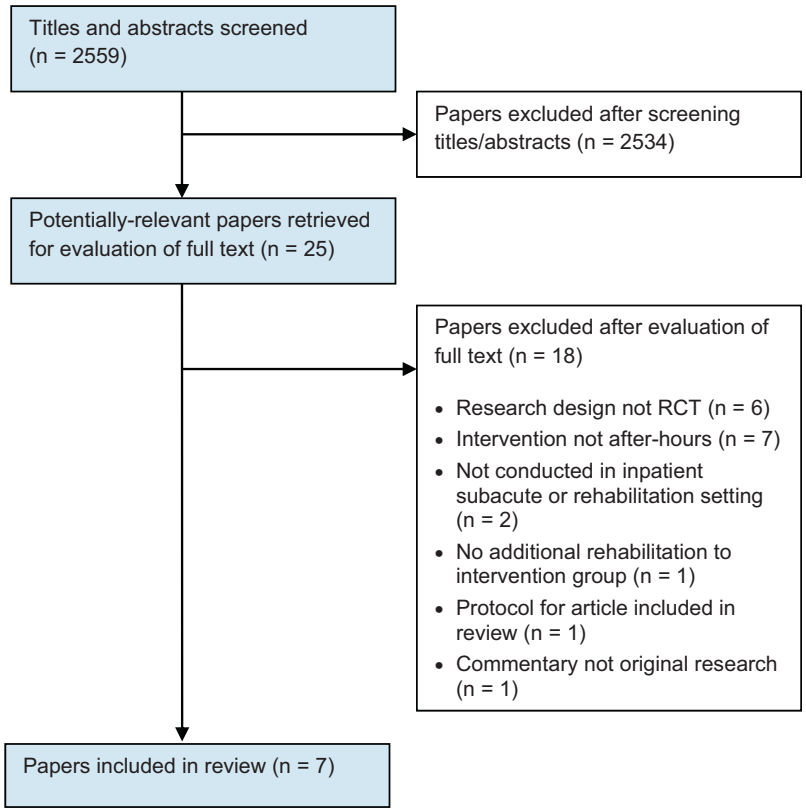


**Figure 1.** Flow of studies through the review.

**Table 1**
Characteristics of the included studies.

| Study | Participants | Intervention | Outcome measures |
|---|---|---|---|
| Brusco et al 2007 [38] | n = 262<br>Age *(yr)* = Exp 77 (SD 13), Con 77 (SD 13)<br>Setting – mixed | Exp = 60 min physiotherapy on weekdays, plus 60 min physiotherapy on Saturday<br>Con = 60 min physiotherapy on weekdays | • Activity = 10-m walk test *(m/s)*, TUG *(s)*, MAS, FIM, Functional Reach Test<br>• Quality of Life = EQ-5D<br>• Length of stay |
| Davidson et al 2005 [36] | n = 41<br>Age *(yr)* = Exp 69 (SD 14), Con = 64 (SD 18)<br>Setting – stroke | Exp = Usual care, plus practice of activities supervised by nursing staff on the weekend. Activities included sitting, sit to stand, standing balance and stepping.<br>Con = Usual care | • Activity = Barthel Index, MAS<br>• Length of stay |
| Galvin et al 2011 [35] | n = 40<br>Age *(yr)* = Exp 63 (SD 13), Con 70 (SD 12)<br>Setting – stroke | Exp = Usual care, plus family-mediated lower limb exercise for 8 wk, 35 min daily in hospital ward (continued into home if discharged). Individualised lower limb exercise prescribed.<br>Con = Usual care | • Impairment = LL FMA<br>• Activity = 6-min walk test *(m)*, Berg Balance Scale, Barthel Index |
| Harris et al 2009 [19] | n = 103<br>Age *(yr)* = Exp 69 (SD 12), Con 69 (SD 15)<br>Setting – stroke | Exp = Usual care, plus a self-administered homework-based upper-limb exercise program for 4 wk. Participants were trained in the program, provided with an exercise instruction booklet and equipment, and monitored weekly.<br>Con = Usual care plus educational booklet about stroke | • Activity = Chedoke Arm and Hand Activity Inventory |
| Peiris et al 2012 [40] | n = 105<br>Age *(yr)* = 74 (SD 12)<br>Setting – orthopaedic | Exp = Usual physiotherapy and occupational therapy on weekdays, plus one Saturday session of physiotherapy and occupational therapy<br>Con = Usual physiotherapy and occupational therapy on weekdays | • Physical activity = steps, time upright *(hrs)* |
| Peiris et al 2013 [37] | n = 996<br>Age *(yr)* = Exp 75 (SD 13), Con 74 (SD 13)<br>Setting – mixed | Exp = Usual physiotherapy and occupational therapy on weekdays, plus Saturday<br>Con = Usual physiotherapy and occupational therapy on weekdays | • Activity = FIM, 10-m walk test *(m/s)*, TUG *(s)*, Modified MAS<br>• Quality of Life = EQ-5D<br>• Length of stay |
| Said et al 2012 [39] | n = 47<br>Age *(yr)* = Exp 81 (SD 5), Con 82 (SD 7)<br>Setting – aged care | Exp = Usual care (multidisciplinary rehabilitation, including 1 to 2 individual or group physiotherapy sessions on weekdays), plus standing and walking activities in the late afternoon and on weekends (individual program delivered by a physiotherapist or physiotherapy assistant)<br>Con = Usual care (multidisciplinary rehabilitation, including 1 to 2 individual or group physiotherapy sessions on weekdays) | • Activity = DEMMI, Barthel Index<br>• Physical activity = upright time *(% target time)*<br>• Length of stay |

Con = control group, DEMMI = de Morton Mobility Index, EQ-5D = EuroQoL questionnaire, Exp = experimental group, FIM = Functional Independence Measure, LL FMA = lower limb section of the Fugl-Meyer Assessment, MAS = Motor Assessment Scale, TUG = Timed Up and Go test.

**Table 2**
Additional amount of after-hours rehabilitation in intervention group.

| Study | Intervention delivery | Additional rehabilitation time *(min)* | |
|---|---|---|---|
| | | total | per day |
| Brusco et al 2007 [38] | Saturday physiotherapy service | 246 | 11.6 |
| Davidson et al 2005 [36] | Nurse-supervised activity practice | 72 | 0.8 |
| Galvin et al 2011 [35] | Family-mediated | 1816 | 32.4 |
| Harris et al 2009 [19] | Self-administered (± family support) | 720 | 25.7 |
| Peiris et al 2012 [40] | Saturday physiotherapy and occupational therapy service | 144 | 20.6 |
| Peiris et al 2013 [37] | Saturday physiotherapy and occupational therapy service | 159 | 7.6 |
| Said et al 2012 [39] | Physiotherapist or assistant | 241 | 15.1 |

effect of extra physiotherapy on people with acute or subacute conditions was also identified.[33] One paper in the reference list was obtained in full text, but it was ineligible because the additional therapy was provided within business hours.[34]

### *Characteristics of the included trials*

Seven articles met the inclusion criteria and were included in the review. The studies investigated a total of 1489 participants. Three studies were in a stroke rehabilitation setting,[19,35,36] two were in mixed rehabilitation[37,38] and one was in mixed aged-care rehabilitation.[39] The 2012 study by Peiris and colleagues[40] was a subgroup analysis of the larger trial conducted by this group and published in 2013.[37] This subgroup analysis focused on participants in the orthopaedic rehabilitation setting.[40] Further details of the studies can be found in Tables 1 and 2.

*Quality*

All seven studies included in the review scored 8/10 on the PEDro scale. This suggests that they have high methodological rigor. Figure 2 summarises the risk of bias of the included studies using the Cochrane Collaboration's checklist. From Figure 2 it can be seen that the area of most risk is in non-blinding of participants and therapists to group allocation. Whilst it is understandably difficult to blind participants in studies where the intervention is obvious, some studies made no attempt to blind weekday treating therapists to group allocation. This may have impacted the results, because weekday staff could alter the amount of usual therapy if they were aware that the study participant was receiving additional rehabilitation after hours or on the weekend.

The amount of additional rehabilitation time provided to the intervention group is presented in Table 2. The additional

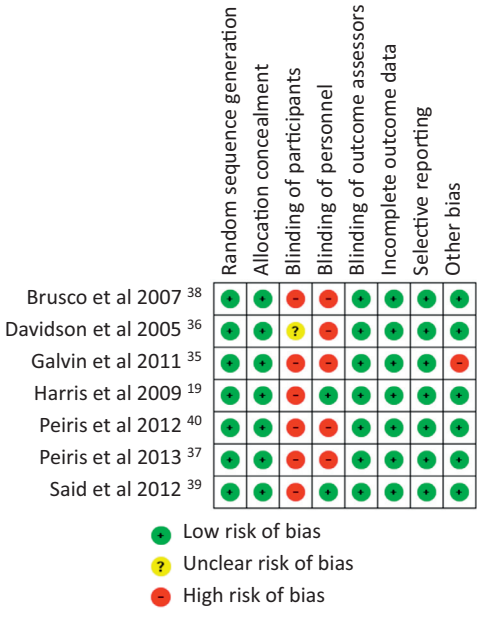


**Figure 2.** Summary of ratings on the Cochrane Risk of Bias tool.

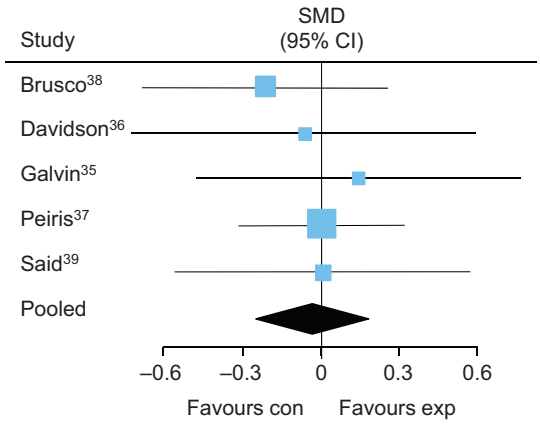


**Figure 3.** Forest plot of the effect of additional after-hours or weekend rehabilitation on physical function, pooling data from five studies and presented as a standardised mean difference (95% CI).

rehabilitation time varied significantly from 72 to 1816 minutes of rehabilitation over the study period, or an average of 0.8 to 32.4 minutes of additional rehabilitation for each day in hospital.

### *Effect of additional after-hours or weekend rehabilitation on function*

Figures 3, 5, 7 and 9 outline the effect of additional after-hours or weekend rehabilitation on functional outcomes.

*Physical function*

Five of the studies assessed physical function using the de Morton Mobility Index (DEMMI) or the standard or modified Motor Assessment Scale (Figure 3, and see Figure 4 on the eAddenda for the detailed forest plot). There was no evidence of heterogeneity between studies (Q = 0.91, $p$ = 0.92). Overall, there was no evidence of an improvement in physical function due to additional weekend or after-hours rehabilitation (SMD −0.03, 95% CI −0.24 to 0.18).

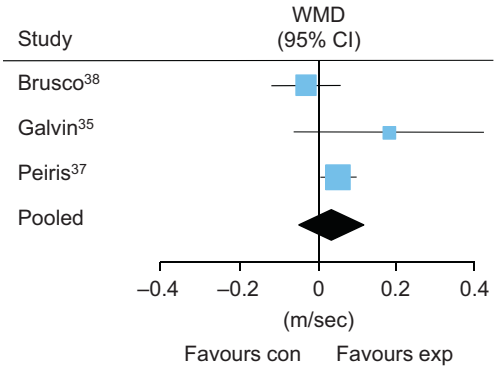


**Figure 5.** Forest plot of the effect of additional after-hours or weekend rehabilitation on walking speed, pooling data from three studies and presented as a weighted mean difference (95% CI).

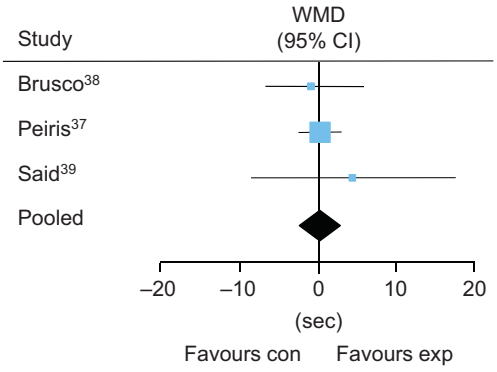


**Figure 7.** Forest plot of the effect of additional after-hours or weekend rehabilitation on the Timed Up and Go test, pooling data from three studies and presented as a weighted mean difference (95% CI).

*Walking*

Three studies investigated walking speed (Figure 5, and see Figure 6 on the eAddenda for the detailed forest plot). The effect of additional rehabilitation on walking speed was not significant (MD 0.03 m/s, 95% CI –0.04 to 0.11) (Figure 5). There was no evidence of heterogeneity between studies (Q = 4.05, $p$ = 0.13).

Three studies investigated the Timed Up and Go test (Figure 7, and see Figure 8 on the eAddenda for the detailed forest plot). Overall, there was no effect of additional rehabilitation on the time taken to complete the test (MD 0.04 seconds, 95% CI –2.33 to 2.41). There was no evidence of heterogeneity between studies (Q = 0.45, $p$ = 0.80).

*Balance*

A study by Galvin and colleagues[35] demonstrated a significant effect in favour of the intervention group on the Berg Balance Scale (range 0 'worst' to 56 'best') on discharge from hospital. The intervention group improved by 14 more points than the control group (95% CI 5 to 23).

*Arm function*

The study by Harris and colleagues[19] demonstrated a between-group difference of 7 points (95% CI 3 to 10) in favour of the intervention group on the Chedoke Arm and Hand Inventory; scores can range from 0 to 63.

*Activities of daily living*

The combined result of the five studies that measured activities of daily living with the Barthel Index or Functional Independence Measure is presented in Figure 9 (see Figure 10 on the eAddenda for the detailed forest plot). The mean result favoured additional after-hours or weekend rehabilitation (SMD 0.10) but this was of

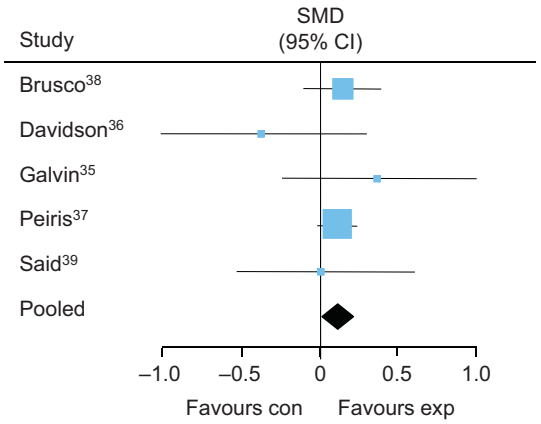


**Figure 9.** Forest plot of the effect of additional after-hours or weekend rehabilitation on activities of daily living, pooling data from five studies and presented as a standardised mean difference (95% CI).

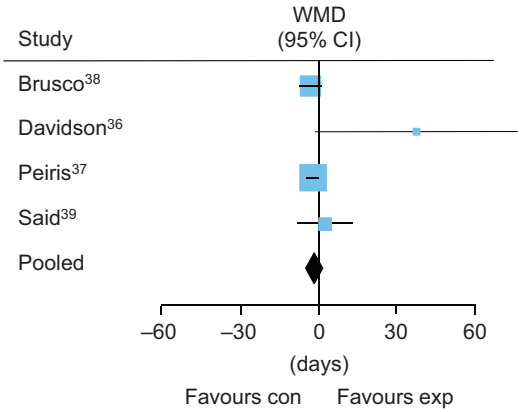


**Figure 11.** Forest plot of the effect of additional after-hours or weekend rehabilitation on length of stay, pooling data from four studies and presented as a weighted mean difference (95% CI).

borderline statistical significance (95% CI 0.00 to 0.21). There was no evidence of heterogeneity between studies (Q = 2.88, $p$ = 0.58).

### *Effect of additional after-hours or weekend rehabilitation on length of stay*

A meta-analysis of four trials examining the effect of additional after-hours and weekend rehabilitation on hospital length of stay is presented in Figure 11 (see Figure 12 on the eAddenda for the detailed forest plot). Overall, additional rehabilitation after hours or on weekends had no significant effect on the length of the stay in rehabilitation (MD –1.8 days, 95% CI –5.1 to 1.6). There was no evidence of heterogeneity between studies ($I^2$ = 0%, $p$ = 0.88).

### *Effect of additional after-hours or weekend rehabilitation on physical activity*

Two studies investigated physical activity, showing that weekend or after-hours rehabilitation could increase physical activity[39] and, more specifically, steps taken and time spent upright.[40] In the study by Said and colleagues,[39] physical activity levels in the intervention group were compared to activity levels observed on the rehabilitation unit in a previous study.[16] The activity levels were double those previously observed of an evening (13.8 minutes) and weekend activity levels improved to be equal to that observed on weekdays (additional 30 minutes, to achieve a total of 1.6 hours upright time).[16,39] In the 2012 study by Peiris and colleagues,[40] an additional Saturday therapy session caused participants to take twice as many steps (MD 428 steps, 95% CI 184 to 673) and spend 50% more time upright (MD 0.5 hours, 95% CI 0.1 to 0.9) on that day.

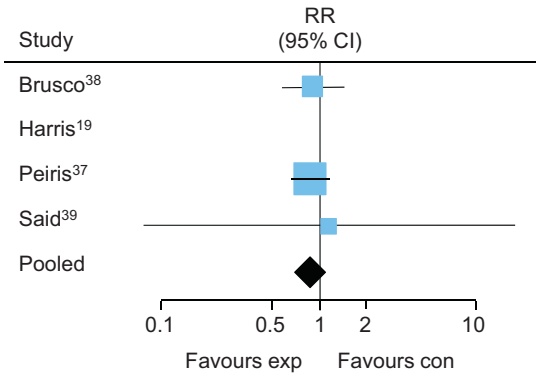


**Figure 13.** Forest plot of the effect of additional after-hours or weekend rehabilitation on adverse events, pooling data from three studies and presented as relative risk (95% CI). Note that no adverse events occurred in either group in the study by Harris et al.[19].

### *Adverse events*

A meta-analysis of four studies was conducted. Despite reporting data about adverse events, the 2012 study by Peiris et al[40] was excluded from this meta-analysis because it reports data on a subset of participants in their larger 2013 trial.[37] The pooled relative risk of experiencing adverse events is expressed in Figure 13 (see Figure 14 on the eAddenda for the detailed forest plot). Overall, there was no increased risk of adverse events with the provision of after-hours or weekend rehabilitation (RR 0.87, 95% CI 0.70 to 1.10). There was no evidence of heterogeneity between studies (Q = 0.05, $p = 0.98$). The reported adverse events included in the analysis were more-serious events such as falls. Harris and colleagues[19] also reported that 15 participants in the intervention group (who undertook an independent upper-limb exercise program) experienced shoulder pain, although it is unclear whether control group participants were asked about this. The data from Peiris and colleagues[37] were obtained via correspondence with the author.

## Discussion

This systematic review suggests that additional after-hours or weekend rehabilitation can improve aspects of physical function and performance of activities of daily living, as well as increase physical activity levels in hospital. However, no significant effect on length of stay in hospital was identified.

The results of this review support other studies suggesting that increased intensity of rehabilitation leads to improved functional outcomes.[6–9] Moreover, it supports the hypothesis that additional rehabilitation can be delivered out of hours, including on the weekend. However, the results are in contrast to a previous systematic review that investigated physiotherapy provided out of hours in hospitals[13] and found no effect of the additional therapy.

The studies in this review varied in the method of delivering the additional rehabilitation. One study used a self-administered exercise program with weekly support from therapy staff,[19] another study used family members to assist with an after-hours exercise program,[35] whilst another study trained nursing staff to deliver exercise programs on the weekend.[36] The remaining four studies used therapists or therapy assistants to provide additional therapy session either after hours or on weekends.[37–40] Both studies using independent or family-mediated training demonstrated a significant impact on function with minimal adverse events (eg, mild shoulder pain after arm exercise).

This review identified that providing additional rehabilitation after hours is effective in improving some patient outcomes. From a hospital perspective, this intervention can be self-administered by the patient, supported by family members or offered by existing members of nursing staff – meaning that it can be implemented at minimal or no cost. On the other hand, this review demonstrated no reduction in length of stay; thus, not necessarily producing any cost savings for the organisation. For clinicians working in rehabilitation, offering after-hours intervention may be a mechanism for improving outcome without a significant increase in workload. This review also provides cautious support to the idea of restructuring rehabilitation services to operate over extended hours, seven days a week.

This review contained high-quality randomised, controlled trials; all with a PEDro score of 8/10. The studies contained participants of similar ages – generally over 65 years. A variety of rehabilitation settings and diagnostic groups were included in the review, with a focus on stroke and orthopaedic rehabilitation. It should be noted that three of the seven studies contained less than 50 participants. Of those, one study was clearly identified as a pilot study designed to gain information, not to detect between-group differences. The search strategy identified the protocol for a current study investigating therapy seven days a week compared to circuit therapy.[41] The results of the latter study, when combined with the full version of the pilot study data included in the present systematic review,[39] may provide additional evidence regarding the efficacy of after-hours rehabilitation.

When interpreting results from the studies in the review, the actual dosage of additional rehabilitation that was provided needs to be considered. Providing more days of rehabilitation, for example, on the weekend, does not necessarily result in a significantly larger amount of rehabilitation. For example, a trial comparing 5-day versus 7-day physiotherapy in the acute orthopaedic setting found no difference in the number of physiotherapy sessions the two groups received.[42] Similarly, in the study by Davidson and colleagues in this review,[36] which investigated a nurse-run weekend exercise program, the additional exercise provided to each participant was minimal, with an average 13 minutes (SD 14) of additional exercise on each weekend day. In this systematic review, we considered whether to examine the effect of the dose of the additional rehabilitation that was provided; however, due to the limited number of studies reporting on each outcome measure, this was not possible.

In conclusion, after-hours or weekend rehabilitation has beneficial effects on aspects of physical function, performance of activities of daily living, and the amount of physical activity in the hospital. There was no effect shown for length of stay in hospital.

**What is already known on this topic**: Rehabilitation that involves repetitive practice of functional tasks and exercise to improve fitness is effective for people with poor mobility and functional performance due to various health conditions. Rehabilitation inpatients perform few therapeutic activities in the evening and on weekends.

**What this study adds**: Additional rehabilitation provided after hours or on weekends improves aspects of physical function, performance of activities of daily living, and the amount of physical activity undertaken in the hospital. Despite these benefits, length of stay in hospital was not significantly affected.

**eAddenda**: Figures 4, 6, 8, 10, 12 and 14 and Appendix 1 can be found online at doi:10.1016/j.jphys.2015.02.017.

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***Correspondence***: Katharine Scrivener, Department of Health Professions, Macquarie University, Sydney, Australia. Email: kate.scrivener@mq.edu.au

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