Additional Saturday rehabilitation for inpatients

Submitted by

Casey Lea Peiris

Bachelor of Physiotherapy with Honours

A thesis submitted in total fulfilment

of the requirements for the degree of

Doctor of Philosophy

Faculty of Health Sciences

Department of Physiotherapy

La Trobe University

Bundoora, Victoria 3086

Australia

June 2013

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List of Abbreviations

ADLS ..... Activities of Daily Living

CI ..... Confidence Interval

CONSORT ..... Consolidated Standards of Reporting Trials

EQ-5D ..... EuroQOL questionnaire

EQ-VAS ..... EuroQOL Visual Analogue Scale

HRQOL ..... Health-related Quality of Life

MD ..... Mean Difference

MMAS ..... Modified Motor Assessment Scale

OT ..... Occupational Therapy

PC-PART ..... Personal Care Participation Assessment and Resource Tool

PRISMA ..... Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PT ..... Physical Therapy

RCT ..... Randomised Controlled Trial

RR ..... Risk Ratio

SF-36 ..... Medical Outcomes Study 36-Item Short-Form Health Survey

SMD ..... Standardised Mean Difference

STROBE ..... Strengthening the Reporting of Observational Studies in Epidemiology

ACKNOWLEDGEMENTS

There are a number of people I would like to thank who have made the completion of this thesis not only possible, but also enjoyable.

First and foremost to my supervisors:

Nick Taylor – you inspired me to commence this journey and I have not looked back since. Your door has always been open to answer my questions and provide guidance and I thank you sincerely for your generosity with your time and for introducing me to the wonderful world of research.

Nora Shields – for your ongoing support, encouragement, feedback and invaluable advice not only academically but also in life. I will be forever grateful.

I would also like to thank the following people for their continual support, encouragement and assistance:

- *Tash Brusco,* who was instrumental in starting the research journey for me
- To all the rehabilitation participants at Peter James Centre and Angliss Hospital who happily agreed to take part in the projects
- To all the physiotherapists, occupational therapists, allied health assistants, rehabilitation consultants and ward staff at Peter James Centre and Angliss Hospital
- To the project staff, in particular *Glenys, Clarissa, Renita, Belinda and Sarah,* for their perseverance and diligence.

Last, but not least, to my family who have supported me through many years of study; to my parents *Margaret* and *Neil*, my brother *Christian*, and most importantly my dear husband *Kal* – thank you all.

SUMMARY

This thesis reports the effects of providing additional Saturday rehabilitation (physiotherapy and occupational therapy) during inpatient rehabilitation on physical activity, length of stay, functional independence and health-related quality of life (HRQOL).

A systematic review of 16 randomised controlled trials concluded that extra physiotherapy reduced length of stay and improved walking ability, activity and HRQOL for patients with acute or sub-acute health conditions. An observational study showed that patients (n=54) receiving inpatient rehabilitation walked for a median of only 8 minutes per day. Although none met physical activity guidelines there was a positive association between physical activity and improvement in mobility (r=.39). A randomised controlled trial (n=105) demonstrated that patients who received additional Saturday rehabilitation took twice as many steps daily [mean difference (MD) 428 steps] and spent 50% more time upright (MD 0.5 hours) compared to patients receiving Monday to Friday rehabilitation. A qualitative study indicated that while patients who received Monday to Friday rehabilitation expected to rest on the weekend, those who received Saturday rehabilitation felt it was important to be working towards recovery over the weekend. Finally, a randomised controlled trial (n=996) found that patients who received Monday to Saturday rehabilitation were almost 20% more likely to have achieved a clinically significant improvement in functional independence [risk ratio (RR) 1.17, 95%CI 1.03 to 1.34] and HRQOL (RR 1.18, 95%CI 1.04 to 1.34) on discharge, despite being discharged 2 days earlier (95%CI 0 to 4), with some benefits maintained at 6 months.

The results of this thesis support the provision of additional weekend rehabilitation services during inpatient rehabilitation. Providing additional rehabilitation may reduce length of stay, can increase physical activity levels from the very low levels observed, and can lead to clinically significant and sustained improvements in functional independence and HRQOL.

STATEMENT OF AUTHORSHIP

Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis submitted for the award of any other degree or diploma.

No other person's work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

All research procedures reported in the thesis were approved by the La Trobe University Faculty Ethics Committee (FHEC10/14) and the Eastern Health Research Ethics Committees (E58/0910) (Appendix 1).

Signed: _____

Date: 04/06/13

Please note: this thesis was prepared to conform to La Trobe University guidelines (Schedule B: Presentation of a Thesis – Examination and Assessment Regulation R 21.12). All spelling conforms to Australian English.

PREFACE

The thesis is presented as a series of published papers. Chapters 2 to 6 in this thesis are presented in the format that they were published. Each of these chapters is intended to stand alone, but can be read in order as part of the entire thesis. These chapters all use the referencing and citation styles required by the journals that they were published in.

Sections of this thesis that were not submitted for publication (Chapter 1/introduction, Chapter 7/general discussion, brief introductions to each published chapter and appendices) use the referencing and citation style of the *Journal of Physiotherapy* and are written in Australian English.

LIST OF PUBLICATIONS

Peiris CL, Taylor NF and Shields N (2011): Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. *Archives of Physical Medicine & Rehabilitation* 92: 1490-1500.

Peiris CL, Taylor NF and Shields N (2012): Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation* 93: 1365-1370.

Peiris CL, Taylor NF and Shields N (2012): Patients value patient-therapist interactions more than the amount or content of therapy during rehabilitation: a qualitative study. *Journal of Physiotherapy* 58: 261-268.

Peiris CL, Taylor NF and Shields N (2013): Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions do much less physical activity than recommended in guidelines for healthy older adults: an observational study. *Journal of Physiotherapy* 59: 39-44.

Peiris CL, Shields N, Brusco NK, Watts JJ and Taylor NF (2013): Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial. *BMC Medicine* 11: 198 doi: 10.1186/1741-7015-11-198

List of Conference Presentations

1. **Peiris CL**, Taylor NF and Shields N: Extra physiotherapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or sub-acute health conditions: a systematic review. Eastern Health Research Forum, October 26 2011, Melbourne, Australia
2. **Peiris CL**, Taylor NF and Shields N: Additional Saturday allied health service increases physical activity levels among patients receiving inpatient rehabilitation for lower limb orthopaedic conditions: a randomised controlled trial. Eastern Health, Allied Health Research Forum, May 3 2012, Melbourne, Australia
3. **Peiris CL**, Taylor NF and Shields N: Additional physical therapy and occupational therapy increases physical activity in orthopedic rehabilitation. American Congress of Rehabilitation Medicine, October 11 2012, Vancouver, Canada
4. **Peiris CL**, Shields N, Brusco NK, Watts JJ and Taylor NF: Additional Saturday allied health services improve function and reduce length of stay: a randomised controlled trial. Eastern Health Research Forum, December 6 2012, Melbourne, Australia.

Chapter 1

INTRODUCTION

In Australia, it is estimated that there are almost 4 million people living with disabilities that limit their function (AIHW 2011). Disability can be the result of a chronic health condition or can occur for a short period of time when a person is recovering from an acute health episode. People with disability after an acute health episode may require a period of inpatient rehabilitation to improve their function before they return home. In Australia, there are approximately 180 rehabilitation facilities managing 83,000 rehabilitation episodes per year (AROC 2013). Rehabilitation is an important component of the Australian health care system and is essential for the flow of patients from acute care. The demand for rehabilitation continues to increase as the number of people living with disabilities increases. Between 1981 and 2003, the number of people living with disabilities in Australia doubled due to increases in chronic disease and accidents, as well as population growth and medical advances that prolong life (AIHW 2011).

For the purpose of this thesis, rehabilitation refers to sub-acute, inpatient rehabilitation that aims to enable people living with disabilities to reach and maintain their optimal physical, intellectual, psychological and social independence so that they can return to living independently in the community (WHO 2013). In Australia, patients are eligible for rehabilitation following an acute admission to hospital if they are medically stable and no longer require acute medical care, but are not able to be discharged home because of reduced functional independence. Patients are generally accepted for rehabilitation if they have the potential to improve and the capacity to participate in therapy. Sub-acute, inpatient rehabilitation is the most intensive level of rehabilitation and is provided in the immediate post-acute phase. Sub-acute rehabilitation

provides a multidisciplinary team approach to restore, as far as possible, an individual's functional independence and health-related quality of life following a recent acute event (such as disabling injury, illness or surgical intervention). In 2011, 48% of patients receiving rehabilitation in Australia had an orthopaedic diagnosis (such as fracture or joint replacement), 10% had a diagnosis of stroke and 21% were admitted to rehabilitation for reconditioning (AROC 2013).

The most common interventions received in rehabilitation are physiotherapy and occupational therapy interventions; more than 75% of patients admitted for rehabilitation receive physiotherapy intervention and 45% receive occupational therapy intervention (AIHW 2011). Physiotherapists and occupational therapists play an important role in the multidisciplinary rehabilitation team by assisting patients to improve their functional independence and health-related quality of life by preparing patients for discharge. Physiotherapy is a profession concerned with the promotion of health and wellbeing and the prevention, treatment or rehabilitation of disorders of human movement (WCPT 1999). The occupational therapy profession is closely aligned with physiotherapy and is also concerned with the promotion of health and wellbeing with a focus on occupation (WFOT 2010). The primary goal of physiotherapy is to assist patients to restore function and to achieve their maximal potential. Physiotherapists do this by employing techniques aimed to improve mobility, strength, motor control, fitness and balance, reduce pain and to increase joint range (Higgs et al 2001). The primary goal of occupational therapy is to enable patients to participate in activities of daily living. Occupational therapists achieve this by assisting patients to do these activities or by modifying the environment to better support participation (Rogers 2005, WFOT 2010). During rehabilitation these allied health professions work closely together utilising functional task training and exercise prescription to prepare patients for successful discharge.

There is strong evidence to support the provision of physiotherapy interventions to improve functional outcomes and health-related quality of life for people with a variety of musculoskeletal, neurological, cardiopulmonary and geriatric conditions (Taylor et al 2005, Taylor et al 2007, Tomlinson et al 2012), and the provision of occupational therapy to improve functional ability and health-related quality of life in older adults, people with stroke and people with rheumatoid arthritis (Steultjens et al 2005). In addition, multidisciplinary rehabilitation services that include both physiotherapy and occupational therapy have been found to be particularly beneficial in improving functional independence for geriatric conditions (Bachmann et al 2010), following hip fracture (Halbert et al 2007), and following stroke (Stroke Unit Trialists' Collaboration 2007). There is strong evidence to support the provision of multidisciplinary inpatient rehabilitation services, but the question remains as to how much rehabilitation therapy should be provided during inpatient rehabilitation.

Allied health therapy provision during rehabilitation

Just as appropriate dosage is crucial to medication having the desired effect; efficient rehabilitation can only be achieved with the appropriate therapy input. Unlike medical and nursing care, which is provided 24-hours per day, 7 days per week, allied health rehabilitation is traditionally only provided for patients between Monday and Friday, from 9 am to 5 pm. Although the majority of acute hospitals in the United Kingdom, Western Europe, Canada and Australia now provide some allied health services on weekends (Campbell et al 2010, Norrenberg and Vincent 2000, Shaw et al 2012), only 30% of rehabilitation facilities in Australia provide allied health services on the weekend (Shaw et al 2012). When allied health services are provided in acute hospitals on the weekend, services are often substantially reduced. For example, when compared to weekdays, service hours and staffing in Canadian hospitals are reduced by almost 90% (Campbell et al 2010), and services are reserved for those at risk of

functional decline over the weekend or patients being admitted or discharged over the weekend. Historical precedence, budget limitations and a lack of evidence to support its effectiveness are all possible explanations for the limited amount of physiotherapy and occupational rehabilitation services being provided on weekends.

There are no national standards in Australia governing minimum provision of allied health rehabilitation services for publicly funded facilities. In the United States of America, federal legislation requires that patients in rehabilitation receive at least 3 hours of allied health rehabilitation per day on at least 5 days of the week (AAPM&R 2011) and private health insurers in Australia require rehabilitation facilities to provide patients with 10 hours per week of allied health rehabilitation to receive payment. However, in public rehabilitation facilities in New South Wales patients may only receive allied health rehabilitation for as little as 3.5 hours per week (Poulos 2010).

Previous systematic reviews on patients with neurological conditions receiving rehabilitation suggest that a higher intensity of physiotherapy is associated with better patient health outcomes in stroke (Kwakkel et al 2004) and post traumatic brain injury (Hellweg and Johannes 2008), with less research conducted on occupational therapy interventions and in other areas of rehabilitation. A retrospective study found that functional gains were weakly associated with the intensity of multidisciplinary rehabilitation for patients with orthopaedic, neurological and debility impairments in a mixed rehabilitation setting (Chen et al 2002). In another retrospective study, patients with orthopaedic and neurological impairments who received additional weekend physiotherapy and occupational therapy rehabilitation services were discharged at a similar functional level, but one day earlier, compared to those who received Monday to Friday therapy (Disotto-Monastero et al 2012). In these studies, additional rehabilitation was provided either by longer therapy sessions, more therapy sessions during the working day or additional therapy sessions out of hours or on weekends. In addition, a recent systematic review and economic

evaluation found that an increased intensity of rehabilitation not only improved some patient outcomes but also led to significant cost savings (Brusco et al 2013). In summary, there is preliminary evidence to suggest that a higher intensity of allied health rehabilitation may be beneficial to some patients receiving inpatient rehabilitation.

In the clinical setting, health services treat patients with a variety of diagnoses in the same rehabilitation wards and staffing is provided for the rehabilitation of patients with a variety of health conditions. High-quality evidence in the form of systematic reviews of randomised controlled trials is not available on the effects of additional rehabilitation services/more intensive rehabilitation for many of the health conditions that patients receive rehabilitation for in a mixed-rehabilitation ward. For health services to decide whether to provide additional allied health rehabilitation services, for example, on the weekends, evidence is needed on its overall effectiveness for the variety of patients treated in their mixed rehabilitation facilities and not just for specific health conditions.

Physical activity during rehabilitation

Rehabilitation aims to promote functional independence and prepare patients for living independently in the community. Since functional independence and community living involve a certain level of physical activity, rehabilitation should therefore not only involve a sufficient amount of rehabilitation input, but also a sufficient level of physical activity to prepare patients for independent living. Physical activity is defined as any bodily movement produced by skeletal muscle that requires energy expenditure (Caspersen et al 1985). Regular physical activity is directly related to positive health outcomes (Schnohr et al 2003, Wen et al 2011). To improve and maintain health, it is recommended that adults and older adults (including those with disability and chronic health conditions) should complete 150 minutes of moderate intensity physical activity per week (WHO 2011), which equates to 30 minutes of moderate intensity

physical activity on at least 5 days of the week (Haskell et al 2007, Nelson et al 2007). Furthermore, it is recommended that older adults who are limited by health conditions be 'as physically active as their abilities and conditions allow' (WHO 2011). Considering rehabilitation aims to prepare patients to return to independent living, patients should be encouraged to be sufficiently physically active to improve their health and function and to be able to attempt to meet physical activity guidelines when they return home. The rehabilitation process should promote physical activity through the practice of functional tasks, unstructured activity such as walking to the dining room or to therapy, and exercise.

Exercise is one of the most commonly prescribed treatment modalities by physiotherapists and occupational therapists during rehabilitation (Higgs et al 2001, Rogers 2005, Taylor et al 2007). Exercise can be defined as the prescription of physical activity with the aim of relieving symptoms or improving function or improving, maintaining or slowing deterioration of health (Basmajian 1984). Prescribed exercise improves functional outcomes for people with a variety of neurological, musculoskeletal and cardiopulmonary conditions (Taylor et al 2007) and can improve walking endurance (MacRae et al 1996), walking speed and balance (Schoenfelder and Rubenstein 2004) for frail older adults. Even though patients receiving inpatient rehabilitation may be limited by their conditions, this thesis proposes that they should be encouraged to be sufficiently physically active to improve their function for successful discharge home and to be able to participate in community life and ongoing physical activity.

Little attention has been paid to physical activity levels of patients receiving inpatient rehabilitation. The limited amount of research suggests that older adults (Patterson et al 2005) and patients with stroke (Campbell 1999, Keith and Cowell 1987) in inpatient rehabilitation are relatively inactive; they spend large amounts of time sitting or lying down and do little physical activity. Inactivity during hospitalisation puts patients at risk of functional decline, decreased muscle strength, falls and cognitive decline (Brown et al 2009, Kortebein 2009), which

highlights the importance of being physically active during hospitalisation and rehabilitation. During rehabilitation, patients with stroke were observed to be most active when a therapist was present (Ada et al 1999). Additionally, physical activity levels in rehabilitation were observed to be lower on weekends when therapy was not provided (Bear-Lehman et al 2001, Janssen et al 2012, Mackey et al 1996, Smith et al 2008). Because physical activity levels are lower when patients do not receive therapy, and the presence of a therapist was observed to be the most important factor driving physical activity, this leads to the hypothesis that providing additional rehabilitation therapy may increase physical activity levels.

Improving rehabilitation delivery

In addition to the demands on health services to provide a sufficient amount of rehabilitation to patients, there is constant pressure on them to reduce patient length of stay, as this is considered to be an indicator of efficiency (Clarke and Rosen 2001). Over an 8-year period in the United States of America, rehabilitation length of stay has reduced by 1 to 3 days for patients with orthopaedic conditions and stroke (Granger et al 2009, Granger et al 2011). Unfortunately, patient outcomes have suffered as a consequence; patients were discharged with a lower level of functional independence and fewer patients were discharged to the community over the same 8-year period (Granger et al 2009, Granger et al 2010, Granger et al 2011). This suggests that the observed reduction in length of stay was achieved at a cost to patients by discharging them at a lower functional level. This could also be costly to health services if patients are not able to cope with the demands of independent living on discharge and need to return to hospital. If health service providers want to reduce length of stay they need to devise a way of doing so without compromising patient health outcomes.

When length of stay is reduced, patients have fewer days to receive rehabilitation. To counteract this, additional rehabilitation may be provided during the working day, out of business hours or

on the weekend, either as individual therapy or group therapy. Because allied health services are usually only provided between Monday and Friday, patients often do not receive rehabilitation on weekends. This contributes to overall low levels of rehabilitation and physical activity, and represents an opportunity to increase rehabilitation services. Additional weekend rehabilitation may contribute to reducing length of stay in mixed-diagnosis rehabilitation populations (Brusco et al 2007, Disotto-Monastero et al 2012). In a retrospective study (Disotto-Monastero et al 2012), additional weekend physiotherapy and occupational therapy reduced length of stay by 1 day (n=3,500) and in a randomised controlled pilot study (Brusco et al 2007) additional Saturday physiotherapy may have reduced length of stay by 3 days, but the study was underpowered (n=262). In both of these studies, there were no differences between groups in terms of functional outcomes despite the reduction in length of stay. This suggests that the provision of weekend rehabilitation may help health services to reduce length of stay without compromising patient health outcomes. However, these findings need to be confirmed in an adequately powered prospective randomised controlled trial.

To increase therapy time and physical activity levels and to improve patient outcomes and reduce length of stay, additional weekend rehabilitation services could be provided. Increasing weekend hospital capacity in other areas such as radiology, cardiology and day procedures has been shown to be feasible, safe and practical and help to increase hospital efficiency (Bell and Redelmeier 2005). Considering the important role that physiotherapists and occupational therapists play in improving patients' functional independence and health-related quality of life and preparing patients for discharge, increasing these rehabilitation services on the weekend may help to improve rehabilitation efficiency and clinical outcomes.

1.1 Aim

Therefore, the research question of this thesis is: Do additional weekend rehabilitation services (particularly physiotherapy and occupational therapy) increase physical activity, reduce length of stay and improve functional independence and health-related quality of life?

1.2 Outline of Research

In pursuit of this aim, five studies were conducted. The thesis is presented as a series of published and unpublished papers. Each chapter in this thesis is presented in the format that it was published. Each chapter is intended to stand alone but can be read in order as part of the entire thesis.

Chapter 2 is a systematic review of the literature on the effects of providing additional physiotherapy services. It was completed in 2010 and has been updated in Appendix 2 to ensure that current literature has been evaluated.

Chapter 3 is an observational study using accelerometers to measure and document the physical activity levels of patients with lower limb orthopaedic conditions in inpatient rehabilitation and to determine whether patients achieve physical activity recommendations.

Chapter 4 is a randomised controlled trial to determine whether providing additional rehabilitation on the weekend affects physical activity levels of patients with lower limb orthopaedic conditions.

Chapter 5 is a qualitative study that explores what patients feel about receiving inpatient rehabilitation and to determine whether their experience differs if they receive additional weekend rehabilitation.

Chapter 6 is a multi-centre randomised controlled trial conducted to determine whether additional weekend rehabilitation improved functional independence and health-related quality of life and reduced length of stay.

Chapter 7 discusses the key findings, clinical implications of the research, strengths and limitations and provides direction for future research.

Chapter 2

EXTRA PHYSICAL THERAPY REDUCES PATIENT LENGTH OF STAY AND IMPROVES FUNCTIONAL OUTCOMES AND QUALITY OF LIFE IN PEOPLE WITH ACUTE OR SUBACUTE CONDITIONS: A SYSTEMATIC REVIEW

2.1 INTRODUCTION

Chapter 1 identified the importance of allied health therapy (particularly physiotherapy and occupational therapy) during inpatient rehabilitation and introduced the idea that providing additional rehabilitation services may have benefits to patients and health services.

A systematic review was conducted to analyse the available evidence on the outcomes of providing additional rehabilitation services. The aim of the review was to determine whether providing additional physiotherapy services reduced length of stay and improved outcomes for people with a variety of acute and sub-acute health conditions. Chapter 2 presents the systematic review and meta-analysis.

Chapter 2 is presented in its published format (Peiris et al 2011):

Peiris CL, Taylor NF and Shields N (2011): Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. *Archives of Physical Medicine & Rehabilitation* 92: 1490-1500.

REVIEW ARTICLE (META-ANALYSIS)

Extra Physical Therapy Reduces Patient Length of Stay and Improves Functional Outcomes and Quality of Life in People With Acute or Subacute Conditions: A Systematic Review

Casey L. Peiris, BPhys, Nicholas F. Taylor, PhD, Nora Shields, PhD

ABSTRACT. Peiris CL, Taylor NF, Shields N. Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. Arch Phys Med Rehabil 2011;92:1490-1500.

Objectives: To investigate whether extra physical therapy intervention reduces length of stay and improves patient outcomes in people with acute or subacute conditions.

Data Sources: Electronic databases CINAHL, MEDLINE, AMED, PEDro, PubMed, and EMBASE were searched from the earliest date possible through May 2010. Additional trials were identified by scanning reference lists and citation tracking.

Study Selection: Randomized controlled trials evaluating the effect of extra physical therapy on patient outcomes were included for review. Two reviewers independently applied the inclusion and exclusion criteria, and any disagreements were discussed until consensus could be reached. Searching identified 2826 potentially relevant articles, of which 16 randomized controlled trials with 1699 participants met inclusion criteria.

Data Extraction: Data were extracted using a predefined data extraction form by 1 reviewer and checked for accuracy by another. Methodological quality of trials was assessed independently by 2 reviewers using the PEDro scale.

Data Synthesis: Pooled analyses with random effects model to calculate standardized mean differences (SMDs) and 95% confidence intervals (CIs) were used in meta-analyses. When compared with standard physical therapy, extra physical therapy reduced length of stay (SMD=−.22; 95% CI, −.39 to −.05) (mean difference of 1d [95% CI, 0–1] in acute settings and mean difference of 4d [95% CI, 0–7] in rehabilitation settings) and improved mobility (SMD=.37; 95% CI, .05–.69), activity (SMD=.22; 95% CI, .07–.37), and quality of life (SMD=.48; 95% CI, .29–.68). There were no significant changes in self-care (SMD=.35; 95% CI, −.06–.77).

Conclusions: Extra physical therapy decreases length of stay and significantly improves mobility, activity, and quality of life. Future research could address the possible benefits of providing extra services from other allied health disciplines in addition to physical therapy.

Key Words: Dose-response relationship; Length of stay; Physical therapy; Rehabilitation; Review, systematic.

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REDUCING PATIENT LENGTH of stay is a high priority for health service providers, and a short length of stay is considered to be an indicator of efficiency.[1,2] In addition to providing therapy, physical therapists have an important role in acute hospitals and rehabilitation centers to assist with discharge planning and to ensure that patients have adequate mobility to be safely discharged. Extra physical therapy (PT), defined as longer PT sessions or more frequent PT sessions, may have a positive effect on patient outcomes. If the benefit of providing extra PT outweighs the cost of providing this service, it may contribute to increased health service efficiency so that patients can achieve good functional outcomes earlier and discharge can occur sooner. From a health service perspective, it is important to determine whether extra PT services, provided to patients with a variety of health conditions, will improve health service efficiency.

Previous studies have provided inconclusive or limited evidence that extra PT may contribute to increased functional gains.[3-5] Observational data from 20 rehabilitation facilities reported that functional gains were significantly, albeit weakly, associated with therapy intensity (defined as total therapy time divided by length of stay) and longer duration of rehabilitation.[3] A systematic review by Kwakkel et al[5] found that extra exercise therapy time after stroke had a small positive effect on activities of daily living (ADLs) and walking speed. The Kwakkel review included trials that examined the effect of specific therapy types (eg, facilitation exercise techniques when added to standard PT) and was conducted more than 7 years ago. Brusco and Paratz[4] studied the effects of additional PT given outside regular business hours, in a systematic review of 9 trials. Their results were inconclusive, and the review included poor-quality trials and a limited number of randomized controlled trials. Randomized controlled trials are preferred in systematic reviews of interventions because they are the study design that has the least chance of bias.[6,7]

Therefore, previous reviews have analyzed the effects of extra exercise in stroke[5] and PT given outside business hours,[4] but we were unable to locate any reviews that have synthesized data on the effect of providing extra PT on length of stay and the outcomes of patients with a variety of health conditions receiving PT intervention from a health service perspective. In recent years, new

List of Abbreviations

ADLs	activities of daily living
CI	confidence interval
PT	physical therapy
SF-36	Medical Outcomes Study 36-Item Short-Form Health Survey
SMD	standardized mean difference

From the Musculoskeletal Research Centre and School of Physiotherapy, La Trobe University, Victoria (Peiris, Taylor, Shields); and Allied Health Clinical Research Office, Eastern Health Level 2, Victoria (Peiris, Taylor) Australia.

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.

Reprint requests to Casey L. Peiris, BPhys, Allied Health Clinical Research Office, Level 2, 5 Arnold St, Box Hill, Victoria, Australia 3128, e-mail: *Casey.Peiris@easternhealth.org.au.*

0003-9993/11/9209-01071$36.00/0
doi:10.1016/j.apmr.2011.04.005

randomized controlled trials have been conducted that aim to evaluate the effect of extra PT on a variety of conditions.

The primary aim of this review was to evaluate the current evidence for providing extra PT time to people with an acute or subacute condition to improve patient outcomes and reduce length of stay.

METHODS

This review was conducted and reported with reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for high-quality reporting of systematic reviews and meta-analyses.[8]

Identification and Selection of Trials

The search strategy combined search terms and synonyms for 2 main concepts: PT and the amount of therapy (available on request). The following electronic databases were searched from the earliest date available until May 12, 2010: CINAHL, MEDLINE, AMED, PEDro, PubMed, and EMBASE. Manual scanning of reference lists of included studies and previous systematic reviews and citation tracking (using Google Scholar to track citations of included trials) were also conducted to ensure all relevant trials were identified. Two reviewers (C.L.P., N.F.T.) independently applied the inclusion and exclusion criteria to the titles and abstracts of all captured trials, and those that clearly did not meet the criteria were excluded. Any disagreements were resolved by discussion between the 2 reviewers, and if consensus could not be reached, a third reviewer was consulted. Where it was uncertain whether the trial met the inclusion criteria, the full-text copies of the trials were obtained for review.

Inclusion criteria. The trials had to be randomized controlled trials comparing extra PT with a standard amount of PT for adult patients (aged ≥18y, with no upper limit) after an acute event, treated in an acute or rehabilitation setting. For the purpose of this review, PT refers to any PT intervention as described by the American Physical Therapy Association.[9] We excluded risk factor management in conditions such as hypertension, obesity, osteoporosis, and heart disease, as well as the evaluation of exercise protocols in healthy people, but included trials that evaluated an acute exacerbation of a chronic condition receiving management in an acute or rehabilitation setting. Experimental group intervention had to be delivered or supervised by a physical therapist and had to consist of an increased amount (session length or frequency of sessions) of the same intervention the comparison group was receiving. Trials were excluded if they evaluated the effect of a specific therapy in addition to usual PT (such as adding acupuncture, upper limb exercises, or gait training), because it would be difficult to determine whether any differences were due to the specific therapy or receiving extra therapy. Trials were also excluded if the comparison group did not receive any PT.

Assessment of Characteristics of Trials

Quality assessment of trials and risk of bias. All trials were critically appraised for methodological quality and risk of bias by 2 reviewers independently (C.L.P., N.F.T.) using the PEDro scale.[10] The PEDro scale, based on the Delphi list described by Verhagen et al,[11] is an 11-item scale assessing eligibility criteria, random allocation, concealed allocation, similarity at baseline, participant blinding, therapist blinding, assessor blinding, greater than 85% retention, intention-to-treat analysis, between-group statistical comparisons and point measures, and measures of variability. Each item that is satisfied according to standardized scoring criteria contributes 1 point to the total score (range, 0–10). The first item, which relates to external validity, is not scored. The PEDro scale has demonstrated evidence of validity as a measure of methodological quality of clinical trials.[12] Trials with a PEDro score of less than 4 out of 10 are considered to be of lower quality.[13] Interrater agreement was recorded, and any disagreements were resolved through discussion between the 2 reviewers. If consensus could not be reached, a third reviewer was consulted. Trials were not excluded based on their risk of bias.

Data extraction. We developed a data extraction form a priori based on the Cochrane Consumers and Communication Review Group's data extraction template,[14] which was revised to suit our review (available on request). The form was pilot-tested on a random selection of 5 included trials and subsequently refined. One reviewer (C.L.P.) independently extracted data, and the second reviewer (N.F.T.) checked extracted data for accuracy. If any discrepancies were evident, the reviewers referred back to the original trial report. Attempts were made to contact the authors of any trial with missing data. Information was extracted from each trial on participants' characteristics (age, sex), patient population (cardiac, neurologic, orthopedic), and trial setting (acute, rehabilitation, inpatient, outpatient); intervention (type, duration, frequency for experimental and comparison group); outcomes (primary and secondary outcomes, type of outcome measures, timing of assessment); results; adverse events; and patient satisfaction with the amount of therapy received. Outcome measures were classified according to the *International Classification of Functioning, Disability, and Health* domains of body function, activity, and participation according to the description by Salter et al.[15] Based on Salter's definition, measures of walking ability were considered measures of body function, and quality-of-life measures were considered to represent participation.[15]

Data analysis. Standardized mean differences (SMDs; effect sizes) were calculated for the outcomes based on postintervention means and the pooled estimate of postintervention SDs, by using Hedges' g. Because it is necessary to use mean and SD values when calculating the SMD, some values had to be transformed using methods suggested by Hozo et al[16] and Higgins and Green.[17] Where outcome data were measured at different times in the experimental and comparison groups depending on length of stay, data were transformed to change per day (n=3 trials). The earliest available data were used for calculation of SMDs (as this would be less subject to other variables such as time and additional therapy outside the trial), unless it was suggested that an outcome measure was more suited to a longer time frame (eg, extended ADL score, which is used to assess a person's ability when he/she has been discharged home after a stroke[18]). Where weighted means were calculated, these were weighted according to participant numbers in each trial.

Meta-analyses were performed with a random-effects model for outcomes using inverse variance methods (RevMan, Version 5.0).[a] The strength of the SMD was determined descriptively according to Cohen,[19] with 0.2 considered small, 0.5 as moderate, and 0.8 as a large effect. Trial results data were only pooled if they fitted into common functional outcome categories of length of stay, walking ability, activity, self-care, and quality of life.

Statistical heterogeneity was assessed using the I^2 statistic, with values of more than 50% representing substantial levels of heterogeneity.[20] Where substantial levels of heterogeneity were present, subgroup analyses were performed post hoc to attempt to explain the heterogeneity—for example, by separating acute from rehabilitation trials and participants with stroke from participants with other diagnoses. Sensitivity analyses were conducted to confirm results of meta-analyses if 1 trial con-

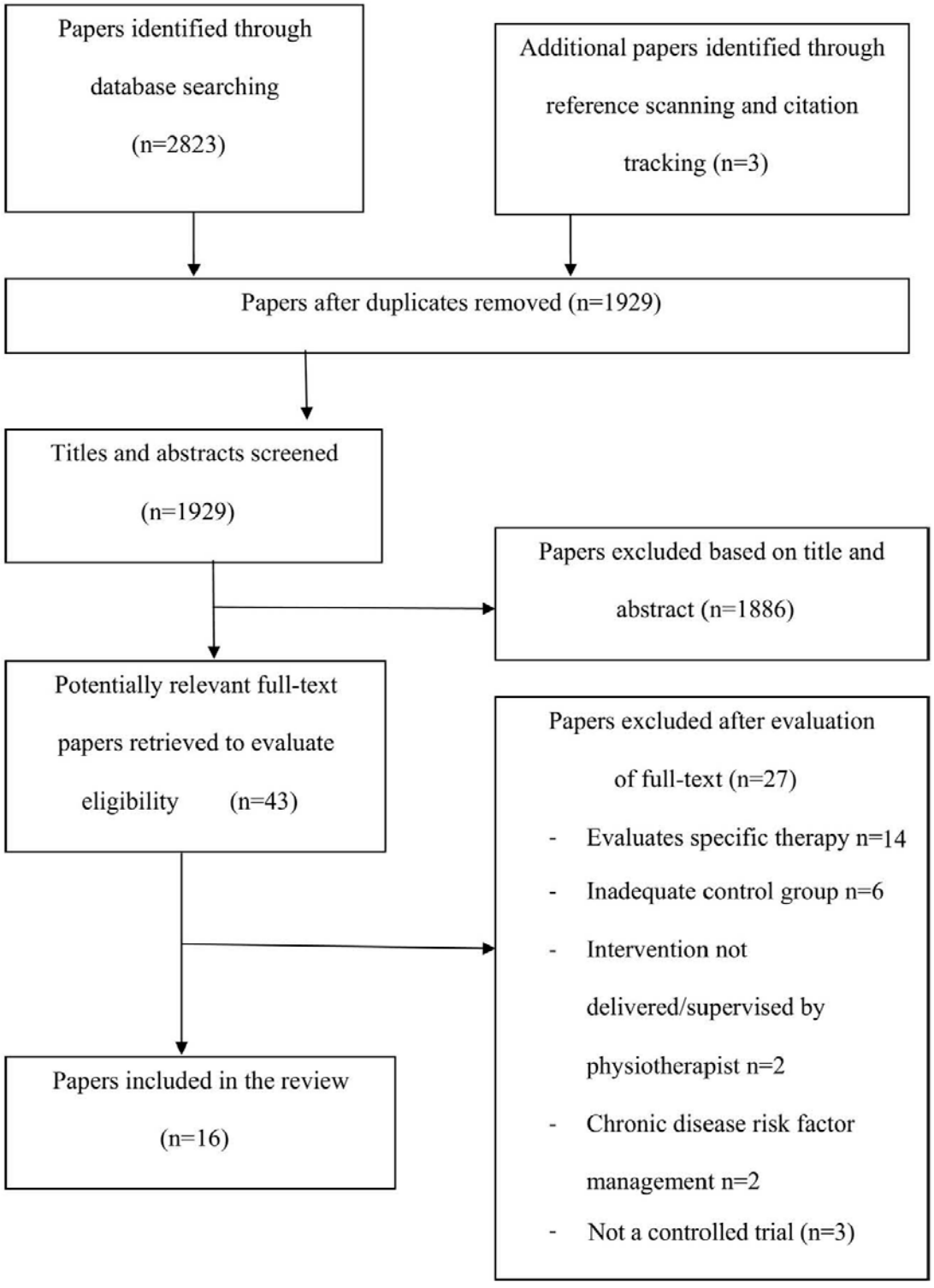

Fig 1. Flow of trials through the review.

Table 1: Study Characteristics

Authors	Patient Health Condition	Setting	Extra OT (Y/N)	PEDro Score	Use of ITT (Y/N)	No. of Participants (Exp/Comp)	Men: Women (Exp/Comp)	Mean Age (Exp/ Comp) (y)	Extra Therapy	Extra PT (min/d)	Outcomes
Bernhardt[24]	Stroke	Acute inpatient stroke unit	N	8	Yes	38/33	22:16/16:17	74.6/74.9	Very early mobilization, 2×/d, 6d/wk	7	Modified Rankin Scale Falls
Bischoff-Ferrari[33]	Hip fracture	Acute inpatient	N	7	Yes	87/86	19:68/17:69	83.4/85.5	30min/d extra	15	Falls
Brusco[25]	Mixed rehabilitation	Inpatient rehabilitation ward	N	8	Yes	130/132	53:77/58:74	77/77	1h extra PT on Saturday	11	Length of stay EuroQOL FIM 10-m walk
Craig[38]	MS with serious relapse	Neurologic clinic or acute inpatient	Y	5	No	20/20	9:11/4:16	38/42	Increased PT time	36	Length of stay Barthel Index SF-36 Human Activity Profile
GAPS[26]	Stroke	Inpatient rehabilitation	N	8	Yes	35/35	24:11/17:18	68/67	Longer sessions of PT	16	Length of stay Barthel Index EuroQOL Rivermead Mobility Index
Hirschhorn[31]	CABGS	Acute inpatient	N	7	Yes	31/31	27:4/26:5	63.2/63.6	Longer, more intense sessions of PT	20	Length of stay SF-36 6-min walk
Lenssen[27]	TKJR	Acute inpatient	N	8	Yes	21/22	15:6/17:5	70/67	Extra PT session per day	20	Length of stay Knee Society Scale
Lincoln[39]	Stroke with UL deficits	Acute and rehabilitation inpatients	N	7	No	94/95	51:43/45:50	73/73	Extra PT 2h/wk	16	Extended ADL Scale
Martinsson[40]	Stroke, impaired conscious level	Acute inpatient	N	7	Yes	15/15	7:8/4:11	78/79	Both longer and more PT sessions	85	Activity Index Lindmark Motor Assessment Chart
Partridge[28]	Stroke	Acute inpatient stroke unit	N	8	No	54/60	ND		Double the amount of PT	30	5-m walk Timed sit-to-stand
Richards[21]	Stroke	Acute inpatient	N	5	No	8/9	2:6/6:3	67.3/70.3	Extra PT session per day	64	Gait velocity Barthel Index
Sivenius[41]	Stroke	Acute and rehabilitation inpatient and outpatient	N	5	No	50/45	18:32/18:27	71.5/70.1	More PT time	ND	ADL Score
Slade[37]	Adult neurologic	Inpatient rehabilitation	Y	6	Yes	75/66	ND	52/54	Longer PT sessions	18	Length of stay Barthel Index
Smith[23]	Stroke	Outpatient rehabilitation	Y	4	No	46/43	31:15/31:12	63/66	Longer PT sessions and more sessions	11	ADL Index
Stockton and Mengersen[42]	THJR	Acute inpatient	N	6	Yes	30/27	17:13/13:14	68.3/68.2	Extra PT session per day	ND	Length of stay Iowa Level of Assistance Scale
Van der Peijl[32]	CABGS	Acute inpatient	N	5	No	134/112	107:27/87:25	63.2/62.0	Extra PT session per day and weekend PT	ND	Length of stay FIM–locomotion

Abbreviations: CABGS, coronary artery bypass graft surgery; Comp, comparison group; Exp, experimental group; ITT, intention to treat; MS, multiple sclerosis; N, no; ND, not done or not reported; OT, occupational therapy; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; THJR, total hip joint replacement; TKJR, total knee joint replacement; UL, upper limb; Y, yes.

tributed more than 50% weight to the overall effect size or if certain trial properties brought the risk of bias (eg, poor quality, not using intention-to-treat analyses or other concurrent interventions). To assess the risk of publication bias, funnel plots were drawn if there were 10 or more trials in a meta-analysis (as tests for funnel plot asymmetry only have sufficient power when there are at least 10 trials).[17]

RESULTS

Study Selection

The database search yielded a total of 2823 studies. Three additional studies were identified through reference scanning and citation tracking.[21-23] After removal of duplicates, 1929 studies were screened on title and abstract. There was substantial agreement between reviewers on which trials did and did not fulfill inclusion criteria (κ=.72; 95% confidence interval [CI], .60–.85). Full-text copies of 43 trials were retrieved for closer examination. Of these, 27 were excluded (appendix 1). When evaluating the full-text trials, there was almost perfect agreement between the 2 reviewers on which trials were to be included or excluded (κ=.95; 95% CI, .86–1.00). Consensus was reached to retain a total of 16 trials for inclusion in the review (fig 1).

Characteristics of Included Trials

Methods. All 16 trials in the review were randomized controlled trials published in English. The included trials had a mean PEDro score of 6.5 out of 10, ranging from 4[23] to 8.[24-28] One trial[28] blinded participants to group allocation by randomly assigning them to different wards where therapy time differed. Nine trials used intention-to-treat analysis, and 10 had concealed allocation and assessor blinding. All trials had random allocation and groups that were similar at baseline, and reported between-group differences. There was substantial agreement between reviewers when rating individual items on the PEDro scale (κ=.75; 95% CI, .64-.85).

Participants. The review included 1699 participants (47% women), of whom 868 received extra PT. Participants had a weighted mean age of 69.8 years. Ten trials evaluated patients with a neurologic diagnosis including adults with stroke (n=8), adults with multiple sclerosis during acute relapse in an acute setting (n=1), and a mixed cohort of adults with neurologic conditions such as stroke and traumatic brain injury (n=1). Two trials evaluated patients with a cardiovascular diagnosis of post–coronary artery bypass surgery. Three trials evaluated patients with an orthopedic diagnosis including adults with total hip joint replacement (n=1), total knee joint replacement (n=1), and after hip fracture (n=1). One trial evaluated a mixed rehabilitation population (table 1).

Intervention. In all trials, the experimental group received more PT than the comparison group. This was achieved in a variety of ways: extra sessions, longer sessions, or both extra and longer sessions (see table 1). Five trials did not specify how extra PT was delivered. Participants in the experimental group received a weighted mean of 19 minutes of extra PT per day (interquartile range, 15–30min) (see table 1). Participants in 3 trials received both extra PT and extra occupational therapy. Interventions varied depending on the participants' health condition, but all trials reported individualized treatments based on usual care.

Outcomes measures. The body function (or impairment) measures used were highly variable and included range of motion, strength, vital capacity, and dexterity measures. However, 7 studies included measures of walking ability (6-min walk test, gait velocity, and Lindmark motor assessment–mobility). Measures related to activity limitations were separated into 2 groups: self-care measures (FIM and Barthel Index) and ADLs (Human Activity Profile, Activity Index, sit to stand, Timed Up and Go test, Berg Balance, and various measures of ADL scores). Quality-of-life measures used were the EuroQOL and the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36). The physical function domain of the SF-36 was chosen for analysis because it has demonstrated sufficient responsiveness and high internal consistency and retest reliability in PT intervention trials after stroke[29] and in orthopedic conditions.[30]

Effects of Extra Physical Therapy

Attempts, via e-mails, were made to contact authors for missing data; no response was received in 2 instances, and information was not available in 1 instance. Therefore, all data were obtained from published results.

Length of stay. When compared with standard PT in 8 trials (n=920), extra PT reduced length of stay by a small but significant amount (SMD=−.22; 95% CI, −.39 to −.05; I^2=32%) (fig 2). On subgroup analysis, this equated to a reduction in length of stay of 4 days (95% CI, 0–7; I^2=0%) in rehabilitation settings and 1 day (95% CI, 0–1; I^2=55%) in acute settings. Weighted mean length of stay was 7 days for participants in acute hospitals and 45 days for those in rehabilitation.

Body function. When compared with standard PT in 7 trials (n=665), extra PT significantly improved walking ability (SMD=.37; 95% CI, .05–.69; I^2=71%) (fig 3). There was a moderate to large degree of heterogeneity in the analysis.

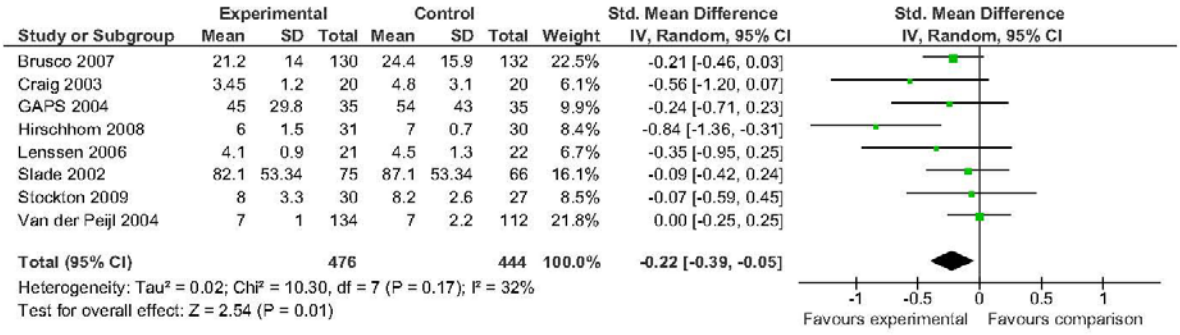

Fig 2. SMD (95% CI) for effect of extra PT on length of stay by pooling data from 8 trials (n=920).

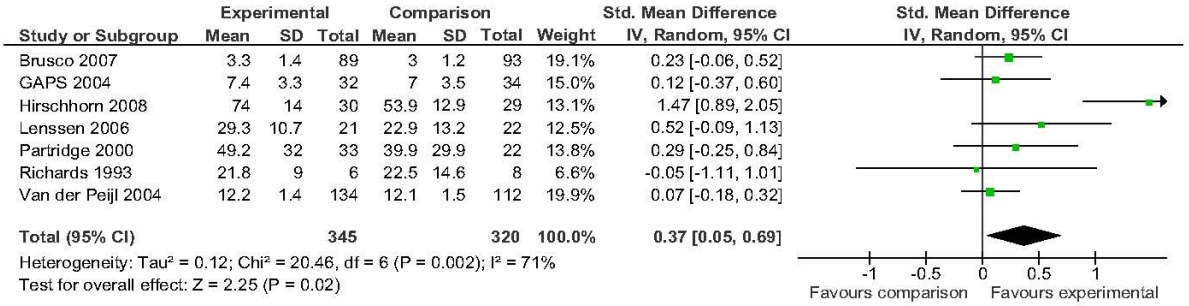

Fig 3. SMD (95% CI) for effect of extra PT on walking ability by pooling data from 7 trials (n=665).

When 1 trial[31] with a very large positive effect was removed in a sensitivity analysis, a smaller effect resulted (SMD=.17; 95% CI, .01–.33; I^2=0%).

Activity. When compared with standard PT in 8 trials (n=1001), extra PT did not have a significant effect on measures of self-care (SMD=.35; 95% CI, −.06–.77; I^2=89%) (fig 4). There was a large degree of heterogeneity in the data. A subgroup analysis of the 2 trials (n=166) that included both extra PT and extra occupational therapy resulted in a moderate, significant effect on self-care (SMD=.51; 95% CI, .20–.82; I^2=0%).

When compared with standard PT in 9 trials (n=724), extra PT resulted in a small, but significant increase in measures of activity (SMD=.22; 95% CI, .07–.37; I^2=4%) (fig 5). In addition, 2 trials reported activity data that were not expressed as means and SDs and, therefore, could not be included in the meta-analysis. Van der Peijl et al[32] assessed the achievement of functional activity milestones daily in participants who underwent coronary artery bypass graft surgery. The extra PT group achieved 4 clinical activity milestones (bed to chair, walking in room, walking in the ward, and attending the exercise group) significantly faster than the participants receiving standard PT. Bernhardt et al[24] assessed disability levels in participants with stroke on the Modified Rankin Scale. The odds of a good outcome (according to Modified Rankin Scale scores) were greater in the extra PT group than in the standard PT group at 3, 6, and 12 months.

Participation. When compared with standard PT in 4 trials (n=424), extra PT resulted in a moderate and significant increase in quality of life (SMD=.48; 95% CI, .29–.68; I^2=0%) (fig 6). Because 1 trial[25] was weighted heavily, we did a sensitivity analysis to confirm the results. With Brusco et al[25] excluded, there was still a moderate and significant improvement in quality of life (SMD=.45; 95% CI, .07–.83; I^2=31%).

Safety. The presence or absence of adverse events was recorded in 8 trials. Seven reported there was no significant difference between groups in the number of adverse events. One trial[24] reported significantly fewer nonserious adverse events in individuals with stroke receiving extra PT when compared with those receiving standard PT (61 adverse events in the experimental group [n=38], 76 in the comparison group [n=33]; *P*=.04). Mortality rates were recorded in 11 trials. There were no significant differences in mortality rates between groups in any trials. Fall rates were reported in 2 trials. Bischoff-Ferrari et al[33] reported that extra PT significantly reduced the rate of falls by 25% (95% CI, −44% to −1%) in the 12 months after hip fracture. Bernhardt[24] reported no difference in fall rates between groups of people with stroke.

Patient satisfaction. Two trials reported on levels of patient satisfaction. After total knee joint replacement,[27] participants reported high levels of satisfaction in both the standard PT and the extra PT groups. After coronary artery bypass graft surgery,[32] significantly more participants in the extra PT group were satisfied with treatment compared with the standard PT group.

Subgroup analyses investigating the differences between acute and rehabilitation settings showed similar magnitudes of SMD compared with the overall meta-analyses but wider CIs because of the smaller sample sizes for walking ability, self-care, activity, and quality of life (table 2). Sensitivity analyses removing the 3 trials that also included extra occupational therapy showed similar pooled SMDs for length of stay, walk-

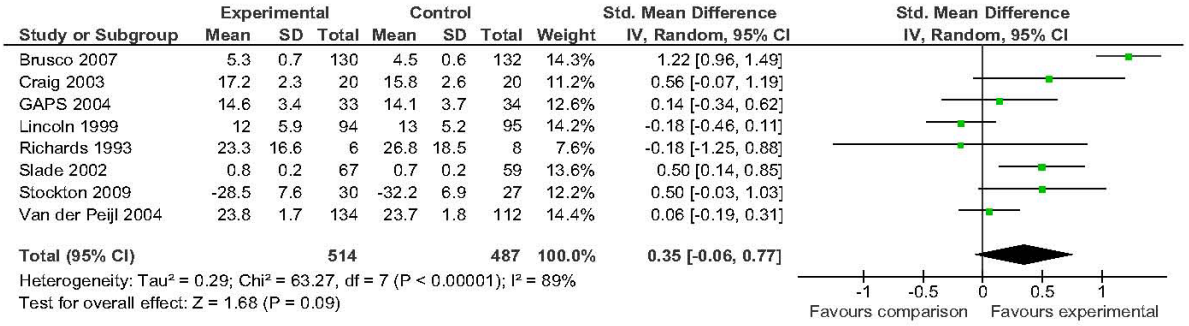

Fig 4. SMD (95% CI) for effect of extra PT on self-care by pooling data from 8 trials (n=1001).

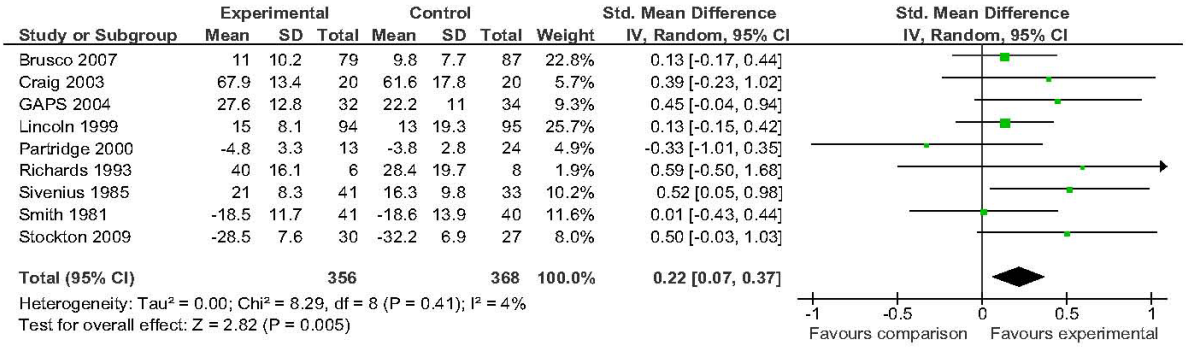

Fig 5. SMD (95% CI) for effect of extra PT on activity by pooling data from 9 trials (n=724).

ing ability, activity, and quality of life when compared with the overall analysis (see table 2). Another sensitivity analysis was conducted excluding the 7 trials that did not use intention-to-treat analysis. Again, results were of similar magnitude to the overall analysis (see table 2). A subgroup analysis comparing stroke with other participant populations showed similar SMDs and CIs for length of stay, activity, and quality of life, but reduced SMDs for walking ability and self-care (see table 2).

DISCUSSION

The results of this systematic review provide evidence from 16 randomized controlled trials, with 1699 participants, that extra PT reduces length of stay and improves the rate of improvement in walking ability, activity, and quality of life, but not self-care in people with acute or subacute conditions. Previous reviews focused on stroke[5] or PT given outside business hours[4] and included trials that were not randomized and controlled. The results of this systematic review are similar to, but the effect sizes are larger in magnitude than those reported in the review by Kwakkel[5] where augmented exercise improved performance of ADLs (standard effect size, .13; 95% CI, .03–.23) and increased walking speed (standard effect size, .19; 95% CI, .01–.36). Our results differ from the results of Brusco and Paratz,[4] who were unable to conclude that extra PT given outside business hours was effective in decreasing length of stay or improving patient discharge mobility status. These results add new evidence to previous reviews by evaluating the effect of extra PT on length of stay, incorporating recent randomized controlled trials and including patients across a broad range of health conditions. The results of this review and meta-analyses are valuable because almost all the individual trials included did not demonstrate statistically significant effects of extra PT, but when pooled in meta-analyses the results were significant. From a health service and health manager's perspective, these results are applicable and relevant because they show that providing extra PT services in acute or rehabilitation settings may be beneficial for patients with a variety of acute or subacute health conditions.

In our review, it appears that an extra 19 minutes of PT per day was needed to achieve the benefits of reduced length of stay and an increased rate of improvement in mobility, activity, and quality of life. This extra PT could be provided through longer sessions, more sessions in a day, or extra sessions on the weekend. However, the provision of extra PT means higher costs, and the decision regarding whether to provide extra PT depends on whether the benefits of extra PT outweigh the costs. It is hard to draw definitive conclusions on whether the improvements in mobility, activity, and quality of life found in this review are sufficient to justify the higher costs of providing these services. However, we have provided evidence that extra PT may reduce acute hospital length of stay by 1 day and rehabilitation length of stay by 4 days in patients with a variety of health conditions such as stroke and after coronary artery bypass graft surgery, hip or knee joint arthroplasty, and hip fracture.

The average cost of 1 day in an acute hospital is approximately U.S. $1237.[34] Our review indicates that extra PT may reduce length of stay, and although a formal cost analysis that should include consideration of health utilization costs after discharge has not been completed, this may lead to cost savings. The implications of such reductions in length of stay are significant for the patient, the health service, and for the community. It means that the individual can return to the community sooner, that individuals may not have to wait so long for

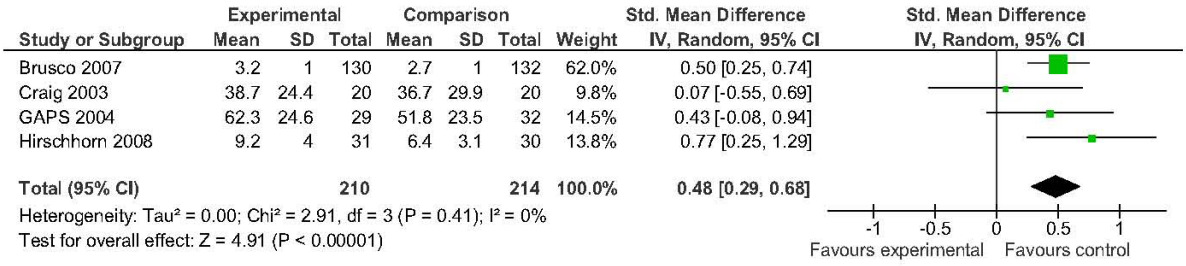

Fig 6. SMD (95% CI) for effect of extra PT on quality of life by pooling data from 4 trials (n=424).

Table 2: Sensitivity or Subgroup Analyses Standardized Mean Difference (95% CIs)

Outcome	Total (n=16)*	Subacute Setting (n=6)*	Acute Setting (n=10)*	Trials With Extra Physiotherapy Only (No Extra OT) (n=13)*	Trials That Used ITT Analyses (n=9)*	Stroke Populations (n=8)*	Other Populations (All Except Stroke) (n=8)*
Length of stay	−.22 (−.39 to −.05)	−.18 (−.36 to 0)	−.32 (−.66 to −.02)	−.23 (−.44 to −.02)	−.25 (−.44 to −.07)	−.24 (−.71 to −.23)	−.23 (−.42 to −.03)
Mobility	.37 (.05 to .69)	.20 (−.05 to .45)	.48 (−.06 to 1.01)	.37 (.05 to .69)	.56 (.01 to 1.10)	.17 (−.17 to .51)	.52 (.02 to 1.01)
Activity	.22 (.07 to .37)	.20 (.03 to .36)	.27 (−.13 to .68)	.24 (.06 to .43)	.28 (.04 to .51)	.20 (−.02 to .43)	.25 (.01 to .49)
Self-care	.35 (−.06 to .77)	.43 (−.27 to 1.12)	.23 (−.07 to .53)	.29 (−.25 to .53)	.61 (.10 to 1.31)	−.10 (−.34 to .14)	.57 (.06 to 1.08)
Quality of life	.48 (.29 to .68)	.49 (.26 to .71)	.44 (−.24 to 1.13)	.53 (.33 to .73)	.53 (.33 to .75)	.43 (−.08 to .94)	.49 (.19 to .78)

Abbreviations: ITT, intention-to-treat; OT, occupational therapy.
*Number of trials.

a bed, that the health service can treat more patients, and that there may be considerable cost savings for the community. Future research could also investigate the most cost-effective way of providing the extra PT, whether it is longer sessions, extra sessions during the day, or extra sessions on the weekend or after hours.

A likely explanation for why extra PT has significant effects on improving walking ability and activity is that PT interventions have a central focus on analyzing and solving problems of movement. Extra PT helps provide the repetitive practice required for motor skill learning and neuroplasticity, and minimizes the negative effects of inactivity that include reduced fitness, muscular atrophy, and even loss of joint range. This is consistent with the foundations of PT practice: a central focus on movement, sound knowledge, clinical reasoning skills, and virtues such as caring and providing empathy.[35] As the attainment of sufficient levels of physical mobility plays a role in determining when a person is ready for discharge, this provides a possible explanation for the observed reduction in length of stay.

The improvements in quality of life may partially be explained by our use of the physical function domain of the SF-36 in our analyses, which is more responsive to PT interventions than other quality-of-life domains. Extra PT may have also contributed to increased quality of life through physical therapists helping to solve problems of mobility and their virtues of caring, acting as a moral agent, and providing empathy.[35] For health-related quality-of-life measures, an effect size of 0.5 is considered a clinically significant change.[36] The results of our meta-analysis appear to reflect a clinically significant change in quality of life. Extra PT did not have a significant impact on self-care. There were, however, statistically significant improvements in self-care when we analyzed the participants receiving both extra PT and extra occupational therapy, as occupational therapists' interventions are more involved in the attainment of independent self-care skills.

A strength of this review is that it follows the PRISMA guidelines for high-quality reporting of systematic reviews and meta-analyses.[8] Rigorous subgroup and sensitivity analyses confirmed the strength of the results, which do not appear to be biased by occupational therapy intervention, trials not using intention-to-treat analysis, different settings, and different diagnoses. It includes all recent and relevant randomized controlled trials. It is clinically achievable, as the provision of an extra 19 minutes of PT per day is possible in the clinical setting.

Study Limitations

A limitation of this review is that relevant data were not reported in some trials and therefore could not be included in meta-analyses. A number of our meta-analyses demonstrated statistical heterogeneity. However, to account for this we conducted subgroup and sensitivity analyses as appropriate. The inclusion of 3 trials that included both extra occupational therapy and PT could also be viewed as a limitation because in these trials, any changes cannot be attributed to the provision of extra PT alone. However, our sensitivity analyses demonstrated that adding extra occupational therapy in addition to extra PT resulted in improved self-care but made no difference to the other outcomes. The review included diverse conditions and settings, which could be viewed as a limitation. We thought that it was important to have this diversity, as it reflects clinical practice from a health service perspective where managers have to make decisions about whether to provide extra PT services in a setting that includes patients with a variety of health conditions. In addition, multiple subgroup and sensitivity analyses were conducted to account for this variation. Another possible limitation is that the average length of stay of included rehabilitation trials was 45 days, which may not reflect current practice. These data may have been skewed by 2 included trials[26,37] with long lengths of stay conducted in neurologic rehabilitation wards. However, a similar reduction in length of stay was also achieved in a rehabilitation trial with a shorter length of stay.[25] Future research could address the possible benefits of providing extra services from other allied health disciplines in addition to PT, and explore the possibility of a dose-response relationship for the amount of extra therapy provided.

CONCLUSIONS

This systematic review has demonstrated that extra PT leads to small to moderate statistically significant reductions in length of stay that may be clinically significant for patients, the health service, health insurance premium payers, taxpayers, and the community. Also, our review has demonstrated that extra PT resulted in increased rates of improvement in walking ability, activity, and quality of life across acute and rehabilitation settings in patients with a variety of health conditions. An extra 19min/d per inpatient are required to achieve these benefits.

APPENDIX 1: EXCLUDED TRIALS

Trial	Reason for Exclusion
Allison et al[43]	Evaluates a specific therapy: additional standing practice
Borello-France et al[44]	Chronic condition/risk factor management: urinary incontinence
Britton et al[45]	Evaluates a specific therapy: sit-to-stand exercises
Chang et al[46]	Evaluates a specific therapy: vestibular-stimulated exercise program
de Lateur et al[47]	Evaluates a specific therapy: additional treadmill training

APPENDIX 1: EXCLUDED TRIALS (Cont'd)

Trial	Reason for Exclusion
de Morton et al[48]	Evaluates a specific therapy: additional exercise program
Donald et al[49]	Evaluates a specific therapy: additional leg-strengthening exercises
Dromerick et al[50]	Intervention not delivered/supervised by physical therapist: treatment delivered by an occupational therapist Evaluates a specific therapy: constraint-induced movement therapy
Fang et al[51]	Inadequate control group: comparison group did not receive PT
Gilbey et al[52]	Evaluates a specific therapy: additional presurgery and postsurgery exercise programs
Giovannelli et al[53]	Inadequate control group: comparison group did not receive PT
Grasel et al[54]	Intervention not delivered/supervised by PT treatment delivered by nursing staff
Haines et al[55]	Evaluates a specific therapy: additional exercise program aimed at reducing falls
Howe et al[56]	Evaluates a specific therapy: lateral weight transference in sitting
Kammerlind et al[57]	Inadequate control group: comparison group did not receive PT
Kim et al[58]	Chronic condition/risk factor management: blood lipid levels in coronary heart disease
Klaber Moffett et al[59]	Inadequate control group: usual PT vs brief therapy using cognitive behavioral principles
Kwakkel et al[60]	Evaluates a specific therapy: upper limb emphasis vs lower limb emphasis
Langhammer et al[61]	Inadequate control group: comparison group did not receive PT
Mosely et al[62]	Evaluates a specific therapy: standing exercise vs sitting and lying exercise
Ntoumenopoulos and Greenwood[63]	Not a randomized controlled trial: quasi-randomized controlled trial
Platz et al[64]	Evaluates a specific therapy: upper limb therapy
Rau et al[65]	Inadequate control group: comparison group did not receive PT
Rodgers et al[66]	Evaluates a specific therapy: upper limb therapy
Ruff et al[22]	Not a randomized controlled trial: quasi-randomized controlled trial
Sunderland et al[67]	Evaluates a specific therapy: intensive upper limb therapy and use of behavioral methods
Winett et al[68]	Not a randomized controlled trial

References

1. Borghans I, Heijink R, Kool T, Lagoe RJ, Westesrt GP. Benchmarking and reducing length of stay in Dutch hospitals. BMC Health Serv Res 2008;8:220-9.
2. Clarke A, Rosen R. Length of stay. How short should hospital care be? Eur J Public Health 2001;11:166-70.
3. Chen CC, Heinemann AW, Granger CV, Linn RT. Functional gains and therapy intensity during subacute rehabilitation: a study of 20 facilities. Arch Phys Med Rehabil 2002;83:1514-23.
4. Brusco NK, Paratz J. The effect of additional physiotherapy to hospital inpatients outside of regular business hours: a systematic review. Physiotherapy 2006;22:291-307.
5. Kwakkel G, van Peppen R, Wagenaar RC, et al. Effects of augmented exercise therapy time after stroke: a meta-analysis. Stroke 2004;35:2529-39.
6. Sackett DL, Straus SE, Richardson WS, Rosenburg W, Haynes RB. Evidence-based medicine. Edinburgh: Churchill Livingstone; 2000.
7. Moher D, Jadad AR, Nichol G, Penman M, Tugwell P, Walsh S. Assessing the quality of randomized controlled trials: an annotated bibliography of scales and checklists. Control Clin Trials 1995;16:62-73.
8. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. J Clin Epidemiol 2009;62:e1-34.
9. Anonymous. Who are physical therapists, and what do they do? Phys Ther 2001;77:1177-87.
10. Centre for Evidence-Based Physiotherapy 2010. The physiotherapy evidence database (PEDro). Available at: www.pedro.org.au. Accessed June 14, 2010. The physiotherapy evidence database (PEDro) scale items. Centre for Evidence-Based Physiotherapy; 2010.
11. Verhagen AP, De Vet H, De Bie R, et al. The Delphi list: a criteria list for quality assessment of randomized controlled clinical trials for conducting systematic reviews developed by Delphi consensus. J Clin Epidemiol 1998;5:1235-41.
12. de Morton NA. The PEDro scale is a valid measure of the methodological quality of clinical trials: a demographic study. Aust J Physiother 2009;55:129-33.
13. Maher CG. A systematic review of workplace interventions to prevent low back pain. Aust J Physiother 2000;46:259-69.
14. Cochrane Collaboration. Data extraction template for Cochrane reviews 2010. Available at: www.latrobe.edu.au/chcp/cochrane/resources. Accessed May 3, 2010.
15. Salter K, Jutai JW, Teasell R, Foley NC, Bitensky J. Issues for selection of outcome measures in stroke rehabilitation: ICF Body Functions. Disabil Rehabil 2005;27:191-207.
16. Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. BMC Med Res Methodol 2005;5:13.
17. Higgins JPT, Green S, editors. Cochrane Handbook for Systematic Reviews of Interventions Version 5.0.2. The Cochrane Collaboration 2009. Available at: www.cochrane-handbook.org. Accessed May 10, 2010.
18. Nouri FM, Lincoln NB. An extended activities of daily living scale for stroke patients. Clin Rehabil 1987;1:301-5.
19. Cohen J. The statistical power of abnormal-social psychological research: a review. J Abnorm Soc Psychol Res 1962;65:145-53.
20. Higgins J, Thompson S, Deeks J, Altman DG. Measuring inconsistency in meta-analyses. BMJ 2003;327:557-60.
21. Richards CL, Malouin F, Wood-Dauphinee S, Williams JI, Bouchard JP, Brunet D. Task-specific physical therapy for optimization of gait recovery in acute stroke patients. Arch Phys Med Rehabil 1993;74:612-20.
22. Ruff RM, Yarnell S, Marinos JM. Are stroke patients discharged sooner if in-patient rehabilitation services are provided seven v six days per week? Am J Phys Med Rehabil 1999;78:143-6.
23. Smith DS, Goldenberg E, Ashburn A, et al. Remedial therapy after stroke: a randomised controlled trial. Br Med J (Clin Res Ed) 1981;282:517-20.
24. Bernhardt J, Dewey H, Thrift A, Collier J, Donnan G. A very early rehabilitation trial for stroke (AVERT): phase II safety and feasibility. Stroke 2008;39:390-6.

25. Brusco NK, Shields N, Taylor NF, Paratz J. A Saturday physiotherapy service may decrease length of stay in patients undergoing rehabilitation in hospital: a randomised controlled trial. Aust J Physiother 2007;53:75-81.
26. Glasgow Augmented Physiotherapy Study. Can augmented physiotherapy input enhance recovery of mobility after stroke? A randomized controlled trial [with consumer summary]. Clin Rehabil 2004;18:529-37.
27. Lenssen AF, Crijns YH, Waltje EM, et al. Efficiency of immediate postoperative inpatient physical therapy following total knee arthroplasty: an RCT. BMC Musculoskelet Disord 2006;7:71.
28. Partridge C, Mackenzie M, Edwards S, et al. Is dosage of physiotherapy a critical factor in deciding patterns of recovery from stroke: a pragmatic randomized controlled trial. Physiother Res Int 2000;5:230-40.
29. Dorman PJ, Slattery J, Farrell B, Dennis M, Sandercock P. Qualitative comparison of the reliability of health status assessments with the EuroQOL and SF-36 questionnaires after stroke. Stroke 1998;29:63-8.
30. Aitken DM, Bohannon RW. Functional independence measure versus short form-36: relative responsiveness and validity. Int J Rehabil Res 2001;24:65-8.
31. Hirschhorn AD, Richards D, Mungovan S, Morris NR, Adams L. Supervised moderate intensity exercise improves distance walked at hospital discharge following coronary artery bypass graft surgery—a randomised controlled trial. Heart Lung Circ 2008;17:129-38.
32. van der Peijl ID, Vliet Vlieland TP, Versteegh MI, Lok JJ, Munneke M, Dion RA. Exercise therapy after coronary artery bypass graft surgery: a randomized comparison of a high and low frequency exercise therapy program. Ann Thorac Surg 2004;77:1535-41.
33. Bischoff-Ferrari HA, Dawson-Hughes B, Platz A, et al. Effect of high-dosage cholecalciferol and extended physiotherapy on complications after hip fracture. Arch Intern Med 2010;170:813-20.
34. Candrilli S, Mauskopf J. How much does a hospital day cost? Proceedings of the 11th Annual International Meeting of the International Society for Pharmacoeconomics and Outcomes Research; 2006 May 20-24, Philadelphia, PA. Available at: www.rtihs.org. Accessed November 11, 2010.
35. Jensen GM, Gwyer J, Hack L, Shepard K. Expertise in physical therapy practice. Boston: Butterworth-Heinemann; 1999.
36. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health related quality of life. The remarkable universality of half a standard deviation Med Care 2003;41:582-92.
37. Slade A, Tennant A, Chamberlain A. A randomised controlled trial to determine the effect of intensity of therapy upon length of stay in a neurological rehabilitation setting. J Rehabil Med 2002;34:260-6.
38. Craig J, Young CA, Ennis M, Baker G, Boggild M. A randomised controlled trial comparing rehabilitation against standard therapy in multiple sclerosis patients receiving intravenous steroid treatment. J Neurol, Neurosurg, Psychiatr 2003;74:1225-30.
39. Lincoln NB, Parry RH, Vass CD. Randomized, controlled trial to evaluate increased intensity of physiotherapy treatment of arm function after stroke. Stroke 1999;30:573-9.
40. Martinsson L, Eksborg S, Wahlgren NG. Intensive early physiotherapy combined with dexamphetamine treatment in severe stroke: a randomized, controlled pilot study. Cerebrovasc Dis 2003;16:338-45.
41. Sivenius J, Pyorala K, Heinonen OP, Salonen JT, Riekkinen P. The significance of intensity of rehabilitation of stroke – a controlled trial. Stroke 1985;16:928-31.
42. Stockton KA, Mengersen KA. Effect of multiple physiotherapy sessions on functional outcomes in the initial postoperative period after primary total hip replacement: a randomized controlled trial. Arch Phys Med Rehabil 2009;90:1652-7.
43. Allison R, Dennett R. Pilot randomized controlled trial to assess the impact of additional supported standing practice on functional ability post stroke [with consumer summary]. Clin Rehabil 2007;21(7):614-9.
44. Borello-France DF, Downey PA, Zyczynski HM, Rause CR, Borello-France DF, Downey PA, et al. Continence and quality-of-life outcomes 6 months following an intensive pelvic-floor muscle exercise program for female stress urinary incontinence: a randomized trial comparing low- and high-frequency maintenance exercise. Phys Ther 2008;88:1545-53.
45. Britton E, Harris N, Turton A. An exploratory randomized controlled trial of assisted practice for improving sit-to-stand in stroke patients in the hospital setting [with consumer summary]. Clin Rehabil 2008;22:458-68.
46. Chang W, Yang Y, Hsu L, Chern C, Wang R. Balance improvement in patients with benign paroxysmal positional vertigo. Clin Rehabil 2008;22:338-47.
47. de Lateur BJ, Magyar-Russell G, Bresnick MG, Bernier FA, Ober MS, Krabak BJ, et al. Augmented exercise in the treatment of deconditioning from major burn injury. Arch Phys Med Rehab 2007;88(12 Suppl 2):S18-23.
48. de Morton NA, Keating JL, Berlowitz DJ, Jackson B, Lim WK. Additional exercise does not change hospital or patient outcomes in older medical patients: a controlled clinical trial. Aust J Physiother 2007;53(2):105-11.
49. Donald IP, Pitt K, Armstrong E, Shuttleworth H. Preventing falls on an elderly care rehabilitation ward [with consumer summary]. Clin Rehabil 2000;14:178-85.
50. Dromerick AW, Lang CE, Birkenmeier RL, Wagner JM, Miller JP, Videen TO, et al. Very Early Constraint-Induced Movement during Stroke Rehabilitation (VECTORS): A single-center RCT. Neurology 2009;73:195-201.
51. Fang Y, Chen X, Li H, Lin J, Huang R, Zeng J. A study on additional early physiotherapy after stroke and factors affecting functional recovery [with consumer summary]. Clin Rehabil 2003;17:608-17.
52. Gilbey HJ, Ackland TR, Wang AW, Morton AR, Trouchet T, Tapper J. Exercise improves early functional recovery after total hip arthroplasty. Clin Orthop 2003;408:193-200.
53. Giovannelli M, Borriello G, Castri P, Prosperini L, Pozzilli C. Early physiotherapy after injection of botulinum toxin increases the beneficial effects on spasticity in patients with multiple sclerosis [with consumer summary]. Clin Rehabil 2007;21:331-7.
54. Grasel E, Schmidt R, Biehler J, Schupp W. Long-term effects of the intensification of the transition between inpatient neurological rehabilitation and home care of stroke patients. Clin Rehabil 2006;20:577-83.
55. Haines TP, Hill KD, Bennell KL, Osborne RH, Haines TP, Hill KD, et al. Additional exercise for older subacute hospital inpatients to prevent falls: benefits and barriers to implementation and evaluation. Clin Rehabil 2007;21:742-53.
56. Howe TE, Taylor I, Finn P, Jones H. Lateral weight transference exercises following acute stroke: a preliminary study of clinical effectiveness [with consumer summary]. Clin Rehabil 2005;19:45-53.
57. Kammerlind AS, Ledin TE, Odkvist LM, Skargren EI. Effects of home training and additional physical therapy on recovery after acute unilateral vestibular loss–a randomized study. Clin Rehabil 2005;19:54-62.
58. Kim JR, Oberman A, Fletcher GF, Lee JY. Effect of exercise intensity and frequency on lipid levels in men with coronary heart disease: Training Level Comparison Trial. Am J Cardiol 2001;87:942-6; A3.
59. Klaber Moffett JA, Jackson DA, Richmond S, Hahn S, Coulton S, Farrin A, et al. Randomised trial of a brief physiotherapy intervention compared with usual physiotherapy for neck pain patients:

outcomes and patients' preference [with consumer summary]. BMJ 2005;330(7482):75-8.
60. Kwakkel G, Wagenaar RC. Effect of duration of upper- and lower-extremity rehabilitation sessions and walking speed on recovery of interlimb coordination in hemiplegic gait. Phy Ther 2002;82(5):432-48.
61. Langhammer B, Stanghelle JK, Lindmark B. An evaluation of two different exercise regimes during the first year following stroke: a randomised controlled trial. Physioth Theory and Practice 2009; 25:55-68.
62. Moseley A, Sherrington C, Lord S, Barraclough E, St GR, Cameron I. Mobility training after hip fracture: A randomised controlled trial. Age Ageing 2009;38:74-80.
63. Ntoumenopoulos G, Greenwood K. Effects of cardiothoracic physiotherapy on intrapulmonary shunt in abdominal surgical patients. Aust J Phys 1996;42:297-303.
64. Platz T, Eickhof C, van KS, Engel U, Pinkowski C, Kalok S, et al. Impairment-oriented training or Bobath therapy for severe arm paresis after stroke: a single-blind, multicentre randomized controlled trial. Clin Rehabil 2005;19:714-24.
65. Rau B, Bonvin F, de Bie R. Short-term effect of physiotherapy rehabilitation on functional performance of lower limb amputees. Prosthet Orthot Int 2007;31:258-70.
66. Rodgers H, Mackintosh J, Price C, Wood R, McNamee P, Fearon T et al. Does an early increased-intensity interdisciplinary upper limb therapy programme following acute stroke improve outcome? [with consumer summary]. Clin Rehabil 2003;17:579-89.
67. Sunderland A, Tinson DJ, Bradley EL, Fletcher D, Langton Hewer R, Wade DT. Enhanced physical therapy improves recovery of arm function after stroke. A randomised controlled trial. J Neurol, Neurosurg, Psychiatr 1992;55:530-5.
68. Winett RA, Goodman JM, Marzolini S. Are multiple sets and usual aerobic training recommended for treatment of CHD? Med Sci Sports Exerc 2009;41:732-3.

Supplier

a. The Cochrane IMS. Available at: http://ims.cochrane.org/revman.

Chapter 3

PATIENTS RECEIVING INPATIENT REHABILITATION FOR LOWER LIMB ORTHOPAEDIC CONDITIONS DO MUCH LESS PHYSICAL ACTIVITY THAN RECOMMENDED IN GUIDELINES FOR HEALTHY OLDER ADULTS: AN OBSERVATIONAL STUDY

3.1 INTRODUCTION

Chapter 2 (Peiris et al 2011) provided evidence that additional physiotherapy services can improve patient outcomes, but current literature does not provide evidence about what inpatients actually do in rehabilitation, particularly the amount of physical activity completed. As identified in Chapter 1, being sufficiently physically active should be an important component of rehabilitation but there is some evidence to suggest that older adults and patients with stroke do little physical activity while in rehabilitation. Little is known about the physical activity levels of adults with lower limb orthopaedic conditions in inpatient rehabilitation. This group of patients may be particularly vulnerable to the effects of low levels of physical activity during rehabilitation considering the difficulties they have restoring mobility after hospitalisation (Beringer et al 2006, Koval and Zuckerman 1994, Resnick et al 2011).

The aim of this chapter was to determine the physical activity levels of patients with lower limb orthopaedic conditions while in inpatient rehabilitation to determine whether they meet physical activity guidelines for older adults.

Chapter 3 is presented in its published form (Peiris et al 2013a):

Peiris CL, Taylor NF and Shields N (2013a): Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions do much less physical activity than recommended in guidelines for healthy older adults: an observational study. *Journal of Physiotherapy* 59: 39-44.

Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions do much less physical activity than recommended in guidelines for healthy older adults: an observational study

Casey L Peiris[1,2], Nicholas F Taylor[1,2] and Nora Shields[1]

[1]Department of Physiotherapy, La Trobe University, [2]Allied Health Clinical Research Office, Eastern Health Australia

Question: Are ambulant patients who are admitted for inpatient rehabilitation for a lower limb orthopaedic condition active enough to meet current physical activity guidelines? **Design:** Prospective observational study. **Participants:** Adults admitted for inpatient rehabilitation for a lower limb orthopaedic condition who were cognitively alert and able to walk independently or with assistance. **Outcome measures:** Participants wore an activity monitor for three full days. Daily time spent in moderate intensity physical activity was used to determine whether the levels of physical activity recommended in clinical guidelines were achieved. **Results:** Fifty-four participants with a mean age of 74 years (SD 11) took a median of 398 (IQR 140 to 993) steps per day and spent a median of 8 (IQR 3 to 16) minutes walking per day. No participant completed a 10-minute bout of moderate intensity physical activity during the monitoring period. One participant accumulated 30 minutes of moderate intensity physical activity and nine participants accumulated 15 minutes of moderate intensity physical activity in a day. Physical activity was associated with shorter length of stay ($r = -0.43$) and higher functional status on discharge ($r = 0.39$). **Conclusions:** Adults with lower limb orthopaedic conditions in inpatient rehabilitation are relatively inactive and do not meet current physical activity guidelines for older adults. Results of this study indicate that strategies to increase physical activity are required. **[Peiris CL, Taylor NF, Shields N (2013) Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions do much less physical activity than recommended in guidelines for healthy older adults: an observational study. *Journal of Physiotherapy* 59: 39–44]**

Key words: Motor activity, Orthopaedics, Rehabilitation, Physical therapy modalities, Exercise therapy

Introduction

Regular physical activity is directly related to positive health outcomes (Schnohr et al 2003, Wen et al 2011). To achieve positive health outcomes guidelines recommend that adults should accumulate 30 minutes of moderate intensity aerobic activity on most days of the week (Pate et al 1995). Updated versions of these guidelines, which also consider older adults (≥ 65 years) and people with chronic health conditions, state that the activity must be completed in bouts of 10 minutes or more, on at least 5 days of the week (Haskell et al 2007, Nelson et al 2007, WHO 2011). There is emerging evidence to suggest that as little as 15 minutes of moderate intensity physical activity may be beneficial to health for community-dwelling adults and older adults (Wen et al 2011). Furthermore, it is recommended that older adults who are limited by health conditions be 'as physically active as their abilities and conditions allow' (WHO 2011).

Orthopaedic rehabilitation aims to promote independence and improve function to prepare patients to return to living independently in the community. Therefore, it could be expected that patients are trained while in rehabilitation to have levels of physical activity that are recommended for maintenance of health, in preparation for living independently in the community. However, adults with lower limb orthopaedic conditions in inpatient rehabilitation may find it difficult to be sufficiently active to meet physical activity guidelines because of the difficulty in restoring mobility after injury and/or surgery (Beringer et al 2006, Groen et al 2012, Koval and Zuckerman 1994, Resnick et al 2011, Schmalzried et al 1998, Silva et al 2005). Following hip fracture, inpatients who were more active during therapy sessions had better functional outcomes than those who were less active (Talkowski et al 2009), suggesting a positive relationship between physical activity and functional outcome. However, we were unable to locate any research that quantifies the physical activity levels of adults with lower limb orthopaedic conditions during inpatient rehabilitation in relation to physical activity guidelines. Therefore, the research questions for this study were:

1. Are ambulant patients who are admitted for inpatient rehabilitation for a lower limb orthopaedic condition active enough to meet current physical activity guidelines?
2. Is there a relationship between physical activity and functional outcome in this population?

What is already known on this topic: Various guidelines recommend the amount, intensity, duration and frequency of physical activity that adults should undertake to maintain health. Orthopaedic rehabilitation aims to restore sufficient function to allow independent living in the community, which ideally would include restoration of the recommended physical activity levels.

What this study adds: Inpatients receiving rehabilitation for lower limb orthopaedic conditions are relatively inactive and do not meet current physical activity guidelines. Changes are required to reverse this sedentary behaviour during rehabilitation.

Method

Design

This prospective observational study was conducted on a subgroup of participants during the baseline phase (ie, prior to the randomised intervention) of a randomised controlled trial evaluating the effects of additional weekend allied health services (Peiris et al 2012a). Participants underwent objective physical activity monitoring for three days and their activity levels were assessed against recommended levels of activity in several guidelines about physical activity for maintenance of health. This study took place on one ward at an inpatient rehabilitation facility with 30 rehabilitation beds servicing a metropolitan area over a 4-month period (1 March 2011 to 30 June 2011).

Participants

Patients were included if they were aged 18 years or older, were admitted for rehabilitation in the orthopaedic ward, had a lower limb orthopaedic condition (eg, hip or knee replacement, hip fracture), were able to walk (independently or with assistance), and were cognitively alert. To estimate the physical activity pattern of an adult reliably, at least three days of monitoring is recommended (Trost et al 2005) so patients were only eligible if they had three consecutive days of weekday monitoring before the randomised intervention of the larger study began. All patients received usual medical, nursing and allied health care.

Outcome measures

Primary outcome: To determine whether physical activity guidelines were being met, activity monitor data were used to compare the level of physical activity to three physical activity guidelines:

1. 30 minutes accumulated moderate intensity physical activity per day (Pate et al 1995);
2. 30 minutes of moderate intensity physical activity per day accumulated in bouts of at least 10 minutes (Haskell et al 2007, Nelson et al 2007, WHO 2011); and
3. 15 minutes accumulated moderate intensity physical activity per day (Wen et al 2011).

Measures of moderate intensity were obtained from the activity monitors through secondary analysis via a custom-made software program using threshold values:

1. Walking cadence > 60 steps/minute. Greater than 100 steps/minute is accepted as moderate intensity (Rowe et al 2011) but at least 60 steps/minute may be beneficial to health (Tudor-Locke et al 2011) and was therefore used as a threshold for moderate intensity in this population where mobility is limited.
2. Metabolic equivalents (METs) > 3.0. The activity monitor assigns a MET value to each activity it records according to the Compendium of Physical Activities (Ainsworth et al 1993). It assigns fixed values to sitting, lying, and standing while the value for stepping increases with increased cadence. It is estimated that individuals expend 3 to 6 times their basal METs when completing moderate intensity activity (Haskell et al 2007).
3. Activity counts > 1075 counts. Activity counts are based on an algorithm that averages bodily accelerations (recorded every tenth of a second) into activity counts per 15 seconds. Greater than 1075 activity counts per 15 seconds is considered moderate intensity in young adult females in free-living situations (Harrington 2010). We were unable to locate threshold values for older adults.

Because normal walking is not always continuous and may include short breaks in motion (eg, when stopping to talk to someone in the corridor) these were accounted for when assessing activity bouts. A modified 10-minute activity bout definition, which takes into account interruptions of up to 2 minutes, was applied and has been used previously (Harrington 2010, Troiano et al 2008).

Secondary outcomes: Outcomes used to describe physical activity levels included steps per day, time spent in upright activities per day (minutes), time spent walking per day (minutes), and time spent inactive per day (hours). The Functional Independence Measure (FIM) was used to assess the amount of assistance required to complete activities of daily living at baseline and on discharge (Hamilton and Granger 1994). The FIM consists of 18 items in two domains: motor (13 items) and cognitive (5 items). Each item is rated on a 7-point scale, where 1 reflects complete dependence and 7 reflects complete independence. Scores range from 18 (lowest function) to 126 (highest function). The FIM mobility score refers to items 9 through 13 which relate to transfers, walking, and stairs. Co-morbidities were recorded using the Charlson Co-morbidities Index (Charlson et al 1994), the 10-metre walk test (Hollman et al 2008) was used to calculate cadence at baseline (steps per minute), and length of stay in inpatient rehabilitation (days) was recorded.

A uniaxial accelerometer-based activity monitor[a] was used to provide an objective measure of physical activity. Activity monitors were attached to the participant's non-affected lower limb on the mid-anterior thigh at the earliest convenient time after admission and remained in place for five days (the middle three days of recording were used to ensure that three complete days were drawn on for analyses). To allow for continuous monitoring (including showering) the monitor was taped inside a zip-lock bag and affixed to the skin with a water-proof medical dressing.

The activity monitor used is a valid and reliable measure of walking in healthy adults (Ryan et al 2006) and community dwelling older adults (Grant et al 2008), and is a valid measure of activity or inactivity for the long-term monitoring of older adults with impaired function (Taraldsen et al 2011) and of steps taken at slower walking speeds (Kanoun 2009).

Data analysis

The number of participants meeting activity guidelines was described. For normally distributed data the mean and standard deviation (SD) were reported. For skewed data the median and inter-quartile range (IQR) were reported. Bivariate correlations examined the relationships between steps taken per day, length of stay and FIM.

Results

Flow of participants through the study

One hundred and nine orthopaedic patients were admitted to the ward during the study period. Only patients who were available to have the activity monitors applied early in the week (Monday or Tuesday) were screened for eligibility to

participate because three uninterrupted days of monitoring were needed before the weekend. Therefore 51 patients were not eligible because they were admitted later in the week. A further 4 patients were excluded due to cognitive impairment. During the study period 54 patients (median 9 days after surgery, fracture, or acute event, IQR 7 to 14) met all inclusion criteria and provided informed consent to participate in the study (Figure 1). The characteristics of the participants are presented in Table 1. All participants were able to walk, with 10 (19%) classified as independently mobile and the remainder requiring supervision or assistance to walk. One participant noted redness and minor itching around the dressing that secured the monitor but did not withdraw due to the minor nature of this irritation. There were no other adverse events and three full days of data were available for analysis for all participants.

Achievement of physical activity guidelines

No participant completed a 10-minute bout of moderate intensity physical activity. No participant accumulated a total of 30 minutes of moderate intensity physical activity on any day according to criteria of cadence > 60 or energy expenditure > 3 METs. When using the threshold value of > 1075 activity counts per 15 seconds, one participant accumulated 30 minutes of moderate intensity physical activity on one day. Nine participants accumulated a total of 15 minutes of moderate intensity physical activity in a day according to the activity counts threshold. Some participants met guidelines on more than one day monitored, therefore the number of days on which the guidelines were met are also presented in Table 2.

Participants took a median of 398 (IQR 140 to 993) steps per day. The most active participant took 2628 steps on one day. Participants spent a median of 8 (IQR 3 to 16) minutes walking per day and a mean of 58 (SD 37) minutes upright and 23.0 (SD 0.7) hours sitting or lying down per day.

Patients did not meet physical activity guidelines regardless of other clinical factors. Days post acute event, diagnosis, and co-morbidities did not impact significantly on physical activity levels. Patients who were classified as independently mobile (n = 10) had higher admission FIM scores (mean difference 14, 95% CI 4 to 24) and took significantly more steps per day (mean difference 496, 95% CI 116 to 876) compared to those who required supervision or assistance to ambulate (n = 44), but they still did not meet physical activity guidelines.

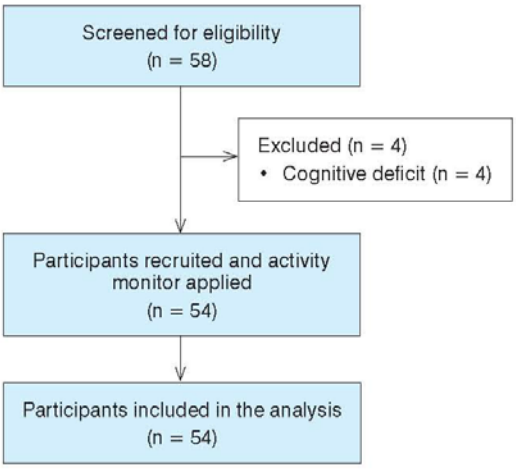

Figure 1. Flow of participants through the study.

Relationship between physical activity and functional outcomes

There was a moderate, negative correlation between steps taken per day and length of stay ($r = -0.43$, $p < 0.01$) (Figure 2) and a moderate, positive correlation between steps taken per day and discharge FIM mobility score ($r = 0.39$, $p < 0.01$). When participants took less than or equal to the median number of steps per day (398 steps per day), their mean length of stay was 24 (SD 17) days. Participants who took more than the median steps per day had a mean length of stay of 14 (SD 4) days.

Overall, steps per day was not significantly correlated with the change in FIM mobility score per day ($r = 0.17$, $p = 0.21$). Considering participants who took less than or equal to the median number of steps per day there was no correlation with FIM mobility change per day ($r = 0.23$, $p = 0.24$). For participants who took more than the median number of steps per day, there was a moderate, positive correlation between steps taken per day and FIM mobility change per day ($r = 0.42$, $p = 0.03$) (Figure 3).

Table 1. Characteristics of the participants.

Characteristic	Participants (n = 54)
Age, mean (SD)	74 (11)
Gender, n female (%)	40 (74)
Independent walking status on admission, n (%)	10 (19)
FIM total score *(18 to 126)*, mean (SD)	
admission	83 (15)
discharge	109 (10)
FIM mobility score *(5 to 35)*, mean (SD)	
admission	14 (6)
discharge	27 (4)
Charlson Co-morbidity Index score, mean (SD)	1 (1)
10MWT cadence *(steps/min)*, mean (SD)	61 (22)
Diagnosis, n (%)	
total knee replacement	17 (31)
total hip replacement	9 (17)
hip fracture	9 (17)
other lower limb fracture	6 (11)
ankle fracture	5 (9)
amputation	4 (7)
other	4 (7)
Length of stay *(days)*, mean (SD)	19 (13)

FIM = Functional Independence Measure, 10MWT = 10-metre walk test

Table 2. Number of participants meeting physical activity guidelines.

Guidelines	Number of participants achieving guidelines on at least 1 day (n = 54)	Number of days guidelines achieved (out of 162 days)
1. 30 minutes of moderate intensity physical activity per day		
cadence > 60	0	0
METs > 3.0	0	0
activity counts > 1075	1	1
2. 30 minutes of moderate intensity physical activity per day in minimum 10-minute bouts		
cadence > 60	0	0
METs > 3.0	0	0
activity counts > 1075	0	0
3. 15 minutes of moderate intensity physical activity per day		
cadence > 60	3	5
METs > 3.0	0	0
activity counts > 1075	9	14

MET = metabolic equivalent

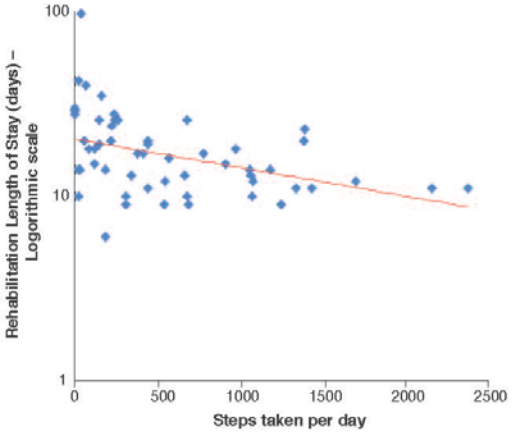

Figure 2. Correlation between steps per day and rehabilitation length of stay. Steps per day correlates with rehabilitation length of stay ($r = -0.43$, $p < 0.01$). Note that the vertical axis is in logarithmic scale.

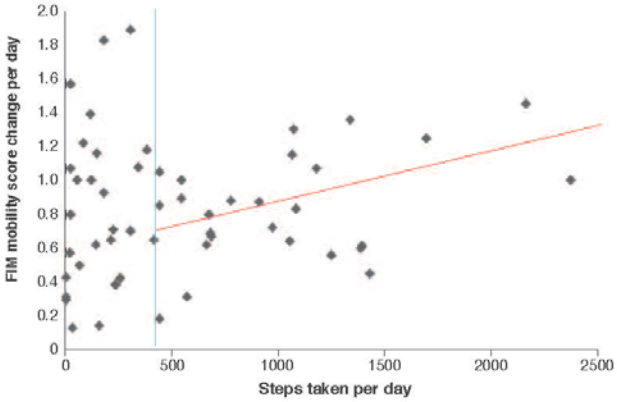

Figure 3. Correlation between steps per day and the amount of change per day in the Functional Independence Measure (FIM) mobility score. Steps per day correlates with FIM mobility change per day when steps per day > median (398 steps, blue line) ($r = 0.42$, $p = 0.03$).

Discussion

No participant consistently achieved the minimum level of health-enhancing physical activity recommended in current guidelines. Overall, participants were relatively inactive taking a median of 398 (IQR 140 to 993) steps per day and spending 8 (IQR 3 to 16) minutes walking per day. In comparison to activity guidelines for healthy older adults (Nelson et al 2007, WHO 2011) or to activity levels of older adults living in the community (Grant et al 2010, Smith et al 2008) or even to physical activity levels of adults in the community living with disability (Tudor-Locke et al 2009) the levels of physical activity completed in inpatient orthopaedic rehabilitation were low.

Despite the very low levels of activity observed in our study, it is possible that current physical activity guidelines for older adults may not be appropriate for inpatients receiving rehabilitation. It should be considered whether it is unreasonable to expect inpatients in rehabilitation to be physically active at a moderate intensity for 30 minutes each day. Currently there are no recommendations on the amount of physical activity inpatients in rehabilitation should complete to improve function and prepare for discharge, although it is recommended that they should be as physically active 'as their abilities and conditions allow' (WHO 2011). This makes it difficult to determine whether the activity level in the current study is considered to be adequate. Physical activity guidelines for people in rehabilitation, who are recovering from a lower limb orthopaedic condition, would need to consider factors such as pain, fatigue, fear of falling, and feeling unwell (Capdevila et al 2006), all of which may make it more difficult to be physically active. However,

in other rehabilitation populations, for example patients recovering from a cardiac event, 30 minutes of moderate intensity physical activity daily can be applied safely during inpatient rehabilitation (Hirschhorn et al 2008).

Physical activity has a direct dose-response relationship with health outcomes (Schnohr et al 2003, Wen et al 2011). Following hip fracture, higher activity levels during therapy correlated with better functional outcomes (Talkowski et al 2009). Similarly, following knee arthroplasty, greater completion of independent home exercises correlated with better functional outcomes (Franklin et al 2006). In our study, physical activity during inpatient rehabilitation was significantly correlated with a reduced length of stay and higher functional levels at discharge. At very low levels of physical activity (less than 398 steps per day) length of stay was higher and there was no correlation between physical activity and functional gains per day. When participants were more active than this they had shorter length of stay and there were significant correlations with functional gains per day. If physical activity guidelines for people in inpatient rehabilitation are to be developed they would need to consider a minimum threshold of physical activity required to lead to significant functional gains. Data from the current study suggesting an association between functional gains and physical activity for participants taking more than 398 steps per day could contribute to development of such guidelines.

No matter whether current physical activity guidelines for older adults are appropriate for orthopaedic rehabilitation inpatients, the results of the current study suggest that these patients could benefit from being more active. A change to the rehabilitation ward environment has been shown to reduce the amount of time patients spent at their bedsides but did not increase physical activity levels (Newall et al 1997) highlighting the need for supervision, encouragement, and a change in attitude of hospital staff who are risk-averse and prefer patients not to mobilise independently. Inpatients in rehabilitation do more physical activity when therapy is being provided (Bear-Lehman et al 2001, Smith et al 2008) and spend little time in self-directed physical activity (Newall et al 1997, Patterson et al 2005, Tinson 1989). This suggests that one potential way of increasing physical activity levels would be to provide additional allied health therapy. In a recent randomised controlled trial, participants who received physiotherapy and occupational therapy interventions six days per week had significantly higher physical activity levels than those who received the intervention on five days (Peiris et al 2012a). Results from a qualitative study of patients in the same setting indicate that patients are agreeable to the additional therapy (Peiris et al 2012b) and the resulting higher levels of physical activity. Other options include group therapy and utilisation of allied health assistants to increase physical activity levels. However, as resources can be limited, efforts need to be made by physiotherapists to implement strategies to empower ward staff, patients, and their carers to increase physical activity levels outside of therapy.

One limitation of our study is that the activity monitor used did not record activity in lying or sitting. However, it has been advocated that doing non-stepping activity such as bed exercises should not be considered mobilisation or a substitute for upright physical activity (Bernhardt et al 2007) and that, in this population, walking is the most important activity to measure (Tudor-Locke et al 2011).

In conclusion, patients with lower limb orthopaedic conditions in inpatient rehabilitation are relatively inactive and do not meet current physical activity guidelines. Given the importance of physical activity for general health and functional improvements following hospitalisation it is important to develop methods to decrease sedentary behaviour and increase physical activity levels in rehabilitation. ■

Footnotes: [a]ActivPAL, PAL Technologies, Glasgow.

Ethics approval: Eastern Health and La Trobe University Ethics Committees approved this study. All participants gave written informed consent before data collection began.

Competing interests: The authors declare no conflict of interest related to this work.

Support: This study is funded by a partnership grant from the National Health and Medical Research Council Australia (ID 541958).

Acknowledgements: The authors would like to sincerely thank Dr Dennis Wollersheim for his contribution in assisting with activity monitor data extraction.

Correspondence: Casey Peiris, Allied Health Clinical Research Office, Eastern Health, Australia. Email: Casey.Peiris@easternhealth.org.au

References

Ainsworth BE, Haskell WL, Leon AS, Jacobs DR, Jr., Montoye HJ, Sallis JF, et al (1993) Compendium of physical activities: classification of energy costs of human physical activities. *Medicine & Science in Sports & Exercise* 25: 71–80.

Bear-Lehman J, Bassile CC, Gillen G (2001) A comparison of time use on an acute rehabilitation unit: subjects with and without a stroke. *Physical & Occupational Therapy in Geriatrics* 20: 17–27.

Beringer TR, Clarke J, Elliott JR, Marsh DR, Heyburn G, Steele IC (2006) Outcome following proximal femoral fracture in Northern Ireland. *Ulster Medical Journal* 75: 200–206.

Bernhardt J, Indredavik B, Dewey H, Langhorne P, Lindley R, Donnan G, et al (2007) Mobilisation 'in bed' is not mobilisation. *Cerebrovascular Diseases* 24: 157–158.

Capdevila X, Dadure C, Bringuier S, Bernard N, Biboulet P, Gaertner E, et al (2006) Effect of patient-controlled perineural analgesia on rehabilitation and pain after ambulatory orthopedic surgery: a multicenter randomized trial. *Anesthesiology* 105: 566–573.

Charlson M, Szatrowski TP, Peterson J, Gold J (1994) Validation of a combined comorbidity index. *Journal of Clinical Epidemiology* 47: 1245–1251.

Franklin PD, McLaughlin J, Boisvert CB, Li W, Ayers DC (2006) Pilot study of methods to document quantity and variation of independent patient exercise and activity after total knee arthroplasty. *Journal of Arthroplasty* 21: 157–163.

Grant PM, Dall PM, Mitchell SL, Granat MH (2008) Activity-monitor accuracy in measuring step number and cadence in community-dwelling older adults. *Journal of Aging & Physical Activity* 16: 201–214.

Grant PM, Granat MH, Thow MK, Maclaren WM (2010) Analysing free-living physical activity of older adults in different environments using body-worn activity monitors. *Journal of Aging & Physical Activity* 18: 171–184.

Groen JW, Stevens M, Kersten RFMR, Reininga IHF, van den Akker-Scheek I (2012) After total knee arthroplasty, many

people are not active enough to maintain their health and fitness: an observational study. *Journal of Physiotherapy* 58: 113–116.

Hamilton BB, Granger CV (1994) Disability outcomes following inpatient rehabilitation for stroke. *Physical Therapy* 74: 494–503.

Harrington D (2010) Objective assessment and modification of physical activity and health indices in adolescent females [online thesis]. http://hdl.handle.net/10344/420 [Accessed 14 September, 2011].

Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al (2007) Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 116: 1081–1093.

Hirschhorn AD, Richards D, Mungovan S, Morris NR, Adams L (2008) Supervised moderate intensity exercise improves distance walked at hospital discharge following coronary artery bypass graft surgery – a randomised controlled trial. *Heart, Lung & Circulation* 17: 129–138.

Hollman JH, Beckman BA, Brandt RA, Merriwether EN, Williams RT, Nordrum JT (2008) Minimum detectable change in gait velocity during acute rehabilitation following hip fracture. *Journal of Geriatric Physical Therapy* 31: 53–56.

Kanoun N (2009) Validation of the ActivPAL activity monitor as a measure of walking at pre-determined slow walking speeds in a healthy population in a controlled setting. *Reinvention: a Journal of Undergraduate Research* 2: 5–9.

Koval KJ, Zuckerman JD (1994) Functional recovery after fracture of the hip. *Journal of Bone & Joint Surgery – American Volume* 76: 751–758.

Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, et al (2007) Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation* 116: 1094–1105.

Newall JT, Wood VA, Hewer RL, Tinson DJ (1997) Development of a neurological rehabilitation environment: an observational study. *Clinical Rehabilitation* 11: 146–155.

Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, et al (1995) Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 273: 402–407.

Patterson F, Blair V, Currie A, Reid W (2005) An investigation into activity levels of older people on a rehabilitation ward: an observational study. *Physiotherapy* 91: 28–34.

Peiris CL, Taylor NF, Shields N (2012a) Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation* 93: 1365–1370.

Peiris CL, Taylor NF, Shields N (2012b) Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study. *Journal of Physiotherapy* 58: 261–268.

Resnick B, Galik E, Boltz M, Hawkes W, Shardell M, Orwig D, et al (2011) Physical activity in the post-hip-fracture period. *Journal of Aging & Physical Activity* 19: 373–387.

Rowe DA, Welk GJ, Heil DP, Mahar MT, Kemble CD, Calabro MA, et al (2011) Stride rate recommendations for moderate-intensity walking. *Medicine & Science in Sports & Exercise* 43: 312–318.

Ryan CG, Grant PM, Tigbe WW, Granat MH (2006) The validity and reliability of a novel activity monitor as a measure of walking. *British Journal of Sports Medicine* 40: 779–784.

Schmalzried TP, Szuszczewicz ES, Northfield MR, Akizuki KH, Frankel RE, Belcher G, et al (1998) Quantitative assessment of walking activity after total hip or knee replacement. *Journal of Bone & Joint Surgery – American Volume* 80: 54–59.

Schnohr P, Scharling H, Jensen JS (2003) Changes in leisure-time physical activity and risk of death: an observational study of 7,000 men and women. *American Journal of Epidemiology* 158: 639–644.

Silva M, McClung CD, Dela Rosa MA, Dorey FJ, Schmalzried TP (2005) Activity sampling in the assessment of patients with total joint arthroplasty. *Journal of Arthroplasty* 20: 487–491.

Smith P, Galea M, Woodward M, Said C, Dorevitch M (2008) Physical activity by elderly patients undergoing inpatient rehabilitation is low: an observational study. *Australian Journal of Physiotherapy* 54: 209–213.

Talkowski JB, Lenze EJ, Munin MC, Harrison C, Brach JS (2009) Patient participation and physical activity during rehabilitation and future functional outcomes in patients after hip fracture. *Archives of Physical Medicine & Rehabilitation* 90: 618–622.

Taraldsen K, Askim T, Sletvold O, Einarsen EK, Bjastad KG, Indredavik B, et al (2011) Evaluation of a body-worn sensor system to measure physical activity in older people with impaired function. *Physical Therapy* 91: 277–285.

Tinson DJ (1989) How stroke patients spend their days. An observational study of the treatment regime offered to patients in hospital with movement disorders following stroke. *International Disability Studies* 11: 45–49.

Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell MT (2008) Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports & Exercise* 40: 181–188.

Trost SG, McIver KL, Pate RR (2005) Conducting accelerometer-based activity assessments in field-based research. *Medicine & Science in Sports & Exercise* 37: S531–543.

Tudor-Locke C, Camhi SM, Leonardi C, Johnson WD, Katzmarzyk PT, Earnest CP, et al (2011) Patterns of adult stepping cadence in the 2005–2006 NHANES. *Preventive Medicine* 53: 178–181.

Tudor-Locke C, Washington TL, Hart TL (2009) Expected values for steps/day in special populations. *Preventive Medicine* 49: 3–11.

Wen CP, Wai JP, Tsai MK, Yang YC, Cheng TY, Lee MC, et al (2011) Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. *Lancet* 378: 1244–1253.

WHO (2011) World Health Organisation Global recommendations on physical activity for health: 65 years and above. http://www.who.int/dietphysicalactivity/physical-activity-recommendations-65years.pdf [Accessed 14 September, 2011].

Chapter 4

ADDITIONAL SATURDAY ALLIED HEALTH SERVICES INCREASE HABITUAL PHYSICAL ACTIVITY AMONG PATIENTS RECEIVING INPATIENT REHABILITATION FOR LOWER LIMB ORTHOPAEDIC CONDITIONS: A RANDOMISED CONTROLLED TRIAL

4.1 INTRODUCTION

Chapter 3 (Peiris et al 2013) found that patients receiving inpatient rehabilitation for lower limb orthopaedic conditions were relatively inactive. They spent the majority of their time sitting or lying down and did not meet physical activity guidelines. However, higher levels of physical activity were associated with shorter length of stay and higher functional status on discharge. As identified in Chapter 1, one means of potentially increasing physical activity levels may be to provide rehabilitation on the weekends.

The aim of Chapter 4 was to determine whether patients who received additional Saturday rehabilitation (physiotherapy and occupational therapy) had increased levels of physical activity.

Chapter 4 is presented in its published form (Peiris et al 2012a):

Peiris CL, Taylor NF and Shields N (2012a): Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation* 93: 1365-1370.

ORIGINAL ARTICLE

Additional Saturday Allied Health Services Increase Habitual Physical Activity Among Patients Receiving Inpatient Rehabilitation for Lower Limb Orthopedic Conditions: A Randomized Controlled Trial

Casey L. Peiris, BPhys, Nicholas F. Taylor, PhD, Nora Shields, PhD

ABSTRACT. Peiris CL, Taylor NF, Shields N. Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial. Arch Phys Med Rehabil 2012;93:1365-70.

Objective: To determine whether adults with lower limb orthopedic conditions who received additional weekend physical therapy (PT) and occupational therapy (OT) demonstrated increased habitual physical activity.

Design: Randomized controlled trial.

Setting: Inpatient rehabilitation center.

Participants: Adults (N=105, 72 women; mean age ± SD, 74±12y) admitted with a lower limb orthopedic condition, cognitively alert and able to walk.

Intervention: The control group received PT and OT Monday to Friday; in addition, the experimental group also received a full Saturday PT and OT service. Participants wore an activity monitor for 7 days.

Main Outcome Measures: Daily steps and daily upright time (hours).

Results: Overall, participants took a mean of 589±640 steps per day and spent a mean of 1.2±0.9 hours upright per day. Experimental group participants took more than twice as many steps (mean difference, 428 steps; 95% confidence interval [CI], 184–673) and spent 50%±20% more time upright (mean difference, 0.5h; 95% CI, 0.1–0.9) than control group participants on Saturdays. In the days after additional therapy, experimental group participants took 63%±28% more steps (mean difference, 283 steps; 95% CI, 34–532) and spent 40%±17% more time upright (mean difference, 0.4h; 95% CI, 0.1–0.8) per day than participants in the control group.

Conclusions: Providing additional rehabilitation services on the weekend increased habitual activity, but patients with lower limb orthopedic conditions admitted to rehabilitation remained relatively inactive even with additional therapy.

Key Words: Motor activity; Occupational therapy; Physical therapy speciality; Randomized controlled trial; Rehabilitation.

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PHYSICAL INACTIVITY HAS important negative health consequences. It is the fourth leading risk factor for global mortality and is responsible for 6% of all deaths.[1] It is an independent risk factor for a number of chronic diseases including cardiovascular disease, diabetes, obesity, hypertension, and depression. Physical activity is defined as any bodily movement produced by skeletal muscle that requires energy expenditure.[2] Habitual physical activity refers to the accumulated activity performed in free-living conditions over at least 1 day as opposed to a discrete event of energy expenditure such as standing up from a chair.[3]

Rehabilitation aims to promote independence; therefore, effective rehabilitation should encourage physical activity and contribute to the improvement of function.[4,5] However, the physical impairments that people are recovering from during rehabilitation can make movement difficult, which may affect their ability to achieve adequate habitual physical activity. The limited amount of available evidence suggests that older adults undergoing inpatient rehabilitation have relatively low levels of physical activity. Patients with stroke were observed to be inactive for 42% to 45% of the waking day,[6,7] and older adults in rehabilitation were inactive for 63% of the waking day.[4] Low levels of physical activity are associated with deconditioning in hospitalized older adults.[8] Little is known about the habitual physical activity levels of people with lower limb orthopedic conditions undergoing inpatient rehabilitation. This group may be particularly vulnerable to the consequences of low habitual physical activity because of the difficulty in restoring mobility after hospitalization.[9-13]

Low levels of activity of adults during hospitalization and rehabilitation suggest attention may need to be directed toward increasing activity during rehabilitation. Increased therapy has been shown to enhance recovery, and 1 way this may be mediated is by increasing habitual physical activity through increased therapy time in rehabilitation.[14] An observational study[15] suggested the presence of a therapist was the most influential factor in undertaking physical activity by people with stroke in rehabilitation. It was also noted that activity levels decreased on the weekend for patients undergoing inpatient rehabilitation when therapy was not conducted on the

List of Abbreviations

CI	confidence interval
OT	occupational therapy
PT	physical therapy

From the Musculoskeletal Research Centre and Department of Physiotherapy, La Trobe University, Victoria (Peiris, Taylor, Shields); and Allied Health Clinical Research Office, Eastern Health, Victoria (Peiris, Taylor), Australia.

Presented to employees of the health service where the research was conducted, Eastern Health, October 26, 2011, Melbourne, Australia.

Supported by the National Health and Medical Research Council Partnership (grant no. ID 541958).

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.

Clinical Trial Registration No.: Australian and New Zealand Clinical Trials Registry ACTRN12609000973213.

Reprint requests to Casey L. Peiris, BPhys, Allied Health Clinical Research Office, Level 2, 5 Arnold St, Box Hill, Victoria, Australia, 3128, e-mail: *Casey.Peiris@easternhealth.org.au.*

In-press corrected proof published online on Apr 26, 2012, at www.archives-pmr.org.

0003-9993/12/9308-01179$36.00/0

http://dx.doi.org/10.1016/j.apmr.2012.03.004

weekend.[16,17] The provision of additional weekend therapy may be 1 strategy to help to increase activity levels on the weekend and may have a carryover effect of increasing independent activity.

Given the limited research available on the levels of habitual physical activity of rehabilitation inpatients and the importance of evaluating whether a strategy of providing additional rehabilitation helps to increase it in these patients, the aim of this trial was to examine habitual physical activity of adults with lower limb orthopedic conditions receiving additional allied health rehabilitation on the weekend compared with those who receive usual Monday to Friday therapy.

METHODS

The study was conducted on a subgroup of patients enrolled in a single-blinded, multicenter, randomized controlled trial evaluating the effects of providing additional allied health services for inpatients.[18] The subgroup of patients with lower limb orthopedic conditions was chosen from one 30-bed orthopedic ward at an inpatient rehabilitation facility (servicing a metropolitan area) over a predefined 4-month period. We compared habitual physical activity levels of patients receiving additional Saturday physical therapy (PT) and occupational therapy (OT) with the activity levels of patients receiving usual Monday to Friday PT and OT services. The trial received ethics approval from the relevant ethics committees, and all participants provided written informed consent.

Participants

Patients were included if they were 18 years or older, were admitted for rehabilitation in the orthopedic ward, had a lower limb orthopedic condition (eg, after hip or knee replacement surgery), were able to walk (independently or with assistance), and were cognitively alert.

Randomization

Participants were randomly assigned to the experimental or control group by means of a concealed method, using permuted blocks of 4, 6, and 8. The block allocation sequence was generated by a randomization plan generator (http://www.randomization.com), and assignments were concealed in sequentially numbered, sealed, opaque envelopes. Only after the participant was enrolled in the trial and provided written informed consent was assignment made by the project officer by opening the next envelope in the sequence. A research team member not involved in recruitment or randomization prepared the envelopes.

Intervention

Usual-care PT and OT were provided to the control group participants daily from Monday to Friday. PT interventions took place in the rehabilitation gym, and OT interventions were conducted in an appropriate setting (eg, kitchen, bathroom); the specific intervention was at the discretion of the treating therapist. Patients at the rehabilitation facility usually receive between 1 and 3 hours of PT and OT a day.

The experimental group received the same amount of intervention as the control group Monday to Friday, but also received a full PT and OT service on Saturday (equating to an additional 1h of PT and 1h of OT). The type of intervention provided on the Saturday was decided by the participant's regular (Monday to Friday) therapists, but was provided by different therapists on the weekends. Instructions were provided by a written handover to the weekend therapist.

Outcome Measures

A uniaxial accelerometer-based activity monitor (ActivPAL[a]) was used to measure habitual physical activity. Activity monitors were attached to the participant's nonaffected thigh soon after admission to rehabilitation and remained in place for 7 days or until discharge if this occurred before 7 days. The monitors were removed only if the participant went into the hydrotherapy pool. If this did occur, a researcher wore the activity monitor and mirrored the participant's movements outside the pool to capture that activity.

The ActivPAL monitor is a valid and reliable measure of walking in healthy adults[19] and community-dwelling older adults,[20] and of activity/inactivity for the long-term monitoring of older adults with impaired function.[21] Three to 5 days of monitoring is recommended.[22]

The FIM[23] was used to assess the amount of assistance required to complete activities of daily living at baseline; comorbidities were recorded using the Charlson Comorbidity Index[24]; and the 10-m walk test[25,26] was used to calculate cadence at baseline (steps per minute).

The primary outcome measures were steps per day and time spent upright (standing and stepping) per day (hours). Secondary outcomes included time spent inactive (sitting and lying) per day (hours) and proportion of total activity completed in therapy. Therapy time was established from patient therapy timetables and matched alongside the activity monitor data to determine physical activity levels during therapy as well as total time spent in PT or OT. Data entry was completed by a researcher blinded to group allocation.

Sample Size Estimation

To estimate the sample size, we assumed a 20% difference in habitual physical activity to be clinically significant (as the experimental group received 20% extra therapy). To detect a 20% improvement in minutes of activity per day with an SD of 49 minutes,[27] with a 1-sided 5% significance level and a power of 80%, a sample size of 53 in each group (total 106) was required.

Data Analysis

Because the 7 days of monitoring was not commenced on the same day of the week for each participant, some days monitored were before the participant received (or did not receive) the additional PT and OT, and some days were after. These times were analyzed separately.

We used independent *t* tests to test for mean differences and 95% confidence intervals (CIs) between groups. For nonnormally distributed data, we also conducted Mann-Whitney *U* tests. The primary analysis was according to intention-to-treat principles, with data analyzed according to group allocation. No imputation techniques were applied for missing data.

Subgroup analyses were completed to investigate whether ambulation status (independent vs nonindependent), diagnosis (elective vs traumatic), and age (<65y vs ≥65y) affected activity by using a series of 2-way analyses of variances with 2 independent factors (grouping factor in subgroup analysis and intervention group).

RESULTS

A total of 109 adults with an orthopedic diagnosis were admitted to the trial between March 1, 2011, and June 30, 2011. Four patients were excluded because of reduced cognitive function. One hundred five patients (median 8d after surgery, fracture, or acute event; interquartile range, 7–13d) provided informed consent, had the activity monitors attached (median

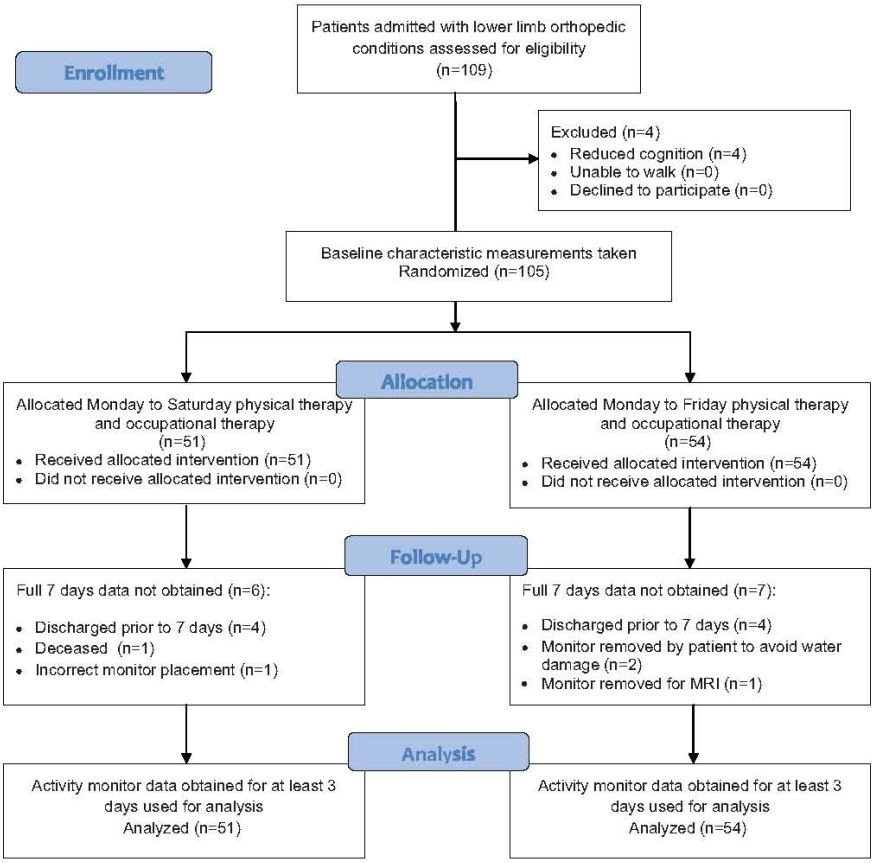

Fig 1. Consolidated Standards of Reporting Trials flow diagram. Abbreviation: MRI, magnetic resonance imaging.

2d after admission; interquartile range, 1–4d), and were randomly allocated to either Monday to Saturday (n=51) or Monday to Friday (n=54) therapy (fig 1). Complete data sets (7 full days) were obtained for 92 participants, and data for at least 3 days were obtained for all 105 participants. Incomplete data sets (data for 3–6 days) were because participants were discharged before 7 days (experimental, n=4; control, n=4), died (experimental, n=1), the monitor was removed for magnetic resonance imaging (control, n=1), the monitor was incorrectly placed (experimental, n=1), or the patient removed the monitor (control, n=2).

Participants

There were 72 women (69% of the sample), and the whole sample had a mean age ± SD of 74±12 years. The most common diagnosis was total knee replacement (n=32), followed by hip fracture (n=23) and other lower limb fractures (n=21). The mean FIM score ± SD on admission was 82±15 out of 126, the mean motor component FIM score ± SD was 14±6 out of 35, and the mean cadence ± SD was 60±23 steps per minute. Nineteen participants (18%) were classified as independently mobile; the remaining participants required assistance to walk (table 1). The groups appeared well matched.

Intervention

Apart from 1 participant who died, all participants in the experimental group received additional Saturday PT and OT.

Table 1: Patient Characteristics

Characteristics	Experimental (n=51)	Control (n=54)	Total (n=105)
Men/women	14/37	19/35	33/72
Age (y)	75±12	73±13	74±12
Walking status on admission			
Independent	11	8	19
Supervision/assistance	40	46	86
FIM score on admission			
Total	85±12	80±18	82±15
Motor	14±5	13±7	14±6
Charlson Comorbidity Index score	1±1	1±1	1±1
10mWT cadence (steps/min)	63±25	57±20	60±23
Diagnosis			
Hip fracture	8	15	23
Total hip replacement	9	7	16
Total knee replacement	15	17	32
Other lower limb fracture	12	9	21
Amputation	2	2	4
Other	5	4	9

NOTE. Values are n or mean ± SD.
Abbreviation: 10mWT, 10-m walk test.

Table 2: Results

Measures	Experimental (M–S Therapy)	Control (M–F Therapy)	Mean Difference (95% CI)	*P* From *t* Test	Mann-Whitney *U* (*P*)
Steps (mean/d)					
Overall	723±674	461±583	262 (19 to 506)	.04	.01
Saturday	755±748	326±470	428 (184 to 673)	<.01	<.01
Sunday	603±683	350±635	253 (−7 to 514)	.06	.02
Before Saturday	658±686	438±590	220 (−27 to 467)	.08	.03
After Saturday	730±690	447±574	283 (34 to 532)	.03	.02
Upright (mean h/d)					
Overall	1.3±0.9	1.1±0.8	0.2 (−0.1 to 0.6)	.18	.15
Saturday	1.5±1.0	1.0±1.0	0.5 (0.1 to 0.9)	.02	<.01
Sunday	1.3±1.0	0.8±0.8	0.4 (0.1 to 0.9)	.02	.02
Before Saturday	1.2±0.8	1.2±0.9	0.0 (−0.3 to 0.4)	.80	.61
After Saturday	1.5±1.0	1.1±0.8	0.4 (0.1 to 0.8)	.02	.02

NOTE. Values are mean ± SD or as otherwise indicated. Full data set (n=105) for all comparisons except Saturday (n=102; M-S n=50, M-F n=52), Sunday (n=101; M-S n=49, M-F n=52), and After Saturday (n=102; M-S n=50, M-F n=52). Before Saturday, before intervention; After Saturday, after intervention.
Abbreviations: M–F, Monday to Friday; M–S, Monday to Saturday.

No participant in the control group received Saturday PT or OT. Experimental group participants received significantly more therapy overall (mean, 8.1h/wk) than control group participants (mean, 5.7h/wk) (mean difference, 2.4h; 95% CI, 1.6–3.2). There was no statistical difference in the amount of therapy received on weekdays (mean difference, 0.5h; 95% CI, −0.3 to 1.3).

Steps

Overall, participants took relatively few steps per day (mean ± SD: 589±640 steps/d). Experimental group participants took 57%±27% more steps per day overall than participants in the control group (mean difference, 262 steps; 95% CI, 19–506). Participants in the experimental group also took more than twice as many steps than the control group participants on Saturdays (mean difference, 428 steps; 95% CI, 184–673). When only the days after receiving or not receiving the additional allied health services on Saturday were analyzed, the experimental group participants took 63%±28% more steps per day than the control group participants (mean difference, 283 steps; 95% CI, 34–532). Since the steps per day data were observed to be positively skewed, the equivalent nonparametric test was also conducted with similar results (table 2). Observed differences in steps per day before Saturday (mean difference, 220 steps; 95% CI, –27 to 467) approached but did not reach statistical significance.

Upright Time and Inactivity

All participants spent little time in upright activities (standing or stepping) per day (mean ± SD, 1.2±0.9h/d). Participants spent a mean ± SD of 22.9±1.0 hours sitting or lying per day. The experimental group participants spent 50%±20% more time in upright activities than control group participants on Saturdays (mean difference, 0.5h; 95% CI, 0.1–0.9). When comparing time spent in upright activities per day before Saturday, the differences between groups did not reach statistical significance (mean difference, 0.0h; 95% CI, −0.3 to 0.4). However, after the extra Saturday therapy, the experimental group spent 40%±17% more time in upright activities per day than control group participants (mean difference, 0.4h; 95% CI, 0.1–0.8).

PT and OT

Participants spent 4% of their time in PT or OT sessions (mean ± SD, 6.9±2.4h/wk) and took 35% of their total steps during these sessions. All participants were least active on Sundays when no therapy was provided. Overall, participants took 141 (95% CI, 67–214) fewer steps and spent 0.2 (95% CI, 0.1–0.3) less hours in upright activities on Sundays when compared with weekdays.

Subgroup Analyses

Participants who were independently mobile took 875 (95% CI, 601–1150) more steps per day and spent 0.8 (95% CI, 0.4–1.2) more hours in upright activities per day than participants who required assistance. Participants who underwent elective surgery spent 0.8 (95% CI, 0.5–1.1) more hours in upright activity per day than participants who had traumatic fracture. Participants younger than 65 years took significantly more steps per day than older participants (mean difference, 395 steps/d; 95% CI, 67–724). No interaction effects on activity between group allocation and ambulation status, diagnosis, or age reached statistical significance.

Adverse Events

One participant noted redness and minor itching from the dressing but did not withdraw from the trial and was able to wear the monitor for the full 7 days. There were no other trial-related adverse events.

DISCUSSION

Participants who received additional allied health rehabilitation on Saturdays were more active than those who did not receive any allied health rehabilitation on the weekend. In the days after the additional allied health rehabilitation on Saturday, participants in the experimental group spent 40% more time upright per day and took 63% more steps per day than those who received no weekend therapy. This finding of increased habitual physical activity after the extra therapy session suggests that the benefits of providing the additional therapy were not confined to that session when the extra therapy was provided.

We observed a trend approaching significance that experimental group participants took more steps per day than the control group participants before receiving the additional Saturday therapy. This may be because patients were not blinded to group allocation, and experimental group patients may have felt an expectation to do more habitual physical activity during rehabilitation because they knew they would be receiving ad-

ditional therapy. Another possible explanation is that therapists were not blinded to group allocation, which may have biased their treatment; however, there was no difference in amount of therapy provided between groups on weekdays.

In the current study, much of the activity took place within PT or OT sessions. Consistent with previous research,[28-31] inpatients spent limited amounts of time in therapy. Despite inpatients spending only 4% of their time in PT and OT, 35% of the steps they took were taken during this time. This disproportionate amount suggests that inpatients with lower limb orthopedic conditions were more active during therapy and spent relatively less time in self-directed activities. Previous observations have concluded that inpatients in rehabilitation spend little time in self-directed physical activity.[4,31] This is also supported by our results from Sundays where inpatients in both groups were least active.

Despite the group differences, overall participants were relatively inactive, taking a mean ± SD of 589±640 steps per day and spending a mean ± SD of 1.2±0.9 hours upright per day. Our results are similar to those of previous research where older adults in mixed inpatient rehabilitation settings spent 1.2[32] and 1.3[17] hours upright per day in comparison with older adults in the community who spent 5.5[17] and 6[32] hours upright per day. The number of daily steps of participants in our trial was less than 10% of the number of steps recommended for older adults[33] to maintain good health, suggesting that these low levels of habitual physical activity may put older adults in rehabilitation at risk of functional decline[34] and at risk of the secondary consequences of inactivity.[1] Although our results provide evidence that Saturday allied health services can be effective in increasing habitual physical activity, this strategy alone may not be sufficient to make clinically significant increases in physical activity levels.

A number of factors could contribute to low habitual activity levels in rehabilitation. It has been suggested that the rehabilitation environment and hospital routines are restrictive,[31] that the low functional level of patients in rehabilitation may limit self-directed habitual physical activity,[16] and that a lack of stimulation in hospital wards is a deterrent to habitual physical activity.[35] Participants in our study had a mean FIM of 82 and would have had the ability to participate in self-directed habitual physical activity. However, most participants required assistance to walk; this dependence on others may have contributed to the observed low levels of habitual physical activity.

It is apparent from this study that inpatients with lower limb orthopedic conditions need to be more active during rehabilitation. Strategies to facilitate this include group treatment sessions,[36] facilitating patients and caregivers to take responsibility for their therapy,[37] and changing the ward environment to encourage habitual physical activity. A change in the rehabilitation environment has been shown to reduce the amount of time patients spent by their bedside, but did not increase self-directed activity,[38] highlighting the need for encouragement and supervision.

Study Limitations

One limitation of the study is that the activity monitor used does not record steps with a cadence of less than 20 steps per minute and does not record activity in lying or sitting (eg, bed and sitting exercises). The ActivPAL, when tested on older people with impaired function,[21] underestimated step counts at slower walking speeds, but placement of the monitor on the nonaffected lower limb resulted in less underestimation. We placed monitors on the nonaffected lower limb to enhance accuracy, and the mean cadence of included participants was 60 steps per minute. In addition, it has been advocated that doing other nonstepping activity such as bed exercises should not be considered as mobilization or as a substitute for upright physical activity.[39] Our research design with random allocation means that any small estimation of steps would not be expected to affect between-group comparisons.

CONCLUSIONS

Additional allied health rehabilitation services on the weekend increased activity levels of patients who received it, not only on the weekend but also in the following days. However, patients with lower limb orthopedic conditions in inpatient rehabilitation may not be sufficiently active. Inpatients are most active during PT and OT sessions and do little habitual physical activity when not under the supervision of physical therapists or occupational therapists.

References

1. World Health Organization. Global recommendations on physical activity for health: 65 years and above. 2011. Available at: http://www.who.int/dietphysicalactivity/physical-activity-recommendations-65years.pdf. Accessed September 14, 2011.
2. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep 1985;100:126-31.
3. Bania T, Dodd KJ, Taylor N. Habitual physical activity can be increased in people with cerebral palsy: a systematic review. Clin Rehabil 2011;25:303-15.
4. Patterson F, Blair V, Currie A, Reid W. An investigation into activity levels of older people on a rehabilitation ward: an observational study. Physiotherapy 2005;91:28-34.
5. Choquette S, Hamel M, Boissy P. Accelerometer-based wireless body area network to estimate intensity of therapy in post-acute rehabilitation. J Neuroeng Rehabil 2008;5:11.
6. Campbell H. What percentage of time, out of their day, do stroke patients spend in active rehabilitation? [dissertation]. Glasgow: Glasgow Caledonian University; 1999.
7. Keith RA, Cowell KS. Time use of stroke patients in three rehabilitation hospitals. Soc Sci Med 1987;24:529-33.
8. Gillis A, MacDonald B. Deconditioning in the hospitalized elderly. Can Nurse 2005;101:16-20.
9. Beringer TR, Clarke J, Elliott JR, et al. Outcome following proximal femoral fracture in Northern Ireland. Ulster Med J 2006;75:200-6.
10. Koval KJ, Zuckerman JD. Functional recovery after fracture of the hip. J Bone Joint Surg Am 1994;76:751-8.
11. Schmalzried TP, Szuszczewicz ES, Northfield MR, et al. Quantitative assessment of walking activity after total hip or knee replacement. J Bone Joint Surg Am 1998;80:54-9.
12. Silva M, McClung CD, Dela Rosa MA, et al. Activity sampling in the assessment of patients with total joint arthroplasty. J Arthroplasty 2005;20:487-91.
13. Resnick B, Galik E, Boltz M, et al. Physical activity in the post-hip-fracture period. J Aging Phys Act 2011;19:373-87.
14. Peiris CL, Taylor NF, Shields N. Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. Arch Phys Med Rehabil 2011;92:1490-500.
15. Ada L, Mackey F, Heard R, Adams R. Stroke rehabilitation: does the therapy area provide a physical challenge? Aust J Physiother 1999;45:33-8.
16. Bear-Lehman J, Bassile CC, Gillen G. A comparison of time use on an acute rehabilitation unit: subjects with and without a stroke. Phys Occup Ther Geriatr 2001;20:17-27.
17. Smith P, Galea M, Woodward M, et al. Physical activity by elderly patients undergoing inpatient rehabilitation is low: an observational study. Aust J Physiother 2008;54:209-13.

18. Taylor NF, Brusco NK, Watts JJ, et al. A study protocol of a randomised controlled trial incorporating a health economic analysis to investigate if additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes. BMC Health Serv Res 2010;10:308.
19. Ryan CG, Grant PM, Tigbe WW, Granat MH. The validity and reliability of a novel activity monitor as a measure of walking. Br J Sports Med 2006;40:779-84.
20. Grant PM, Dall PM, Mitchell SL, et al. Activity-monitor accuracy in measuring step number and cadence in community-dwelling older adults. J Aging Phys Act 2008;16:201-14.
21. Taraldsen K, Askim T, Sletvold O, et al. Evaluation of a body-worn sensor system to measure physical activity in older people with impaired function. Phys Ther 2011;91:277-85.
22. Trost SG, McIver KL, Pate RR, Trost SG, McIver KL, Pate RR. Conducting accelerometer-based activity assessments in field-based research. Med Sci Sports Exerc 2005;37(11 Suppl):S531-43.
23. Hamilton BB, Granger CV. Disability outcomes following inpatient rehabilitation for stroke. Phys Ther 1994;74:494-503.
24. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. J Clin Epidemiol 1994;47:1245-51.
25. Smith MT, Baer GD. Achievement of simple mobility milestones after stroke. Arch Phys Med Rehabil 1999;80:442-7.
26. Hollman JH, Beckman BA, Brandt RA, et al. Minimum detectable change in gait velocity during acute rehabilitation following hip fracture. J Geriatr Phys Ther 2008;31:53-6.
27. Granat MH, Grant PM, Dall PM. Quantification of activity patterns of the elderly population in different care settings. In: Proceedings of the 4th World Conference of the International Society of Physical Medicine and Rehabilitation, June 10-14, 2007. Seoul (Republic of Korea): International Society of Physical Medicine and Rehabilitation; 2007.
28. Bernhardt J, Dewey H, Thrift A, Donnan G. Inactive and alone: physical activity within the first 14 days of acute stroke unit care. Stroke 2004;35:1005-9.
29. Lincoln NB, Willis D, Philips SA, Juby LC, Berman P. Comparison of rehabilitation practice on hospital wards for stroke patients. Stroke 1996;27:18-23.
30. Thompson R, McKinstry W. How do rehabilitation patients spend their days? An investigation into the effect of a group therapy programme on time use. N Z J Physiother 2009;37:122-6.
31. Tinson DJ. How stroke patients spend their days. An observational study of the treatment regime offered to patients in hospital with movement disorders following stroke. Int Disabil Stud 1989;11:45-9.
32. Grant PM, Granat MH, Thow MK, Maclaren WM. Analysing free-living physical activity of older adults in different environments using body-worn activity monitors. J Aging Phys Act 2010;18:13.
33. Tudor-Locke C, Washington TL, Hart TL. Expected values for steps/day in special populations. Prev Med 2009;49:3-11.
34. Brown CJ, Redden DT, Flood KL, et al. The underrecognized epidemic of low mobility during hospitalization of older adults. J Am Geriatr Soc 2009;57:1660-5.
35. Clissett P. The effect of recreational activities on older people's rehabilitation. Nurs Stand 2001;15(50):39-42.
36. De Weerdt W, Nuyens G, Feys H, et al. Group physiotherapy improves time use by patients with stroke in rehabilitation. Aust J Physiother 2001;47:53-61.
37. De Weerdt W, Feys H. Assessment of physiotherapy for patients with stroke. Lancet 2002;359:182-3.
38. Newall JT, Wood VA, Hewer RL, Tinson DJ. Development of a neurological rehabilitation environment: an observational study. Clin Rehabil 1997;11:146-55.
39. Bernhardt J, Indredavik B, Dewey H, et al. Mobilisation 'in bed' is not mobilisation. Cerebrovasc Dis 2007;24:157-8; author reply 159.

Supplier

a. ActivPAL activity monitor; PAL Technologies Ltd, 50 Richmond St, Glasgow G1 1XP, Scotland, UK.

Chapter 5

PATIENTS VALUE PATIENT-THERAPIST INTERACTIONS MORE THAN THE AMOUNT OR CONTENT OF THERAPY DURING INPATIENT REHABILITATION: A QUALITATIVE STUDY

5.1 INTRODUCTION

In Chapter 4 (Peiris et al 2012a) evidence was presented that patients who received additional Saturday rehabilitation were more active on Saturdays and on the days following the additional rehabilitation. However, quantitative data does not provide insight into how patients perceive inpatient rehabilitation and why those who were allocated to the intervention group were more active following the additional therapy. Two studies identified in Chapter 2 (Peiris et al 2011) investigated patient perceptions of additional therapy in the form of patient satisfaction surveys. After total knee replacement (Lenssen et al 2006), patients who received usual care physiotherapy and patients who received additional physiotherapy services were both equally highly satisfied with their physiotherapy treatment. However, after coronary artery bypass graft surgery (van der Peijl et al 2004) more patients in the additional physiotherapy group were satisfied with their treatment compared to the usual care physiotherapy group. Considering that patient perceptions and attitudes may have an impact on the outcomes of rehabilitation (Ohman 2005), the aim of Chapter 5 was to explore how patients receiving inpatient rehabilitation experienced receiving physiotherapy and whether their experience differed if they received additional weekend physiotherapy.

Chapter 5 is presented in its published form (Peiris et al 2012b):

Peiris CL, Taylor NF and Shields N (2012b): Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study. *Journal of Physiotherapy* 58: 261-268.

Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study

Casey L Peiris[1,2], Nicholas F Taylor[1,2] and Nora Shields[1]

[1]Department of Physiotherapy, La Trobe University, [2]Allied Health Clinical Research Office, Eastern Health Australia

Question: How do patients receiving inpatient rehabilitation experience physiotherapy and does their experience differ if they receive extra Saturday physiotherapy? **Design:** Qualitative study using in-depth interviews and thematic analysis. Interviews were audio-taped, transcribed, member checked and coded independently by two researchers. Data were triangulated using published quantitative data. **Participants:** Nineteen adults undergoing inpatient rehabilitation for neurological and musculoskeletal impairments who received either usual care (Monday to Friday therapy) or additional Saturday therapy. **Results:** One main theme (personal interactions), and five sub-themes (empathetic and caring physiotherapists, socialisation with other patients, alleviated boredom, changed perceptions of the weekend, and contentment with amount of therapy) emerged from the data. Patients valued interacting with physiotherapists and other patients. Patients were content with the amount of physiotherapy whether or not they had additional Saturday physiotherapy. However, having additional Saturday physiotherapy changed the patients' perceptions of Saturdays; patients who received Saturday physiotherapy viewed Saturday as a day where they would be working towards improving their function, while patients who did not receive Saturday physiotherapy expected to rest on the weekend. **Conclusion:** The patient-therapist interaction was more important to the patient than the amount or content of their physiotherapy, but Saturday therapy changed patients' perceptions of weekends in rehabilitation. **[Peiris CL, Taylor NF, Shields N (2012) Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study. *Journal of Physiotherapy* 58: 261–268]**

Key words: Physical therapy specialty, Qualitative research, Professional-patient relations

Introduction

During rehabilitation, inpatients spend relatively little time receiving therapy (Bernhardt et al 2004, Thompson and McKinstry 2009). Additional physiotherapy reduces length of stay and improves mobility, activity, and quality of life for people in acute and rehabilitation settings (Peiris et al 2011). Additional physiotherapy services can be provided by health services on the weekends to increase physiotherapy contact, which may reduce length of stay and increase efficiency (Brusco et al 2007). Although providing extra physiotherapy may improve patient outcomes, little is known about how patients feel about receiving or not receiving extra physiotherapy rehabilitation services.

Patient perceptions and attitudes are important because they may influence the outcomes of rehabilitation (Ohman 2005). Therefore, to provide effective rehabilitation, physiotherapists need to be aware of the elements of rehabilitation that are important to their patients (Galvin et al 2009). Previous qualitative research conducted on the experience of physiotherapy in stroke units suggests that patients would often like more physiotherapy than they receive (Galvin et al 2009, Lewinter and Mikkelsen 1995) and that an area of dissatisfaction identified by patients and their carers was the amount of physiotherapy (Wiles et al 2002). However, these qualitative studies have been limited to the perceptions of patients with stroke and have not investigated whether receiving an increased amount of physiotherapy changes patients' perceptions.

An indication of patient perceptions on increasing the amount of physiotherapy during rehabilitation can be derived from published patient satisfaction surveys. Following stroke, more patients preferred receiving allied health therapy 6 days/week compared to 7 days/week (Ruff et al 1999). After coronary artery bypass graft surgery, more patients preferred receiving physiotherapy 7 days/week compared 5 days/week (van der Peijl et al 2004). However, following

What is already known on this topic: Patient perceptions and attitudes are important because they may influence the outcomes of rehabilitation.

What this study adds: Interactions with the therapist and other patients are valued by inpatients receiving rehabilitation. These factors appear to be more important to patients than the amount of therapy received. Saturday physiotherapy was not only viewed as a positive experience but it changed patients' expectations so that they thought every day was for rehabilitation.

total knee joint replacement, patients were equally satisfied with the standard (once/day) and an augmented (twice/day) physiotherapy service (Lenssen et al 2006). These patient satisfaction surveys are limited because they do not explore the broad range of feelings and experiences that patients report about their rehabilitation (Wain et al 2008). An alternative method of evaluating patient experiences, through in-depth interviews, may provide a more complete understanding of the patient experience of physiotherapy rehabilitation and how this was influenced by the provision of extra physiotherapy sessions. Therefore, the specific research questions were:

1. How do inpatients in a rehabilitation setting experience physiotherapy rehabilitation? and
2. Does their experience differ if they receive additional Saturday physiotherapy services?

Method

Design

Qualitative research methods using in-depth interviews were chosen as they provide a means of exploring the experience of additional Saturday physiotherapy in rehabilitation from the perspective of the patients.

Participants

Participants were recruited from a 60-bed inpatient rehabilitation centre that is the main rehabilitation centre in a health service providing services for more than 800 000 people in metropolitan and outer metropolitan areas. A mixed sample of patients was chosen to reflect the diversity of patients in public rehabilitation settings. From a health service perspective, rehabilitation centres usually treat patients with a variety of conditions, therefore the opinions of patients with different diagnoses were sought. To gain an in-depth understanding of patient experiences, which relies on individuals who are able to provide rich accounts of their experiences, a purposive sampling technique was used to select both men and women who had a variety of different diagnoses. Patients were included if they were inpatients in the rehabilitation centre, enrolled in a randomised controlled trial investigating the effects of additional Saturday rehabilitation services, randomly allocated to receive either usual care physiotherapy from Monday to Friday (5 days/week) or from Monday to Saturday (6 days/week) (Taylor et al 2010), and had been admitted for at least 9 days (to ensure they had been in the centre for at least two Saturdays). Exclusion criteria included a diagnosis of receptive or expressive dysphasia and cognitive impairment as patients with these conditions may have found it difficult to participate in an in-depth interview. Potentially eligible patients were approached in person by a clinician who was not involved in delivery of their rehabilitation.

Data collection

In-depth interviews were used for data collection as they are considered the most suitable way of generating rich data about experiences by allowing individuals to tell their stories in detail (Kvale 2007). A pre-interview (Paterson and Bramadat 1992) was conducted with each patient at their bedside one day prior to their recorded in-depth interview to capture the patient's interest in and commitment to the research project. During the pre-interview patients were informed of the aims of the research and were told the topic areas (Table 1) that they would be asked about so that they could prepare for the interview. The audio-recorded, in-depth interviews were conducted in a meeting room in the rehabilitation centre. Experience of physiotherapy rehabilitation was investigated by asking questions in relation to general feelings, likes and dislikes and comments on the amount of physiotherapy they received. An interview schedule (see Table 1) was used as a flexible guide to ensure all topics of interest were covered while allowing patients to tell their own stories in the order that they preferred.

Table 1. In-depth interview questions.

Topic area Aim	Sample questions
Physiotherapy rehabilitation	
Participants to discuss their overall view of physiotherapy	• In your own words, can you please tell me about your experience of physiotherapy? • What did you like about physiotherapy? What didn't you like about physiotherapy? • What changes/progress have you made during your time here? • Is there anything you would like to change about your physiotherapy rehabilitation here?
Amount of physiotherapy	
Participants to describe whether they feel they get enough therapy	• What did you think about the amount of physiotherapy you received? • What did you think of the extra physiotherapy (or not receiving the extra physiotherapy) on Saturdays?
Saturdays in rehabilitation	
Participants to discuss their experiences of Saturdays in-depth Participants who received Saturday therapy to discuss their experiences of the service	• What did you think about the Saturday physiotherapy? • What did you like about the Saturday physiotherapy/not getting Saturday physiotherapy? • What didn't you like about Saturday physiotherapy/not getting Saturday physiotherapy? • What did you think about going/not going to the gym on the weekend? • What did you feel about having a different therapist on the weekend? • Is there anything else you would like to share about your experience of physiotherapy or Saturday physiotherapy? • Did getting/not getting physiotherapy on Saturday make any differences to what you would normally do on Saturday?

Some questions differed depending on whether the patient received Saturday physiotherapy. The same researcher (CP), who was not involved in the patient's rehabilitation, conducted all interviews and pre-interviews.

Data analysis

All recorded data from the interviews were transcribed verbatim. The transcribed interviews and the researchers' initial interpretation of the emerging themes (eg, physiotherapists were friendly) were then given to the patients to check for accuracy. Member checking helps to ensure that both the transcript and the researchers' interpretations are an accurate representation of the patient's experience (Liamputtong 2009). If patients did not agree with the transcripts or interpretation they were given the opportunity to amend them. Once the transcripts were returned to the researchers, all patients were assigned an ID number and transcripts were de-identified to ensure anonymity.

Data collection and data analysis occurred almost simultaneously to help with sampling and refining tentative categories. After member checking of transcripts and initial themes was completed by patients, the transcripts were then read in their entirety by two researchers who examined the data line-by-line and independently assigned codes (eg, personal interactions, motivation, and boredom) to sections of text. The next step was to look at connections and comparisons between codes to develop themes and sub-themes. After codes were assigned and themes were identified independently, the researchers met to discuss these until consensus was reached. If consensus was unable to be reached a third researcher was available to help resolve any discrepancies. The researchers then decided on a main theme and re-read the transcripts to selectively search for data related to the identified themes (selective coding). When the final list of themes was agreed, the transcripts were then re-read to ensure no participant perspectives had been overlooked during coding and thematic development. The penultimate step was to find links and relationships between the themes and the final step was the formulation of theory.

To achieve methodological rigour, rich accounts of the population (for transferability) and research method (for dependability) were recorded. Purposive sampling techniques and the presentation of multiple viewpoints held by patients were used to increase credibility. Documentation of coherent links between collected data and generated themes (using verbatim quotations from the patients as evidence) and member checking (to validate the transcripts and researchers' interpretation) were completed for confirmability. The research process was documented in detail and preserved so that an audit trail was possible. Finally, the results of the qualitative analysis were triangulated against quantitative results from a independent group of patients (n = 105) from the same setting who were enrolled in the same randomised controlled trial of providing additional Saturday rehabilitation (Peiris et al 2012).

As researchers cannot avoid taking their own experiences with them into the research process (Johnson and Waterfield 2004) brief summaries of the researcher's backgrounds are provided to enhance reflexivity. The principal researcher (CP) was a physiotherapist at the rehabilitation centre and was not involved in the treatment of the patients. The other researchers (NT and NS) were physiotherapists, worked at an affiliated university, and had experience in qualitative research.

Results

Participants

Nineteen of the 20 patients invited to participate took part in the study, 11 of whom received the extra Saturday therapy. One participant could not take part in the study as she was discharged home prior to the scheduled interview. The mean age of the participants was 77 years (range 60–92). Sixteen participants were women, 14 had an orthopaedic condition (most commonly total hip replacement) and five had a neurological condition (most commonly stroke) (see Table 2). All participants had experienced at least two Saturdays at the rehabilitation centre. The average length of stay in the rehabilitation centre at the time of interview was 27 days (range 14–78). All participants agreed with their transcripts and the researchers' interpretation of emerging themes so only one round of member-checking was completed.

Physiotherapists

Nine physiotherapists (5 women), median age 25 years (IQR 24 to 32) were involved in the care of the interviewed patients. Five of these were junior physiotherapists (aged 21–25 years with one month to two years of professional experience) and four were senior physiotherapists (aged 27–51 years with 4–28 years of professional experience). The physiotherapists had been working in their profession for a median of 2.5 years (IQR 1.8 to 8) and had worked at the rehabilitation centre for a median of 1 year (IQR 0.5 to 3.3).

Main Theme

Personal interactions: The rehabilitation experience was reported as a new and foreign experience to most of the patients interviewed. Patients appeared to focus on what was familiar to them, that is, the personal attributes of those they interacted with and the subsequent interactions that occurred and not the content or outcomes of physiotherapy rehabilitation. Patients seemed to associate physiotherapy with two main factors: personal attributes of their physiotherapists, and interaction with staff and other patients during physiotherapy. When questioned about the amount of therapy they received (including Saturday therapy), patients' responses were linked to their feeling towards the personal attributes of their physiotherapists. Therefore personal interactions with therapists and other patients was our main theme and all sub-themes related back to personal interactions in some way (see Box 1).

Box 1. Main theme and sub-themes for patients' experience of physiotherapy rehabilitation and Saturday physiotherapy.

Personal interactions

Empathetic and caring physiotherapists
- Encouraging and motivational
- Made physiotherapy a positive experience

Socialisation with other patients
- Motivational

Alleviated boredom
- Friendly physiotherapists and patients
- Saturday physiotherapy broke the monotony of the weekend

Changed perceptions of weekends in rehabilitation
- An extension of weekdays in rehabilitation

Contentment with amount of therapy
- Therapist knows best

Table 2. Patient characteristics.

Participant number	Sex	Age	Diagnoses	Group allocation	LOS at time of interview (days)
1	F	73	Guillian-Barre Syndrome	M–F	45
2	F	82	# surgical neck of humerus	M–F	33
3	F	67	THR	M–F	14
4	F	75	Stroke	M–F	78
5	M	87	TKR	M–F	19
6	F	76	Hip fracture	M–F	15
7	F	81	Lower limb weakness	M–F	15
8	F	83	THR	M–F	22
9	F	92	# femur and # olecranon	M–S	15
10	F	76	# tibial plateau	M–S	26
11	F	78	Stroke	M–S	21
12	F	74	Hip fracture	M–S	36
13	F	87	below knee amputation	M–S	28
14	M	74	THR	M–S	14
15	M	64	Stroke	M–S	46
16	F	72	TKR	M–S	14
17	F	60	TKR	M–S	14
18	F	79	THR	M–S	16
19	F	76	# ankle	M–S	38

LOS = length of stay, F = female, M = male, # = fracture, THR = total hip replacement, TKR = total knee replacement, M–F = Monday to Friday, M–S = Monday to Saturday

Sub-themes

Patients valued empathic and caring physiotherapists. Patients expressed positive attitudes towards their physiotherapists. They reported that their physiotherapists were friendly, knowledgeable, and compassionate:

> *So kind and professional, and caring, and they definitely know what they're doing.* (P18)

> *The physios, they are lovely, they help you and are always friendly.* (P19)

> *They understand your problem – which a lot don't understand it. These people understand your problem and they help you when you can't do it.* (P3)

Patients also said their physiotherapists were a source of motivation:

> *Their morale and their energy towards patients is fantastic … They really are on your side and they really do want you to get better and, you know, power on!* (P17)

and described having therapy with them as a positive experience:

> *When I came back I always felt much better. And that's why I always looked forward to each session – I really did!* (P9)

Socialisation with other patients during therapy was motivational. Patients said that they welcomed the social component of their physiotherapy rehabilitation. They talked about sharing the rehabilitation experience with other patients in the gym environment, and felt that it made the whole experience more enjoyable:

> *You make friends very quickly in the gym.* (P17)

> *And I think mixing with all the people helps you recover a lot quicker.* (P10)

Patients reported that they valued the encouragement that other patients provided during therapy:

> *We encourage each other, and pat each other on the back.* (P17)

> *We talk about everything and they're encouraging. They say 'You've done a good job today' or 'You're doing better', things like that.* (P8)

Socialising with and receiving encouragement from the other patients was perceived to create a motivational atmosphere in the gym:

> *You might think 'Oh, I'd rather have a little doze' (laughs) but then you get down amongst everything and you come to life'.* (P18)

Physiotherapy alleviated boredom. Patients commented that they found being in rehabilitation *a bit boring* (P14) and that the interactions that occurred during physiotherapy helped to alleviate the boredom:

It's lovely. They're all friendly, they all want to talk, which passes the time. (P8)

The gym environment, possibly facilitated by the physiotherapists, encouraged social interaction. Although patients stated that they enjoyed interacting with other patients in the gym, they did not appear to do this on the wards:

Really, I don't mix up with anybody. Except the persons in the gym. Make a lot of friends there. (P5)

When reflecting on their weekends without physiotherapy sessions, patients commented:

It does get boring. (P8)

All you do is eat and sleep. (P1)

Physiotherapy on Saturdays was seen as a break from the monotony of the wards over the weekend and patients felt that it provided purpose to their day and eased their boredom:

Oh, well, it's a great idea really, because you do get a little bored just sitting around up there. (P18)

I find it's a break from the monotony – from being sitting in a chair all day long. (P19)

Saturday therapy changed patients' perceptions of rehabilitation on the weekend. Patients who received Monday to Saturday therapy perceived Saturday as an extension of their weekday rehabilitation and it was *just another physio day* (P12). Patients reported that they liked Saturday physiotherapy sessions for the same reasons they liked weekday physiotherapy sessions: interaction with therapists, socialisation with other patients and motivation to participate. In addition, they also reported that there wasn't a break in therapy:

Oh, I think it kept the flow, I really do. I think after two days off the muscles would be back flopping everywhere and so forth. (P11)

Because you could stiffen up I guess if there's nothing in between. (P18)

Because if you have two days not doing any physio, you know, I think you slow up again and you forget about what you're supposed to be doing. (P16)

For patients who received Monday to Saturday physiotherapy, the interactions that occurred on Saturdays appeared to create an expectation that physiotherapy should be part of every day in rehabilitation, which seemed to help patients accept and embrace the additional physiotherapy.

Patients who received Monday to Friday physiotherapy reported different perceptions of what the weekends were for. They did not feel like Saturday was a typical rehabilitation day:

Um, I think in our minds, Saturday and Sunday are days that you just don't do things like that. (P7)

Instead patients reported they would be entertaining visitors or doing sedentary activities on the weekend:

I have visitors and that's important too. (P4)

Um, sleep. (P1)

Ah, precious little you could say (laughs). (P7)

Oh, watch television, that's it. (P5)

These patients said they were concerned that they would not get enough rest if they received additional physiotherapy:

That's enough for me at the moment. I couldn't cope with any more because I get so very tired. (P4)

This was in contrast to patients who did receive physiotherapy on Saturdays who reported that they got enough rest already:

Plenty of rest (laughs). Too much rest (laughs). (P13)

You get plenty of rest. Plenty of it! (P19)

Contentment with the amount of physiotherapy; after all, therapist knows best! Most patients had not given much thought to the amount of physiotherapy they received but when asked they responded that they were content with the amount of physiotherapy provided regardless of whether or not they received Saturday physiotherapy:

As far as I'm concerned that physio was very adequate and just what I needed. (P13)

They appeared not to associate the amount of therapy they received with their progress, and reported that they trusted their physiotherapists to choose how much therapy they needed:

But they know. They know how much. (P5)

I think they did it to what they really knew we should be having. (P9)

However, there were some patients who received Monday to Friday physiotherapy who would have preferred to receive more physiotherapy:

I was a bit disappointed. I would like to have had (physiotherapy) on the weekend. (P8)

I sometimes think it could be a bit more. (P7)

Patients who received Monday to Saturday physiotherapy reported that more therapy would be even more beneficial to their progress (and would help reduce boredom):

I tend to assume that the more I get the better. (P15)

Well, it sounds as though I'm being greedy, but I'd choose twice a day. Because it gets me moving and it's good for my leg. The more I use it, the better it feels. (P9)

I'd sooner do seven days rather than, you know, 'cause as I'm saying, Sundays, what do you do? (P14)

Perhaps this was because they had an expectation that every day in rehabilitation should involve physiotherapy.

Triangulation with quantitative data

Most of the qualitative findings of the current study converge with the quantitative results from an independent group of patients receiving Saturday therapy in the same setting (Peiris et al 2012) (Table 3). Quantitative results confirmed

Table 3. Triangulation of the qualitative findings with the quantitative findings from Peiris et al (2012).

Theme	Qualitative findings	Quantitative findings	Triangulation
Motivation during therapy	Patients reported that therapists and other patients provided encouragement and motivation to be active in the gym during physiotherapy.	Despite spending only 4% of their time in therapy, 35% of the steps patients took were taken during therapy. Patients who received M–S therapy took more than twice as many steps on Saturdays than patients who received M–F therapy, mean difference 428 steps (95% CI 184 to 673), and spent 50% more time in upright activities, mean difference 0.5 hours (95% CI 0.1 to 0.9).	Convergent
Sedentary activity outside of therapy	Patients reported boredom and participating in sedentary activities when not receiving therapy.	All patients were least active on Sundays (when no therapy was provided) when they took 141 fewer steps (95% CI 67 to 214) compared to weekdays.	Convergent
Changed perceptions of weekends in rehabilitation	Patients who received M–S therapy felt that the weekends were as important as weekdays for rehabilitation.	As well as being more active on Saturdays, patients who received M–S therapy took an extra 253 steps (95% CI –7 to 514) and spent an extra 0.4 hours (95% CI 0.1 to 0.9) upright on Sunday when no therapy was provided compared to patients who received M–F therapy.	Convergent
	Patients who received M–F therapy felt the weekends were important for resting.	Patients who received M–F therapy were least active on the weekends.	Convergent
	Patients who received M–F therapy feared they wouldn't get enough rest if they had additional therapy on Saturday.	Patients spent a mean of 22.9 hours (SD 1.0) sitting or lying down each day.	Divergent

M–S = Monday to Saturday, M–F = Monday to Friday, CI = confidence interval, SD = standard deviation

that patients who reported being motivated during therapy were more physically active during therapy and that patients were sedentary outside of therapy and did indeed get 'plenty of rest'. The changed perceptions of the weekend that patients in this study reported converge with results from the quantitative study where patients who received Saturday therapy were more active on both Saturdays and on Sundays (when they did not receive any therapy) compared to those who received Monday to Friday therapy.

Discussion

Personal interaction with their physiotherapists and other patients in the gym was the main reason that participants described positive experiences of physiotherapy rehabilitation. In agreement with previous research conducted in a neurological rehabilitation setting (Wain et al 2008), daily interactions with staff and other patients were viewed as pleasurable experiences for the participants and were considered important to their recovery. Participants reported valuing the attributes of their physiotherapists more than the amount or content of the physiotherapy they received. This finding is consistent with a previous study in a private practice setting, which identified communication ability and other personal attributes of physiotherapy staff as more important than the content or outcome of treatment (Potter et al 2003). The results of our study reinforce the importance of personal interactions in the patients' experience of physiotherapy treatment in rehabilitation suggesting that development of communication skills may be important for physiotherapists who work in rehabilitation.

In contrast to previous research in stroke (Galvin et al 2009, Lewinter and Mikkelsen 1995, Wiles et al 2002) most participants in this study reported contentment with the amount of physiotherapy they received regardless of whether they received physiotherapy on Saturday. Our study included participants with a variety of conditions requiring physiotherapy and who may have different views. Patients with orthopaedic conditions, for example, may not want more physiotherapy if their condition is associated with pain as they recover from injury or surgery. In our study, however, participants with stroke did not differ in their views when compared to participants with orthopaedic or other conditions. Participants with stroke were mostly happy with the amount of therapy and equally as likely to want more physiotherapy as patients with orthopaedic or other conditions. Another possible reason that results differ is that participants in our study were still receiving physiotherapy at the time the interviews were conducted and were not reflecting back after therapy had finished.

Participants in our study said they were happy to let their physiotherapists decide how much therapy they received and reported that they trusted their therapists as experts and had faith that they would do what was best for them. This may be indicative of our sample of older adults who are of the generation who simply believe that 'doctor knows best' (Hovenga and Kidd 2010) in contrast to younger patients who may be less accepting of authority.

Some participants who received Monday to Friday therapy were happy with the amount of physiotherapy because they feared they would not be able to cope with any more due to fatigue. Participants who received Saturday physiotherapy were more likely to advocate for even more intensive therapy, possibly due to the fact that they knew they could manage the additional physiotherapy without negative consequences and they had different expectations of what weekends in rehabilitation should comprise. Quantitative

data from an independent group of patients in the same setting (Peiris et al 2012) found those who received extra Saturday therapy were more active over the entire weekend (including Sunday when no therapy was received) than those who did not receive Saturday therapy. This supports the notion that patients who received Monday to Friday physiotherapy felt it was important to rest on the weekend while those who received extra Saturday therapy had the expectation to keep working on their rehabilitation goals throughout the weekend.

Boredom is a common complaint in hospitalised adults (Clissett 2001) and it emerged as a sub-theme in how the participants experienced physiotherapy. Quantitative results (Peiris et al 2012) confirmed that patients were most active during therapy (where patients reported that interacting with others was enjoyable and motivational) and were sedentary outside of therapy (where patients reported boredom). Additional Saturday physiotherapy extended therapy time and helped ease boredom on the weekend. Following cardiovascular surgery patients reported higher satisfaction levels when receiving weekend physiotherapy as they felt they had more time to communicate with their therapists (van der Peijl et al 2004). Participants reported liking additional weekend physiotherapy for all the same reasons they liked regular weekday physiotherapy; it eased boredom and enabled interaction with therapists and other patients.

Participants who received Saturday physiotherapy enjoyed it, engaged actively in it, and had changed perceptions of what weekends were for in rehabilitation so that they felt they should be actively participating in rehabilitation over the weekend. Results from associated quantitative data indicate that Saturday therapy increased physical activity levels (Peiris et al 2012). Providing additional Saturday physiotherapy in a mixed rehabilitation setting may also reduce length of stay (Brusco et al 2007). These positive results for the patient and the health service provide support for the provision of Saturday physiotherapy in rehabilitation centres if resources allow. Clinicians cannot conclude that their patients are getting enough therapy simply because they are 'satisfied' because satisfaction is a result of interactions, trust, and a lack of expectations during rehabilitation. Clinicians can, however, be assured that their patients will be happy and more active and may get home sooner if Saturday physiotherapy is provided.

This study's qualitative findings are not necessarily generalisable (Wiles et al 2002). Situations are experienced differently depending on who is experiencing them. Therefore the findings of this study are specific to the patients who were interviewed. However purposive sampling was undertaken to include a diverse population, recruitment continued to saturation, and accurate accounts of the population have been provided to enhance transferability of the findings to similar patient groups. Although quantitative data used for triangulation was obtained from an independent group of patients in the same setting, it was in agreement with the qualitative data in this study indicating a degree of transferability.

Obtaining the perspectives of patients experiencing inpatient rehabilitation is a valuable way of evaluating physiotherapy services. The results of this study suggest that personal interactions with the therapist and other patients are important contributors to the patient experience of rehabilitation. These factors appear to be more important to patients than the amount of therapy received. Saturday physiotherapy was not only viewed as a positive experience but it changed patients' expectations so that they thought every day was for rehabilitation. ■

Ethics: Eastern Health and La Trobe University Ethics Committees approved this study. All participants gave written informed consent before data collection began.

Competing interests: The authors declare no conflict of interest related to this work.

Correspondence: Ms Casey Peiris, Allied Health Clinical Research Office, Eastern Health, VIC Australia. Email: Casey.Peiris@easternhealth.org.au

References

Bernhardt J, Dewey H, Thrift A, Donnan G (2004) Inactive and alone: physical activity within the first 14 days of acute stroke unit care. *Stroke* 35: 1005–1009.

Brusco NK, Shields N, Taylor NF, Paratz J (2007) A Saturday physiotherapy service may decrease length of stay in patients undergoing rehabilitation in hospital: a randomised controlled trial. *Australian Journal of Physiotherapy* 53: 75–81.

Clissett P (2001) The effect of recreational activities on older people's rehabilitation. *Nursing Standard* 15: 39–42.

Galvin R, Cusack T, Stokes E (2009) Physiotherapy after stroke in Ireland: a qualitative insight into the patients' and physiotherapists' experience. *International Journal of Rehabilitation Research* 32: 238–244.

Hovenga EJS, Kidd ML (Eds) (2010) Health informatics: an overview. Amsterdam: IOS Press BV.

Johnson R, Waterfield J (2004) Making words count: the value of qualitative research. *Physiotherapy Research International* 9: 121–131.

Kvale S (2007) Doing interviews. London: Sage.

Lenssen AF, Crijns YH, Waltje EM, van Steyn MJ, Geesink RJ, van den Brandt PA, et al (2006) Efficiency of immediate postoperative inpatient physical therapy following total knee arthroplasty: an RCT. *BMC Musculoskeletal Disorders* 7: 71.

Lewinter M, Mikkelsen S (1995) Patients' experience of rehabilitation after stroke. *Disability & Rehabilitation* 17: 3–9.

Liamputtong P (2009) Qualitative research methods (3rd edn). Hong Kong: Oxford University Press.

Ohman A (2005) Qualitative methodology for rehabilitation research. *Journal of Rehabilitation Medicine* 37: 273–280.

Paterson B, Bramadat I (1992) Use of the preinterview in oral history. *Qualitative Health Research* 2: 99–115.

Peiris CL, Taylor NF, Shields N (2011) Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. *Archives of Physical Medicine & Rehabilitation* 92: 1490–1500.

Peiris CL, Taylor NF, Shields N (2012) Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation* 93: 1365–1370.

Potter M, Gordon S, Hamer P (2003) The physiotherapy experience in private practice: the patients' perspective. *Australian Journal of Physiotherapy* 49: 195–202.

Ruff RM, Yarnell S, Marinos JM (1999) Are stroke patients discharged sooner if in-patient rehabilitation services are provided seven v six days per week? *American Journal of Physical Medicine & Rehabilitation* 78: 143–146.

Taylor NF, Brusco NK, Watts JJ, Shields N, Peiris C, Sullivan N, et al (2010) A study protocol of a randomised controlled trial incorporating a health economic analysis to investigate if additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes. *BMC Health Services Research* 10: 308–314.

Thompson R, McKinstry W (2009) How do rehabilitation patients spend their days? An investigation into the effect of a group therapy programme on time use. *New Zealand Journal of Physiotherapy* 37: 122–126.

van der Peijl ID, Vliet Vlieland TP, Versteegh MI, Lok JJ, Munneke M, Dion RA (2004) Exercise therapy after coronary artery bypass graft surgery: a randomized comparison of a high and low frequency exercise therapy program. *Annals of Thoracic Surgery* 77: 1535–1541.

Wain HR, Kneebone II, Billings J (2008) Patient experience of neurologic rehabilitation: a qualitative investigation. *Archives of Physical Medicine & Rehabilitation* 89: 1366–1371.

Wiles R, Ashburn A, Payne S, Murphy C (2002) Patients' expectations of recovery following stroke: a qualitative study. *Disability & Rehabilitation* 24: 841–850.

Chapter 6

ADDITIONAL SATURDAY REHABILITATION IMPROVES FUNCTIONAL INDEPENDENCE AND QUALITY OF LIFE AND REDUCES LENGTH OF STAY: A RANDOMISED CONTROLLED TRIAL

6.1 INTRODUCTION

Chapters 2 to 5 provided evidence that additional weekend rehabilitation may improve patient outcomes, increase levels of physical activity and change patient perceptions of rehabilitation. The systematic review and meta-analysis in Chapter 2 suggested that extra physiotherapy had beneficial effects for patients with a variety of acute and sub-acute health conditions but most of the included trials alone did not show significant effects. Additionally, the review included only one trial that was conducted in a mixed rehabilitation setting and two trials (n=166) that also provided extra occupational therapy services. Considering the important role that occupational therapists have in rehabilitation and the focus on mixed rehabilitation settings in this thesis, there is a lack of evidence evaluating the effects of additional rehabilitation services (particularly physiotherapy and occupational therapy) in mixed rehabilitation populations.

The aim of this chapter was to determine whether providing additional rehabilitation services on a Saturday improved functional outcomes for patients with a variety of health conditions.

Chapter 6 is presented in its published form (Peiris et al 2013b):

Peiris CL, Shields N, Brusco NK, Watts JJ and Taylor NF (2013b): Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial. *BMC Medicine* 11: 198 doi: 10.1186/1741-7015-11-198

Peiris et al. BMC Medicine 2013, 11:198
http://www.biomedcentral.com/1741-7015/11/198

BMC Medicine

RESEARCH ARTICLE Open Access

Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial

Casey L Peiris[1,2*], Nora Shields[1,3], Natasha K Brusco[1,4], Jennifer J Watts[5] and Nicholas F Taylor[1,2]

Abstract

Background: Many inpatients receive little or no rehabilitation on weekends. Our aim was to determine what effect providing additional Saturday rehabilitation during inpatient rehabilitation had on functional independence, quality of life and length of stay compared to 5 days per week of rehabilitation.

Methods: This was a multicenter, single-blind (assessors) randomized controlled trial with concealed allocation and 12-month follow-up conducted in two publically funded metropolitan inpatient rehabilitation facilities in Melbourne, Australia. Patients were eligible if they were adults (aged ≥18 years) admitted for rehabilitation for any orthopedic, neurological or other disabling conditions excluding those admitted for slow stream rehabilitation/ geriatric evaluation and management. Participants were randomly allocated to usual care Monday to Friday rehabilitation (control) or to Monday to Saturday rehabilitation (intervention). The additional Saturday rehabilitation comprised physiotherapy and occupational therapy. The primary outcomes were functional independence (functional independence measure (FIM); measured on an 18 to 126 point scale), health-related quality of life (EQ-5D utility index; measured on a 0 to 1 scale, and EQ-5D visual analog scale; measured on a 0 to 100 scale), and patient length of stay. Outcome measures were assessed on admission, discharge (primary endpoint), and at 6 and 12 months post discharge.

Results: We randomly assigned 996 adults (mean (SD) age 74 (13) years) to Monday to Saturday rehabilitation (n = 496) or usual care Monday to Friday rehabilitation (n = 500). Relative to admission scores, intervention group participants had higher functional independence (mean difference (MD) 2.3, 95% confidence interval (CI) 0.5 to 4.1, $P = 0.01$) and health-related quality of life (MD 0.04, 95% CI 0.01 to 0.07, $P = 0.009$) on discharge and may have had a shorter length of stay by 2 days (95% CI 0 to 4, $P = 0.1$) when compared to control group participants. Intervention group participants were 17% more likely to have achieved a clinically significant change in functional independence of 22 FIM points or more (risk ratio (RR) 1.17, 95% CI 1.03 to 1.34) and 18% more likely to have achieved a clinically significant change in health-related quality of life (RR 1.18, 95% CI 1.04 to 1.34) on discharge compared to the control group. There was some maintenance of effect for functional independence and health-related quality of life at 6-month follow-up but not at 12-month follow-up. There was no difference in the number of adverse events between the groups (incidence rate ratio = 0.81, 95% CI 0.61 to 1.08).

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* Correspondence: Casey.Peiris@easternhealth.org.au
[1]Department of Physiotherapy, La Trobe University, Melbourne, Victoria, Australia
[2]Allied Health Clinical Research Office, Eastern Health, Box Hill, Victoria 3128, Australia
Full list of author information is available at the end of the article

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Conclusions: Providing an additional day of rehabilitation improved functional independence and health-related quality of life at discharge and may have reduced length of stay for patients receiving inpatient rehabilitation.

Trial registration: Australian and New Zealand Clinical Trials Registry ACTRN12609000973213

Please see related commentary: http://www.biomedcentral.com/10.1186/1741-7015-11-199.

Keywords: Occupational therapy, Physiotherapy, Rehabilitation, Quality of life

Background

Rehabilitation involves specialized, coordinated, multidisciplinary care that aims to restore functional independence in physical and cognitive activities [1]. Allied health services are commonly provided as part of a multidisciplinary team during inpatient rehabilitation with physiotherapy and occupational therapy services being the most frequently required [2]. There is evidence that multidisciplinary rehabilitation is effective [3-6], so the question is not 'what' should be provided during rehabilitation but 'how much' should be provided to lead to the most efficient gains in functional independence during rehabilitation [7].

There has been recent debate in the UK about providing 7-day acute healthcare in the National Health Service [8,9]. It has been noted that in such a complex healthcare system, one area cannot work effectively at the weekend without having access to other areas that must also be functioning at the weekend [8,9]. Recent debate has centered on consultant and elective medical care, but rehabilitation services also need to be considered as they are an important part of the healthcare system.

Despite the view that most hospitals provide weekend rehabilitation, only 30% of rehabilitation hospitals in Australia offer weekend therapy [10]. Although weekend allied health services are more common in acute hospitals in the UK, Western Europe, Canada and Australia [10-12], staffing is reduced by up to 88% on weekends compared to weekdays, and is offered only to patients at risk of deterioration or those being discharged over the weekend [11]. A possible explanation for the limited amount of weekend therapy being provided is the lack of evidence to support it. A recent retrospective study found that 7 days per week of rehabilitation did not improve function, but reduced length of stay by 1 day compared to 5 days per week of rehabilitation [13]. Another study indicated that additional Saturday physiotherapy may reduce length of stay during rehabilitation [14] but was underpowered and did not include any other members of the multidisciplinary team or follow-up. Health service providers require quality evidence to determine whether weekend therapy is beneficial for all rehabilitation patients before they can decide whether to staff a full weekend service.

The primary aim of this study was to determine what effect providing an additional Saturday rehabilitation service in inpatient rehabilitation had on the discharge outcomes of functional independence, quality of life and length of stay. The secondary aim was to investigate if any benefits of providing additional therapy were maintained at 6 and 12 months after discharge from inpatient rehabilitation.

Methods

Design

This was a multicenter, single-blind, randomized controlled trial. The trial was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12609000973213) prior to patient recruitment. The trial was conducted according to the published trial protocol [15]. The only significant variations to the protocol related to the management of missing data, as described below in the data analysis section, and that the number of participants recruited exceeded the estimated sample. Ethics approval was received from University and Health Service Human Ethics Committees and written informed consent was provided by all participants.

Settings

The trial took place at 2 publically funded metropolitan rehabilitation facilities (Angliss Hospital and Peter James Centre) with a combined total of 90 rehabilitation beds (providing multidisciplinary inpatient rehabilitation services in eastern metropolitan Melbourne, Australia). Recruitment occurred from 1 July 2010 to 30 June 2011. In Australia, patients admitted for rehabilitation are usually not able to return directly home from acute hospital due to reduced functional independence. Before being accepted for inpatient rehabilitation, patients are typically assessed in an acute hospital as being able to participate actively in rehabilitation with the expectation that they will improve sufficiently to return to community living.

Participants

Participants were included if they were aged 18 years or older and had been admitted for rehabilitation at either of the two facilities. Participants with any orthopedic (e.g. fractures, elective joint replacements), neurological (e.g. stroke, multiple sclerosis, Parkinson disease) or other disabling condition (cardiac, pulmonary, deconditioning) were included. Participants were excluded if they were

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admitted for slow-stream rehabilitation termed 'geriatric evaluation and management' (as this patient group are managed differently to patients admitted for standard rehabilitation) or if they were enrolled in another intervention trial. Participants were not excluded if their primary language was a language other than English (an accredited interpreter assisted with informed consent and outcome measurement) or if they had reduced cognition (the next of kin was approached for informed consent).

Randomization procedure

Participants were randomized to the intervention or the control group using a concealed method, with 1:1 allocation. The block allocation sequence was generated electronically and assignments concealed in sequentially numbered, sealed, opaque envelopes. Only after the participant was enrolled in the trial and had completed baseline testing was assignment made by opening the next envelope in the sequence. A member of the research team who was not involved in recruitment, assessment or treatment of participants prepared the envelopes.

Intervention

Usual care rehabilitation was provided to all participants in both groups daily from Monday to Friday. Rehabilitation therapy focused on task-specific training and discharge planning and was at the discretion of the treating therapist. Patients at the two facilities usually receive about 2 h of physiotherapy and occupational therapy per weekday as well as full nursing, medical and other allied health services.

In addition, the intervention group was scheduled to receive a full physiotherapy and occupational therapy service on Saturday (an additional 1 h of each therapy). Weekend therapists may or may not have been the patient's usual therapist but were therapists employed by the hospital network and not research staff. The content of the therapy provided at the weekend was similar to that which was provided during the week as determined by the patient's Monday to Friday therapists. Instructions were provided by a written handover.

Outcome measures

Outcome measures were assessed directly at admission and discharge and by telephone at 6 months and 12 months. The primary endpoint was assessment at discharge with follow-up measures of functional independence and health-related quality of life at 6 months and 12 months. Outcome assessors who measured primary and secondary outcomes were blinded to group allocation. The success of blinding was evaluated at the discharge assessment by asking assessors to guess their patient's group allocation. Treating therapists and other members of the rehabilitation team (who made decisions regarding discharge) were not blinded to group allocation.

Primary outcomes

Functional independence was assessed using the functional independence measure (FIM) [16] administered by credentialed assessors. The FIM consists of 18 items in 2 domains: motor (13 items) and cognitive (5 items). Each item is rated on a 7-point scale, where 1 reflects complete dependence and 7 reflects complete independence. Scores range from 18 (lowest function) to 126 (highest function). The FIM self-care score refers to items 1 to 6, which relate to feeding, grooming and dressing. The FIM mobility score refers to items 9 to 13, which relate to transfers, walking and stairs. The FIM has demonstrated strong psychometric properties in rehabilitation settings with good reliability (intraclass correlation coefficient (ICC) = 0.99) [17] and evidence of responsiveness and validity as a global disability measure for patients receiving rehabilitation [18]. An increase in FIM of 22 points or more is considered to reflect a clinically significant improvement in functional independence [19].

Health-related quality of life was assessed using the EuroQoL questionnaire (EQ-5D) and visual analog scale (EQ-VAS) [20]. The EQ-5D rates five domains of health including mobility, self-care, usual activities, anxiety/depression and overall health status, scores for which can be converted into a utility index score by using data from the general population [21]. The EQ-5D utility index has been used in a range of health conditions and changes in EQ-5D are correlated with changes in condition-specific measures [22]. A change in the EQ-5D utility index score of half a standard deviation was considered clinically significant [23].

Length of stay was measured as the number of overnight stays in the rehabilitation facility and was included as a primary outcome based on pilot data [14] that suggested patients who received additional Saturday therapy were discharged earlier but at a similar functional level to patients who received Monday to Friday therapy.

Secondary outcomes

Secondary outcome measures included the Personal Care Participation Assessment and Resource Tool (PC-PART) [24], 10-m walk test [25,26], and the timed up and go test [27]. The modified Motor Assessment Scale [28] was completed by patients with stroke. Discharge destination was categorized as 'same' if participants returned to their usual place of residence or 'worse' if participants were unable to return home because they required more supported accommodation on discharge. The need for follow-up physiotherapy or occupational therapy on discharge was recorded.

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Adverse events, including falls, skin tears and infections were recorded using the health services incident reporting database. Adverse events were classified as severe, moderate, mild, or no harm.

Other outcome measures

Health service utilization and costs for participants in this trial will be reported elsewhere. Subsets of participants enrolled in the current trial had additional measures taken to explore the effects of additional rehabilitation. Physical activity levels were monitored [29,30] and in-depth interviews were conducted [31] on subsets of participants.

Sample size

Based on one of the primary outcome measures (length of stay), a sample size of 712 participants was estimated in the trial protocol [15]. To recruit this number of participants a recruitment period of 18 months was anticipated.

Statistical analysis

Analysis of covariance (ANCOVA) was used to analyze between-group differences in discharge (primary endpoint), 6-month and 12-month scores with baseline scores as covariate [32]. Intention to treat analysis, based on original group allocation, was used with any missing primary outcome data imputed using multiple imputation methods [33]. We assumed data were missing at random and used linear imputation for the continuous variables of length of stay, FIM, EQ-5D and EQ-VAS at admission, discharge, 6 months and 12 months via chained equations imputation generating five imputed datasets. In the trial protocol we specified that we would use the last value carried forward method [34]. Since the trial protocol was written, it has been recommended that multiple imputations may be a more appropriate method of dealing with missing data as it is less subject to bias [33,35]. The multiple imputation method was therefore chosen for dealing with missing data in this trial. For secondary outcomes, available data of all participants who were allocated were included in analyses without any imputation for missing data. Absolute risks, relative risks and number needed to treat (NNT) were calculated for the number of participants in each group who achieved clinically significant improvements, using the threshold values specified above, in primary outcome measures, returned to their usual accommodation, and required follow-up allied health therapy. A negative binomial regression model was used to analyze adverse events [36].

Results

Over a 12-month period 1,225 eligible patients were admitted to rehabilitation at the 2 sites. A total of 996 patients provided informed consent to participate and were randomized to receive either Monday to Saturday rehabilitation (intervention) (n = 496) or Monday to Friday rehabilitation (control) (n = 500). Recruitment rates were higher than originally expected and the project steering committee decided to stop recruitment earlier than planned as it appeared that the target sample size would be reached prior to 18 months. Without any interim analyses being performed, it was decided to stop recruitment at 12 months. The primary outcome measure of length of stay was obtained for all participants (100%) on discharge. By the end of the trial (12-month follow-up) 106 participants had died (intervention group n = 54, control group n = 52). In all, 86% of participants (852 of 996) were available for follow-up at 6 months and 82% (813 of 996) at 12 months (Figure 1). Overall, 94% of primary outcome data was complete at discharge, 82% at 6 months and 79% at 12 months.

Participants

Participants had a mean (SD) age of 74 (13) years and 637 (64%) were women (Table 1). A total of 579 (58%) participants were admitted with an orthopedic diagnosis, 203 (20%) with a neurological diagnosis and 214 (21%) participants were admitted with other disabling impairments. A total of 94% of participants were living independently in the community prior to their acute hospital admission.

Intervention

Participants in the intervention group received a mean of 53 more minutes of rehabilitation therapy (95% CI 31 to 74) per week compared to the control group. A total of 457 (92%) participants in the intervention group and 8 (2%) participants in the control group received at least 1 session of additional Saturday rehabilitation.

From available data, assessors correctly guessed group allocation on discharge 55% of the time.

Effects of intervention

Functional independence

Participants in the intervention group had higher FIM scores on discharge (mean difference (MD) 2.3, 95% CI 0.5 to 4.1, $P = 0.01$), and possibly at 6 months (MD 2.0, 95% CI 0.0 to 4.0, $P = 0.05$), but not at 12 months (MD 1.3, 95% CI −0.9 to 3.5, $P = 0.24$) compared to the control group (Table 2). Participants in the intervention group were 17% more likely to achieve a clinically significant improvement in FIM of at least 22 FIM points at discharge (Risk Ratio (RR) 1.17, 95% CI 1.03 to 1.34) compared to those in the control group. For every 13 patients provided with the intervention, 1 additional patient achieved a clinically significant improvement in FIM at discharge (NNT 13, 95% CI 7 to 71) (Table 3).

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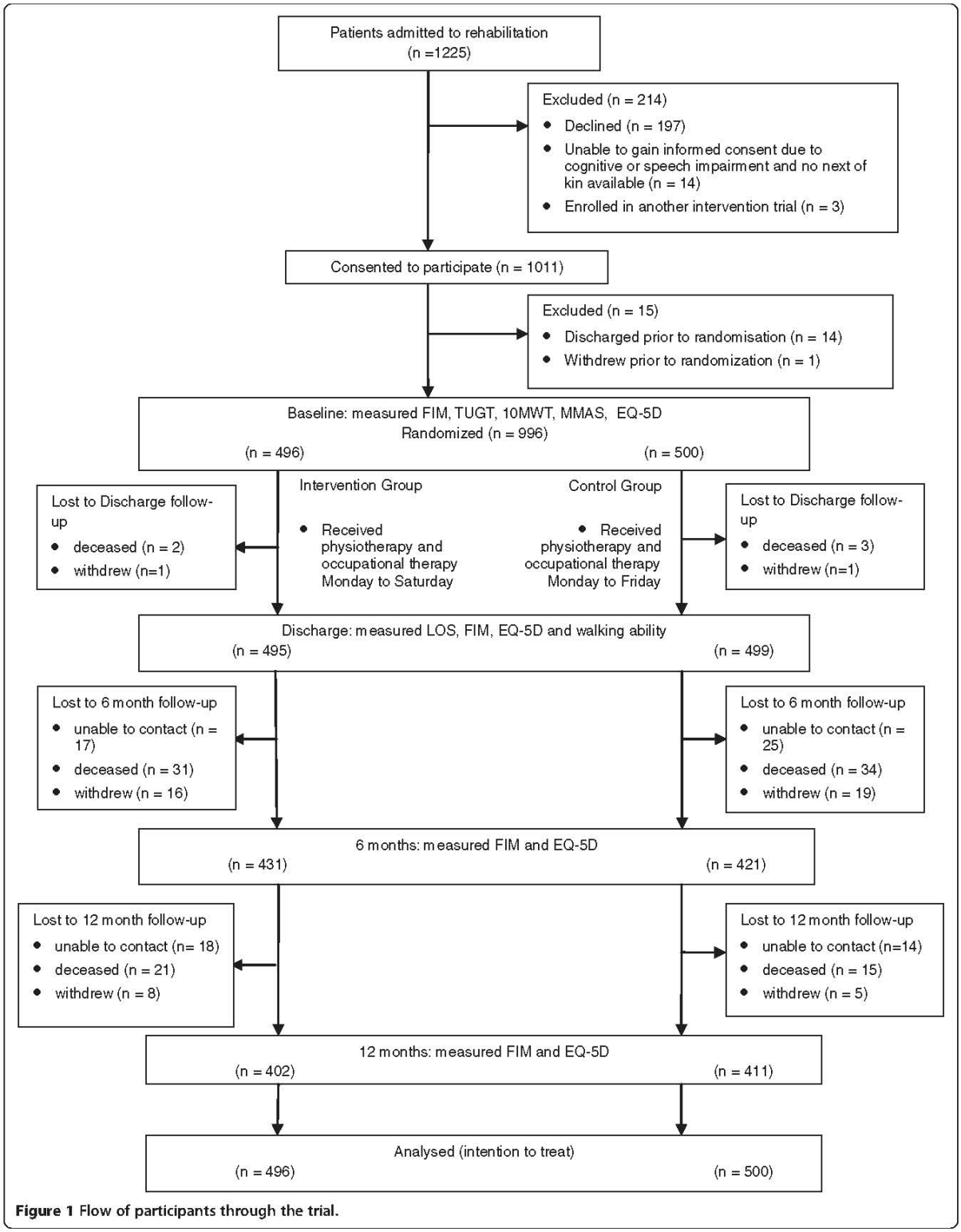

Figure 1 Flow of participants through the trial.

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Table 1 Baseline characteristics

Characteristic	Randomized (n = 996)	
	Intervention (n = 496)	Control (n = 500)
Age in years, mean (SD)	75 (13)	74 (13)
Age group, n (%)		
≤59 years	63 (13)	72 (14)
60 to 79 years	236 (48)	234 (47)
≥80 years	197 (40)	194 (39)
Gender, n male (%)	188 (38)	171 (34)
Diagnosis category, n (%)		
Stroke	81 (16)	79 (16)
Other neurological conditions	20 (4)	23 (5)
Orthopedic conditions	283 (57)	296 (59)
Pain syndromes	24 (5)	19 (4)
Cardiac/Pulmonary	25 (5)	23 (5)
Other disabling impairments	63 (13)	59 (12)
Functional independence (FIM)		
Total, mean (SD)	83 (20)	83 (21)
Mobility component, mean (SD)	16 (7)	16 (7)
Self-care component, mean (SD)	27 (8)	27 (8)
Cognitive component, mean (SD)	31 (6)	31 (6)
Health-related quality of life		
EQ-5D utility index, mean (SD)	0.32 (0.35)	0.37 (0.35)
Visual analog scale (0 to 100 mm), mean (SD)	57 (21)	56 (22)
Charlson comorbidity index, mean (SD)	1 (1)	1 (1)
Living independently in the community prior to admission, n (%)	466 (94)	466 (93)

Intervention = Monday to Saturday rehabilitation, control = Monday to Friday rehabilitation.
EQ-5D EuroQoL five dimensions questionnaire.

Health-related quality of life

Participants in the intervention group had higher EQ-5D utility index scores (MD 0.04, 95% CI 0.01 to 0.07, $P = 0.009$) on discharge and possibly at 6 months (MD 0.03, 95% CI −0.01 to 0.08, $P = 0.15$) but not at 12 months (MD 0.01, 95% CI −0.04 to 0.05, $P = 0.77$) when compared to the control group. Participants in both groups scored similarly on the EQ-5D VAS at discharge, 6 months and 12 months (Table 2). Participants who received Monday to Saturday rehabilitation were 18% more likely to achieve a clinically significant improvement in health-related quality of life utility index score at discharge (RR = 1.18, 95% CI 1.04 to 1.34) than participants who received Monday to Friday rehabilitation. This difference was maintained at 6 months and possibly at 12 months. For every 12 patients provided with the intervention, 1 additional patient achieved a clinically significant improvement in EQ-5D at discharge (NNT 12, 95% CI 7 to 45) (Table 3).

Length of stay

The intervention group may have had a shorter length of stay by 2 days (95% CI 0 to 4, $P = 0.1$) compared to the control group, with length of stay reduced from a mean of 23 (SD 20) days to 21 (SD 16) days. Few participants were discharged on a weekend day; 15 participants in the intervention group and 11 participants in the control group.

Secondary outcomes

There were no significant differences between the groups in PC-PART, modified Motor Assessment Scale, or timed up and go test at discharge (Table 4). The intervention group may have had a faster walking speed on discharge compared to the control group (MD 0.03, 95% CI 0.00 to 0.06, $P = 0.09$). In total, 88% of participants who were living independently in the community prior to their admission returned to their previous living accommodation; there were no differences between groups in terms of discharge destination (RR = 0.98, 95% CI 0.93 to 1.03) or need for follow-up outpatient or community allied health services (RR = 0.96, 95% CI 0.90 to 1.01).

Adverse events

No serious adverse events occurred during the additional Saturday rehabilitation. There were a total of 240 adverse events reported during inpatient rehabilitation. Adverse events included non-injurious falls (intervention group n = 50, control group n = 70) and minor medical issues such as skin tears (intervention group n = 42, control group n = 41). No adverse events were classified as causing serious harm and two were classified as causing moderate harm (intervention group n = 1, control group n = 1). Participants in the intervention group had an observed adverse event rate of 19% less than participants in the control group (incidence rate ratio = 0.81, 95% CI 0.61 to 1.08), but this did not reach statistical significance.

Discussion

During inpatient rehabilitation, providing additional allied health services helped patients to get better quicker. Patients who received additional Saturday rehabilitation were discharged at a higher level of functional independence and with higher health-related quality of life than those who received Monday to Friday rehabilitation despite being discharged home sooner. The likely reduction in length of stay did not come at the expense of poorer discharge outcomes. Participants who received Monday to Saturday rehabilitation were just as likely to be discharged home (and not to a residential facility) and just as likely to need follow-up outpatient services on discharge compared to those in the control group. These results confirm findings from a systematic review about the benefits of providing additional therapy [37] and add to previous research on

Table 2 Primary outcomes

Outcome	Groups								Difference between groups		
	Admission		Discharge		Month 6		Month 12		Discharge, Int - Con	Month 6, Int - Con	Month 12, Int - Con
	Int	Con	Int	Con	Int	Con	Int	Con			
FIM total	84 (19)	84 (20)	106 (18)	104 (20)	109 (17)	107 (19)	109 (17)	108 (19)	2.3 (0.5 to 4.1)*; $P = 0.01$	2.0 (0.0 to 4.0)*; $P = 0.05$	1.3 (−0.9 to 3.5); $P = 0.24$
Mobility score	16 (7)	16 (7)	26 (6)	25 (7)	28 (7)	28 (7)	29 (7)	28 (8)	1.0 (0.3 to 1.6)*; $P = 0.006$	0.6 (−0.2 to 1.3); $P = 0.14$	0.6 (−0.3 to 1.4); $P = 0.19$
Self-care score	27 (8)	27 (8)	36 (7)	35 (8)	37 (7)	36 (8)	37 (8)	37 (8)	0.6 (−0.2 to 1.3); $P = 0.13$	0.8 (−0.1 to 1.7); $P = 0.09$	0.4 (−0.6 to 1.4); $P = 0.41$
EQ-5D VAS (0 to 100)	57 (21)	56 (22)	71 (19)	70 (17)	71 (20)	70 (21)	71 (20)	70 (19)	1.1 (−1.0 to 3.2); $P = 0.30$	0.3 (−2.2 to 2.8); $P = 0.84$	0.8 (0 to 1.6); $P = 0.59$
EQ-5D utility index	0.32 (0.35)	0.37 (0.35)	0.65 (0.28)	0.62 (0.28)	0.63 (0.36)	0.61 (0.37)	0.64 (0.39)	0.64 (0.34)	0.04 (0.01 to 0.07)*; $P = 0.009$	0.03 (−0.01 to 0.08); $P = 0.15$	0.01 (−0.04 to 0.05); $P = 0.77$

Intervention (Int) n = 496, control (Con) n = 500; intervention = Monday to Saturday rehabilitation, control = Monday to Friday rehabilitation). Mean (SD) of groups and mean (95% CI) difference between groups at admission, discharge, 6 months and 12 months are shown.
*$P \leq 0.05$.
EQ-5D EuroQoL five dimensions questionnaire, *FIM* functional independence measure, *VAS* visual analog scale.

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Table 3 Numbers of participants (absolute risk %) who had achieved a minimally clinically important difference in functional independence and health-related quality of life from admission to assessment at discharge, 6 months and 12 months

Outcome	Time point	Intervention	Control	Relative risk difference (95% CI)	Number needed to treat (95% CI)
Functional independence (FIM)	Discharge	256 (52)	220 (44)	1.17 (1.03 to 1.34)*	13 (7 to 71)
	6 months	274 (55)	261 (52)	1.06 (0.94 to 1.19)	33 (−32 to 11)
	12 months	284 (57)	266 (53)	1.07 (0.96 to 1.20)	25 (−47 to 10)
Health-related quality of life (EQ-5D)	Discharge	262 (53)	222 (44)	1.18 (1.04 to 1.34)*	12 (7 to 45)
	6 months	287 (58)	243 (49)	1.19 (1.06 to 1.34)*	11 (7 to 33)
	12 months	289 (58)	262 (52)	1.11 (1.00 to 1.24)	17 (−326 to 8)

Intervention = Monday to Saturday rehabilitation, control = Monday to Friday rehabilitation.
*Statistically significant.
EQ-5D EuroQoL five dimensions questionnaire.

the provision of additional weekend rehabilitation services [13,14] by providing evidence from an adequately-powered, prospective, randomized controlled trial including 12-month follow-up.

In this trial, patients who received Monday to Saturday rehabilitation did not receive a great deal more rehabilitation (mean 53 minutes, 13% extra) than patients who received Monday to Friday rehabilitation but this additional rehabilitation did improve outcomes. The amount of additional rehabilitation was somewhat less than the expected, which could be due to missed sessions of therapy as a consequence of feeling unwell, day leave on a Saturday or because patients were admitted late in the week and had not been recruited, assessed and randomized to be scheduled for weekend therapy. However, the additional rehabilitation provided did improve outcomes.

Rehabilitation in the form of physiotherapy and occupational therapy typically focused on task specific training and discharge planning. This additional rehabilitation alone may have been enough to improve outcomes if patients made gains during the extra sessions of therapy. However, other factors may have also contributed to improved outcomes. Patients who received Saturday rehabilitation did not have a 2-day break in therapy, which may have reduced time for functional decline due to inactivity. Analysis of the physical activity levels of a subset of participants in the current trial found that those receiving Saturday rehabilitation were more physically active on both days of the weekend compared to those who received Monday to Friday rehabilitation [29]. In addition, higher levels of physical activity during rehabilitation were associated with higher levels of functional independence on discharge and shorter length of stay [30]. Therefore, the additional physical activity associated with weekend rehabilitation may have contributed to improving outcomes. In a qualitative study on another subset of participants in the current trial, additional Saturday rehabilitation was reported to change patient perceptions of what weekends in rehabilitation were for [31]. Patients who received Saturday rehabilitation expected to be working towards their rehabilitation goals over the weekend while those who received Monday to Friday rehabilitation expected to rest over the weekend. These changed patient expectations may have contributed to improved outcomes with Monday to Saturday rehabilitation in the current trial.

We also found that benefits in functional independence and health-related quality of life gained from additional weekend rehabilitation may have been maintained for up to 6 months post discharge suggesting that the more successful outcome achieved during rehabilitation may have had ongoing effects. Most improvement occurred during inpatient rehabilitation when therapy was being provided

Table 4 Secondary outcomes

Outcome (number of participants in analysis)	Groups				Difference between groups	
	Admission		Discharge		Intervention - control	*P* value
	Intervention	Control	Intervention	Control		
PC-PART (0 to 43) (n = 963)	13(8)	14(8)	2(4)	3(6)	−0.3 (−0.9 to 0.3)	0.30
10-m walk test (m/s) (n = 694)	0.52(0.31)	0.48(0.28)	0.73(0.30)	0.68(0.29)	0.03 (0.00 to 0.06)	0.09
Timed up and go test (s) (n = 677)	42(36)	39(24)	24(21)	24(13)	−1 (−3 to 1)	0.32
MMAS (0 to 48) (n = 151)	25(15)	27(14)	34(14)	34(12)	1.9 (−0.4 to 4.2)	0.10

Intervention = Monday to Saturday rehabilitation, control = Monday to Friday rehabilitation. Mean (SD) of groups and mean (95% CI) difference between groups on discharge are shown.
MMAS Modified Motor Assessment Scale for participants with stroke (a lower score indicates a higher level of impairment), *PC-PART* Personal Care Participation Assessment and Resource Tool (a lower score indicates more independence with personal care tasks).

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with only relatively small gains following discharge (Table 2). Previous trials on functional outcomes following rehabilitation for stroke [38-40] and hip fracture [41] also found that most functional gains were made between admission and discharge from rehabilitation with results maintained (but not improved upon) at 6-month or 12-month follow-up. Therefore, it cannot be assumed that patients are going to get better on their own at home following discharge from rehabilitation, reinforcing the importance of maximizing functional gains during the inpatient rehabilitation period.

There were no significant differences between groups in terms of most secondary outcomes, including the timed up and go test, PC-PART and the modified Motor Assessment Scale. This may reflect the goals of rehabilitation where interventions were focused on improving overall functional independence for discharge back to living in the community rather than specific activities such as balance, walking speed or upper limb function.

Recent debate has highlighted the issue of weekend healthcare provision and the benefits and difficulties in providing weekend healthcare [8,9]. Our trial demonstrated that providing weekend rehabilitation services, at least on a Saturday, improved functional independence and health-related quality of life and reduced length of stay, which may have clinical implications for both patients and health services. These results may also be applicable to settings and cultures where rehabilitation is currently provided 5 days a week even if Saturday may be a usual work day as the Saturday rehabilitation in this trial reflects an additional day, or a sixth day of rehabilitation. Patients may not have to wait for as long for a rehabilitation bed, and can return home sooner with better function to resume their usual activities in the community. However, one of the key concerns about providing weekend care is the question of who will pay for the additional services [8,42]. Because intervention group participants achieved better clinical outcomes at discharge despite likely having a shorter length of stay in our trial, health service providers may be able to treat more patients throughout the year which may lead to cost advantages. A formal economic evaluation is being conducted separately alongside the current trial.

This trial included participants with a variety of health conditions requiring rehabilitation, non-English speaking participants, and participants with cognitive impairment making the results generalizable to many metropolitan inpatient rehabilitation facilities. A limitation is that subgroup analyses were not planned or completed, therefore we do not know if the results are particularly applicable to patients with certain diagnoses. However, our trial was not powered for subgroup analyses and such *post hoc* analyses are discouraged [43]. In addition, we took a health service perspective about staffing a service rather than providing therapy based on a specific diagnosis. Risk of bias was minimized through concealed, random allocation of participants and the use of blinded assessors throughout the clinical trial and follow-up period; however, patients, therapists and other clinical staff were not blinded to group allocation. Follow-up measurements at 6 and 12 months were completed by telephone and not face-to-face which may have introduced error; however, all project officers were credentialed to administer the FIM, there were high compliance rates, and there is evidence that telephone administration of the FIM and EQ-5D is suitable for older adults following hospitalization [44,45]. Another potential limitation is that the additional rehabilitation was only provided by physiotherapists and occupational therapists. We acknowledge the important contributions of other members of the rehabilitation team such as social workers, podiatrists and dietitians. However, we chose physiotherapy and occupational therapy as they are the most commonly required and provided interventions during rehabilitation [2].

Conclusions

Providing additional allied health services (physiotherapy and occupational therapy) on Saturdays during inpatient rehabilitation helped patients to regain their functional independence faster. Future research could focus on the dose–response relationship of additional weekend rehabilitation services, and explore whether the additional amount of rehabilitation therapy or reducing the consecutive amount of time without rehabilitation therapy improved outcomes.

Abbreviations

ANCOVA: Analysis of covariance; CI: confidence interval; EQ-5D: EuroQoL five dimensions questionnaire; EQ-VAS: EuroQoL questionnaire visual analog scale; FIM: Functional independence measure; MD: Mean difference; PC-PART: Personal Care Participation Assessment and Resource Tool; RR: Risk ratio.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

NS, NB, JW and NT were responsible for study concept and study design and CP contributed to study design. CP and NB were responsible for data collection. CP, NS and NT were responsible for data analysis and data interpretation. CP wrote the first draft of the manuscript and CP, NS, NB, JW and NT contributed to writing the final manuscript. CP and NT are the guarantors. All authors read and approved the final manuscript.

Acknowledgements

This trial is funded by a partnership grant between Eastern Health and La Trobe University from the National Health and Medical Research Council (NHMRC) Australia (ID 541958).

We thank Victor Brusco for the development and ongoing maintenance of the primary database used throughout the clinical trial; the project officers (Renita Yap, Belinda Haines, Clarissa Koukounas and Glenys Harrison); the data entry and follow-up phone call assessors (Sarah Foster, Rhonda Povah, Haley Tkatchyk, and Tanya Johansen); as well as Eastern Health and the physiotherapists, occupational therapists, allied health assistants and rehabilitation consultants (Genevieve Kennedy and Kwong Teo) at Angliss Hospital and Peter James Centre who supported this project.

Author details
[1]Department of Physiotherapy, La Trobe University, Melbourne, Victoria, Australia. [2]Allied Health Clinical Research Office, Eastern Health, Box Hill, Victoria 3128, Australia. [3]Allied Health Learning and Research Unit, Northern Health, Bundoora, Victoria, Australia. [4]Physiotherapy Services, Cabrini Health, Malvern, Victoria, Australia. [5]School of Health and Social Development, Faculty of Health, Deakin University, Burwood, Victoria, Australia.

Received: 13 May 2013 Accepted: 10 July 2013
Published: 10 September 2013

References

1. Nocon A, Baldwin S: *Trends in Rehabilitation Policy: A Review of the Literature.* London, UK: King's Fund Publishing; 1998.
2. Australasian Rehabilitation Outcomes Centre: **The Australasian Rehabilitation Outcomes Centre Annual Report: the state of rehabilitation in Australia in 2011.** [https://ahsri.uow.edu.au/aroc/annualreports/index.html]
3. Bachmann S, Finger C, Huss A, Egger M, Stuck AE, Clough-Gorr KM: **Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomised controlled trials.** *BMJ* 2010, **340**:c1718.
4. Halbert J, Crotty M, Whitehead C, Cameron I, Kurrle S, Graham S, Handoll H, Finnegan T, Jones T, Foley A, Shanahan M, Hip Fracture Rehabilitation Trial Collaborative Group: **Multi-disciplinary rehabilitation after hip fracture is associated with improved outcome: a systematic review.** *J Rehabil Med* 2007, **39**:507–512.
5. Stroke Unit Trialists Collaboration: **Organised inpatient (stroke unit) care for stroke.** *Cochrane Database Syst Rev* 2007, **4**:CD000197.
6. Wade DT, de Jong BA: **Recent advances in rehabilitation.** *BMJ* 2000, **20**:1385–1388.
7. Haines TP, Kuys S, Clarke J, Morrison G, Bew P: **Dose–response relationship between physiotherapy resource provision with function and balance improvements in patients following stroke: a multi-centre observational study.** *J Eval Clin Pract* 2010, **17**:136–142.
8. Flynn P: **Should the NHS work at weekends as it does in the week? No.** *BMJ* 2013, **346**:f622.
9. Keogh B: **Should the NHS work at weekends as it does in the week? Yes.** *BMJ* 2013, **346**:f621.
10. Shaw KD, Taylor NF, Brusco NK: **Physiotherapy services provided outside of business hours in Australian hospitals: a national survey.** *Physiother Res Int* 2013, **18**:115–123.
11. Campbell L, Bunston R, Colangelo S, Kim D, Nargi J, Hill K, Brooks D: **The provision of weekend physiotherapy services in tertiary-care hospitals in Canada.** *Physiother Canada* 2010, **62**:347–354.
12. Norrenberg M, Vincent JL: **A profile of European intensive care unit physiotherapists. European Society of Intensive Care Medicine.** *Intensive Care Med* 2000, **26**:988–994.
13. Disotto-Monastero M, Chen X, Fisch S, Donaghy S, Gomez M: **Efficacy of 7 days per week inpatient admissions and rehabilitation therapy.** *Arch Phys Med Rehab* 2012, **93**:2165–2169.
14. Brusco NK, Shields N, Taylor NF, Paratz J: **A Saturday physiotherapy service may decrease length of stay in patients undergoing rehabilitaiton in hospital: a randomised controlled trial.** *Aust J Physiother* 2007, **53**:75–81.
15. Taylor NF, Brusco NK, Watts JJ, Shields N, Peiris C, Sullivan N, Kennedy G, Teo CK, Farley A, Lockwood K, Radia-George C: **A study protocol of a randomised controlled trial incorporating a health economic analysis to investigate if additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes.** *BMC Health Serv Res* 2010, **10**:308–314.
16. Hamilton BB, Granger CV: **Disability outcomes following inpatient rehabilitation for stroke.** *Phys Ther* 1994, **74**:494–503.
17. Hamilton BB, Laughlin JA, Fiedler RC, Granger CV: **Interrater reliability of the 7-level functional independence measure (FIM).** *Scand J Rehabil Med* 1994, **26**:115–119.
18. Hobart JC, Lamping DL, Freeman JA, Langdon DW, McLellan DL, Greenwood RJ, Thompson AJ: **Evidence-based measurement: which disability scale for neurologic rehabilitation?** *Neurology* 2001, **57**:639–644.
19. Beninato M, Gill-Body KM, Salles S, Stark PC, Black-Schaffer RM, Stein J: **Determination of the minimal clinically important difference in the FIM instrument in patients with stroke.** *Arch Phys Med Rehab* 2006, **87**:32–39.
20. Group EQ: **EuroQol–a new facility for the measurement of health-related quality of life. The EuroQol Group.** *Health Policy* 1990, **16**:199–208.
21. Sakthong P, Charoenvisuthiwongs R, Shabunthorn R: **A comparison of EQ-5D index scores using the UK, US, and Japan preference weights in a Thai sample with type 2 diabetes.** *Health Qual Life Out* 2008, **6**:71.
22. Kind P, Dolan P, Gudex C, Williams A: **Variations in population health status: results from a United Kingdom national questionnaire survey.** *BMJ* 1998, **316**:736–741.
23. Norman GR, Sloan JA, Wyrwich KW: **Interpretation of changes in health related quality of life. The remarkable universality of half a standard deviation.** *Med Care* 2003, **41**:582–592.
24. Vertesi A, Darzins P, Lowe S, McEvoy E, Edwards M: **Development of the Handicap Assessment and Resource Tool (HART).** *Can J Occu Ther* 2000, **67**:120–127.
25. Hollman JH, Beckman BA, Brandt RA, Merriwether EN, Williams RT, Nordrum JT: **Minimum detectable change in gait velocity during acute rehabilitation following hip fracture.** *J Geriatr Phys Ther* 2008, **31**:53–56.
26. Smith MT, Baer GD: **Achievement of simple mobility milestones after stroke.** *Arch Phys Med Rehab* 1999, **80**:442–447.
27. Podsiadlo D, Richardson S: **The timed "Up & Go": a test of basic functional mobility for frail elderly persons.** *J Am Geriatr Soc* 1991, **39**:142–148.
28. Loewen SC, Anderson BA: **Reliability of the modified motor assessment scale and the Barthel index.** *Phys Ther* 1988, **68**:1077–1081.
29. Peiris CL, Taylor NF, Shields N: **Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial.** *Arch Phys Med Rehab* 2012, **93**:1365–1370.
30. Peiris C, Taylor NF, Shields N: **Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions do much less physical activity than recommended in guidelines for healthy older adults: an observational study.** *J Physiother* 2013, **59**:6.
31. Peiris CL, Taylor NF, Shields N: **Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study.** *J Physiother* 2012, **58**:261–268.
32. Vickers AJ: **Parametric versus non-parametric statistics in the analysis of randomized trials with non-normally distributed data.** *BMC Med Res Methodol* 2005, **5**:35.
33. Sterne JA, White IR, Carlin JB, Spratt M, Royston P, Kenward MG, Wood AM, Carpenter JR: **Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls.** *BMJ* 2009, **338**:b2393.
34. Hollis S, Campbell F: **What is meant by intention to treat analysis? Survey of published randomised controlled trials.** *BMJ* 1999, **319**:670–674.
35. Schulz KF, Altman DG, Moher D: **CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials.** *BMJ* 2010, **340**:c332.
36. Robertson MC, Campbell AJ, Herbison P: **Statistical analysis of efficacy in falls prevention trials.** *J Gerontol Ser A-Biol Sci Med Sci* 2005, **60**:530–534.
37. Peiris CL, Taylor NF, Shields N: **Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review.** *Arch Phys Med Rehab* 2011, **92**:1490–1500.
38. Lincoln NB, Parry RH, Vass CD: **Randomized, controlled trial to evaluate increased intensity of physiotherapy treatment of arm function after stroke.** *Stroke* 1999, **30**:573–579.
39. Sutbeyaz S, Yavuzer G, Sezer N, Koseoglu BF: **Mirror therapy enhances lower-extremity motor recovery and motor functioning after stroke: a randomized controlled trial.** *Arch Phys Med Rehab* 2007, **88**:555–559.
40. Yavuzer G, Selles R, Sezer N, Sutbeyaz S, Bussmann JB, Koseoglu F, Atay MB, Stam HJ: **Mirror therapy improves hand function in subacute stroke: a randomized controlled trial.** *Arch Phys Med Rehab* 2008, **89**:393–398.
41. Jones GR, Miller TA, Petrella RJ: **Evaluation of rehabilitation outcomes in older patients with hip fractures.** *Am J Phys Med Rehab* 2002, **81**:489–497.
42. Wyatt MG: **Funding is insufficient for the NHS to work at weekend as it does in the week.** *BMJ* 2013, **346**:f1854.

43. Schulz KF, Grimes DA: *The Lancet Handbook of Essential Concepts in Clinical Research (The Lancet Handbooks)*. Grand Rapids, MI: Elsevier; 2006.
44. McPhail S, Lane P, Russell T, Brauer SG, Urry S, Jasiewicz J, Condie P, Haines T: **Telephone reliability of the Frenchay Activity Index and EQ-5D amongst older adults.** *Health Qual Life Out* 2009, **7**:48.
45. Petrella RJ, Overend T, Chesworth B: **FIM after hip fracture: is telephone administration valid and sensitive to change?** *Am J Phys Med Rehab* 2002, **81**:639–644.

doi:10.1186/1741-7015-11-198
Cite this article as: Peiris *et al.*: Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial. *BMC Medicine* 2013 **11**:198.

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Chapter 7

GENERAL DISCUSSION

This thesis investigated the effects of providing additional rehabilitation services on patient functional outcomes, their rehabilitation experience and their physical activity levels. Results from the research presented provides evidence that additional Saturday rehabilitation increases physical activity levels, positively changes patients' perceptions towards being more active participants in rehabilitation, improves functional independence and health-related quality of life and reduces length of stay for people receiving inpatient rehabilitation. In this chapter, the key findings of the research and other relevant literature will be summarised and discussed in relation to possible explanations, clinical implications, strengths and limitations and directions for future research.

7.1 PHYSICAL ACTIVITY DURING INPATIENT REHABILITATION

"Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it" – Plato (380 BC)

Patients receiving inpatient rehabilitation are inactive

Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions are inactive; the observed patients spent only 1.2 hours in upright activities and only 8 minutes walking per day (Peiris et al 2013a, Peiris et al 2012a). These results concur with the findings of previous research conducted in inpatient settings where older adults in rehabilitation spent only 1.3 hours

upright per day (Smith et al 2008). Relative to findings that community-dwelling older adults typically spend approximately 6 hours upright per day (Grant et al 2010, Smith et al 2008) and community-dwelling people after stroke spend about 4 hours upright per day (Alzahrani et al 2011), it suggests that patients in inpatient rehabilitation are inactive. Previous observational studies suggest that patients with stroke have similarly low levels of physical activity while in hospital (Bear-Lehman et al 2001, Keith and Cowell 1987, Mackey et al 1996, Tinson 1989). In one study, patients with stroke spent 10% more time completely inactive than patients without stroke (Bear-Lehman et al 2001). This high level of inactivity observed during inpatient rehabilitation was also reflected in the qualitative study when patients with orthopaedic and neurological diagnoses reported that they felt like all they did was *'eat and sleep'* and that therapy felt like a break from *'sitting in a chair all day long'* (Peiris et al 2012b).

Patients in rehabilitation completed 35% of their physical activity during physiotherapy and occupational therapy sessions despite spending only 4% of their time in those sessions (Peiris et al 2012a) suggesting that patients do little self-directed physical activity. This is supported by an observational study conducted on six older adults in rehabilitation where patients spent only 0.4% of their day in self-directed physical activity but spent 64% of their day completely physically and mentally inactive (Patterson et al 2005). Even within therapy sessions, patients with stroke were observed to spend only 31% of their time completing exercises or task-related practice when their therapist was not directly with them (Ada et al 1999). The lack of self-directed physical activity is further apparent in previous studies (Bear-Lehman et al 2001, Janssen et al 2012, Mackey et al 1996, Smith et al 2008) and in this thesis (Peiris et al 2012a) where patients were least active on weekends when no rehabilitation was provided. Even though patients only took a mean of 398 - 589 steps per day overall (Peiris et al 2013a, Peiris et al 2012a), they took 141 (95%CI 67 to 214) fewer steps on Sundays (Peiris et al 2012a). Further, despite spending just over 60 minutes upright per day, patients spent 12 to 30 minutes less in upright activities on weekends (Peiris et al 2012a, Smith et al 2008).

The aim of rehabilitation is to prepare patients to return to living independently in the community. For this reason, rehabilitation should involve a sufficient level of physical activity to restore functional independence and improve health. Patients in rehabilitation are recovering from illness or injury and therefore may need to balance the amount of physical activity they do with periods of rest. However, this thesis contends that physical activity levels of patients in inpatient rehabilitation are too low. Their sedentary behaviour is of considerable concern as it may not adequately prepare patients to return to independent living and may contribute to the poor functional recovery observed following hospitalisation for hip fracture (Beringer et al 2006, Craik 1994, Fierens et al 2006, Koval and Zuckerman 1994), lower limb joint replacement (Franklin et al 2006, Schmalzried et al 1998) and stroke (Appelros et al 2003, Hankey et al 2002).

Risks of lack of physical activity

Physical inactivity is a leading risk factor for mortality and chronic disease and is responsible for 6% of all deaths (WHO 2011). In addition to being inactive during rehabilitation, patients recruited for the studies in this thesis were predominantly older adults, who are generally less active than younger adults and who already have an increased risk of developing chronic diseases and musculoskeletal conditions due to ageing (Chodzko-Zajko et al 2009). Combining inactivity with older age puts patients at greater risk of developing or exacerbating the effects of chronic disease.

Older adults are particularly vulnerable to the effects of inactivity during hospitalisation due to the reduced functional reserve associated with ageing (Kortebein 2009). A relatively short period of inactivity, such as that which occurs during hospitalisation, can be associated with functional decline, decreased muscle strength, increased risk of falls, decreased appetite, constipation, glucose intolerance, cognitive decline and need for nursing home placement

(Brown et al 2009, Kortebein 2009). Consistent with these risks, the patients recruited for the studies presented in this thesis who were least active had a longer length of stay in rehabilitation and were discharged at a lower level of functional independence (Peiris et al 2013a).

Patients often do not return to their previous levels of functional independence following hospitalisation for lower limb orthopaedic conditions (Beringer et al 2006, Craik 1994, Koval and Zuckerman 1994, Taylor et al 2010a), and rarely meet physical activity guidelines (Resnick et al 2011, Schmalzried et al 1998, Silva et al 2005). People who continue to have low levels of physical activity after a hip fracture have higher levels of disability, are more likely to have a second hip fracture and are at risk of further functional decline (Marks 2011, Resnick et al 2011, Rodaro et al 2004). This highlights the importance of being physically active and restoring physical activity following illness or injury.

As long-term lack of physical activity (such as that which is common in older adults living in the community) and short periods of inactivity (such as that which occurs during hospitalisation) both have negative health consequences, it is important for physical activity to be encouraged during rehabilitation for the improvement and maintenance of health.

Benefits of physical activity

Regular physical activity is directly related to positive health outcomes in healthy adults (Schnohr et al 2003, Wen et al 2011). Physical activity can lead to improvements in body composition, psychological wellbeing, vascular function, cardiac function and musculoskeletal fitness (Warburton et al 2006). Available evidence suggests that older adults and people with chronic health conditions are no different to healthy adults in their response to physical activity and the benefits that may result from being sufficiently physically active (Chodzko-Zajko et al 2009, Dawes 2008). Regular physical activity is essential for healthy ageing as it maintains and

increases muscle strength and fitness, which reduces the risk of developing chronic health conditions, and is valuable in the management of these chronic health conditions (Chodzko-Zajko et al 2009).

To achieve these positive health outcomes, adults and older adults should complete 150 minutes of moderate-intensity physical activity throughout the week (WHO 2011), which equates to 30 minutes on at least 5 days of the week (Haskell et al 2007, Nelson et al 2007), in bouts of 10 minutes or more. Another popular public health target is to accumulate 10,000 steps per day (Tudor-Locke and Bassett 2004). This is based on a background number of steps per day, plus the amount of steps required to achieve 150 minutes of moderate intensity physical activity over a week. This has been modified to a lower target of 7,000 steps per day for older adults and people living with disability and/or chronic illness (Tudor-Locke et al 2011). Patients did not meet physical activity guidelines or targets during inpatient rehabilitation; on average patients took less than 600 steps per day and walked for only 8 minutes per day (Peiris et al 2013a, Peiris et al 2012a).

In the study reported in Chapter 3, higher levels of physical activity by patients with lower limb orthopaedic conditions were moderately associated with a faster rate of functional improvement and shorter length of stay (Peiris et al 2013a). This is consistent with reports that patients with hip fracture who were more active within therapy sessions had higher functional ability and more complete recovery of pre-fracture function at 6 and 12 months post rehabilitation (Talkowski et al 2009). Also, higher repetitions of independent exercise following discharge from hospital by patients with total knee replacement have been associated with larger improvements in physical function (Franklin et al 2006). Similar associations have been seen when observing patients with stroke in rehabilitation, where there was a positive correlation between change in physical activity levels and change in functional independence (Janssen et al 2012). Although it does not imply causation, this association combined with the physiological

benefits of physical activity lead to a reasonable hypothesis that higher levels of physical activity during inpatient rehabilitation could be beneficial. Patients seemed to be aware of this, stating in the in-depth interviews that '*the more I use it, the better it feels'* (Peiris et al 2012b). This hypothesis would need to be tested with further clinical research investigating the relationship between physical activity dose and patient health outcomes. This thesis highlights the very low levels of physical activity observed during inpatient rehabilitation and raises the question of whether increasing levels of physical activity in this setting could enhance recovery. It also identifies the need to examine strategies to increase physical activity during inpatient rehabilitation.

Dose-response relationship

Higher levels of physical activity were associated with a faster rate of improvement in functional independence and shorter length of stay in inpatient rehabilitation (Peiris et al 2013a). However, overall activity levels were still low; even the most active participant was considered to be sedentary and took less than 30% of the target amount of steps per day for healthy adults (2,628 of 10,000) and less than 40% of the target amount of steps per day for older adults and adults living with disability and/or chronic illness (2,628 of 7,000). If relatively small increases in physical activity during rehabilitation are associated with better health outcomes, would larger increases improve outcomes further?

There seems to be a positive relationship between physical activity and health, whereby the most physically active people have the best health (Warburton et al 2006). However, it has been observed that often the largest gains in health are obtained from increasing physical activity from sedentary to low-active with smaller, additive gains made from increasing activity further, for example from moderate to vigorous (Warburton et al 2006, Wen et al 2011). As discussed above, there is some preliminary evidence that higher levels of physical activity and exercise

during rehabilitation may be associated with better physical function (Franklin et al 2006, Janssen et al 2012, Peiris et al 2013, Talkowski et al 2009). However, further research is needed to establish this relationship and to determine the optimal dose of physical activity in rehabilitation. At this stage it seems that during rehabilitation even relatively small increases in physical activity may be beneficial to patient health outcomes.

In addition, recent research has identified sedentary time (too much sitting as distinct from not enough physical activity) as a significant health risk (Owen et al 2010). Patients admitted for inpatient rehabilitation appeared to have too much sedentary time, spending 23 hours per day sitting or lying down (Peiris et al 2013a, Peiris et al 2012a). An audit completed on patients with stroke in the same rehabilitation centre where the studies presented in this thesis were completed supports this idea. Patients were observed to be inactive at 91% of the observation points throughout the waking day and were in bed for 44% of observations points between 9:00 am and 7:00 pm (Rice et al 2012). As too much sedentary time is associated with negative health outcomes, frequent, short periods of physical activity may be beneficial in this population. For the inpatient rehabilitation population, it may not just be about increasing moderate level physical activity in 10 minute bouts, but also about decreasing sedentary time by having frequent, smaller bouts of physical activity.

This thesis contends that patients in rehabilitation were doing too much sitting and not enough physical activity. Guidelines suggest that adults and older adults who are affected by health conditions that limit physical activity should be as physically active as their conditions allow, while attempting to meet physical activity guidelines. Future research investigating how much physical activity this equates to for patients in inpatient rehabilitation is warranted as patients may benefit from even small increases in amount and frequency of physical activity.

Barriers to supporting an increase in physical activity during inpatient rehabilitation

A number of factors contribute to low levels of physical activity during rehabilitation. The rehabilitation environment and its existing routines, including meetings, ward rounds, and inflexible timetabling can be restrictive and partly responsible for inactivity as patients are expected to be waiting and available for visiting doctors, nurses and allied health therapists (Tinson 1989). The lack of stimulation in hospital wards may also be a deterrent to physical activity, as patients who would otherwise be active are discouraged by a lack of incentive (Clissett 2001). Changes to the ward environment, such as the inclusion of an activities room, kitchen and garden (Newall et al 1997) and access to environmental enrichment equipment and activities (Janssen et al 2013) to make the ward more stimulating and conducive to being active have been investigated. These studies found that an enriched environment led to increases in social and cognitive activity (Janssen et al 2013) but not significant increases in physical activity for patients with stroke (Janssen et al 2013, Newall et al 1997). This suggests that a number of factors may be important in limiting physical activity and that changing only one of these factors may be insufficient to elicit change in physical activity levels.

The low functional level of patients may be a limiting factor to self-directed physical activity (Bear-Lehman et al 2001). Patients recruited for the randomised controlled trial had a mean FIM score of 83 out of 126 on admission, indicating that typically they required supervision or assistance to complete some tasks (Peiris et al 2013b). Patient symptoms such as pain, fatigue, fear of falling and feeling unwell, as well as restraining medical devices such as catheters, may also make it difficult for patients to be physically active during rehabilitation (Capdevila et al 2006). Many patients in rehabilitation require the assistance of aids or other people to walk, therefore lack of availability of staff and assistive devices may also hinder physical activity during rehabilitation.

Additionally, patients are often actively discouraged from being independently active due to staff perceiving that they are at risk of falling or due to hospital policies designed to reduce the incidence of falls. Patients are often advised not to stand up or walk without the assistance of a staff member, but in the absence of available staff members this means that patients are inactive for extended periods of time. In a rehabilitation environment, such strict falls policies are contradictory to the aims of rehabilitation and can be unrealistic. Being overly risk-adverse may be an important factor in limiting physical activity and increasing sedentary behavior during inpatient rehabilitation.

In addition to these environmental and physical factors, admission to rehabilitation can prompt patients to take on the sick role resulting in a negative patient attitude towards physical activity (Faulkner and Aveyard 2002). A patient in Chapter 5 was relieved that she was not receiving additional weekend rehabilitation, as she felt that she needed to rest during rehabilitation stating: '*I couldn't cope with any more because I get so very tired*'(Peiris et al 2012b). While in rehabilitation, traditional beliefs and the ward environment may encourage the sick role. Patients can feel that resting for recovery is part of rehabilitation, and having their meals delivered to their beds and their televisions installed above their beds may confirm these beliefs. The sick role can also act as a barrier to patient participation in physical activity during rehabilitation.

Strategies to increase physical activity during inpatient rehabilitation

In an observational study, the most important factor driving physical activity following stroke was the presence of a therapist (Ada et al 1999). This suggests that increasing the amount of rehabilitation would increase physical activity levels. Patients who were participants in the qualitative study (Peiris et al 2012b) reported that their therapists were indeed motivating and that being in the gym environment with other patients was also motivating. To increase patient contact with therapists, who would provide supervision and motivation for patients to be

physically active, additional therapy sessions or group therapy may be provided by health services.

Patients in inpatient rehabilitation who received additional rehabilitation services had higher levels of physical activity compared to patients who received usual care (Glasgow Augmented Physiotherapy Study 2004, Peiris et al 2012a). Patients with lower limb orthopaedic conditions who received a modest amount of additional rehabilitation on Saturdays took 63% more steps per day and spent 40% more time in upright activities following the additional therapy compared to patients who did not receive it (Peiris et al 2012a). Patients with stroke who received additional physiotherapy services each weekday spent 66% more time in upright activities compared to patients who received a standard amount of therapy each weekday (Glasgow Augmented Physiotherapy Study 2004). Although patients who received additional rehabilitation had large percentage gains in physical activity, overall physical activity levels were still low. Even with additional rehabilitation, patients with orthopaedic conditions still only took a mean of 730 steps per day and spent 1.5 hours upright per day (Peiris et al 2012a) and patients with stroke spent less than 2 hours upright per day (Glasgow Augmented Physiotherapy Study 2004). This is still only around 10% of the recommended steps per day and one-quarter of the time that community-dwelling older adults spend upright per day.

Due to limited resources, providing additional individual therapy sessions may not always be feasible. Alternative options may include utilising allied health assistants or group therapy sessions to increase contact time with therapists. In an observational trial, patients with stroke who received group physiotherapy spent more time in physiotherapy sessions and more time socialising with other patients than patients who received individual therapy (De Weerdt et al 2001). In a non-randomised controlled trial, patients with stroke who received physiotherapy provided in a circuit group format received significantly more therapy per day and were more

likely to be able to walk independently on discharge compared to patients who received individual physiotherapy (English et al 2007).

Because barriers to physical activity are multi-factorial, strategies to increase physical activity during inpatient rehabilitation may need to address more than one factor. In addition to increasing the amount of rehabilitation provided, rehabilitation facilities need to consider falls prevention policies, staff attitudes towards physical activity and enriching the ward environment.

7.2 Additional Rehabilitation Services

Additional weekend rehabilitation improves patient health outcomes

As well as increasing physical activity levels, additional Saturday rehabilitation improved functional independence and health-related quality of life and may have reduced length of stay (Peiris et al 2013b). Patients who received additional Saturday rehabilitation had greater functional independence on discharge and were 17% more likely to achieve a clinically significant improvement in functional independence during their inpatient stay despite being discharged home sooner. These patients also had higher health-related quality of life scores on discharge and were 18% more likely to achieve a clinically significant improvement in health-related quality of life during their inpatient stay than patients who did not receive Saturday rehabilitation. This has positive benefits for patients, who were able to return home sooner, at a higher level of functional independence and health-related quality of life so that they could resume their roles in the community.

Results from this thesis also support recently published observational research. A retrospective audit compared a 7-day per week to a 5-day per week rehabilitation model in a large number of

patients (n=3,500) in a mixed rehabilitation setting over a 2-year period in the United States of America (Disotto-Monastero et al 2012). Patients who received 7-days per week of rehabilitation were discharged at a similar functional level but in a shorter period of time indicating higher efficiency. Length of stay was reduced from 20 days to 19 days and the facility had a 7% increase in admissions under the 7-days per week model. Retrospective, cross-sectional observational study designs are subject to bias as errors may have occurred in data entry and/or coding and health services are constantly changing. Other changes, such as funding and staffing changes, as well as the general trend towards reducing length of stay over time (Clarke and Rosen 2001), may have occurred simultaneously that may also have impacted on the primary outcome of length of stay in the DiSotto-Monastero study. However, the reported results in this study are similar to the findings reported in the randomised controlled trial (Peiris et al 2013b).

Results from the randomised controlled trial were consistent with results from the systematic review (Peiris et al 2011). The review concluded that providing an increased amount of physiotherapy (not necessarily on the weekend) to patients in acute and sub-acute settings increased walking ability, reduced activity limitation and increased health-related quality of life while also reducing length of stay. This systematic review has been updated since the original search was completed in May 2010 to ensure all relevant literature has been evaluated (Appendix 2). The updated systematic review included 4 new trials: 2 trials analysed the effects of extra physiotherapy following stroke (Cooke et al 2010, Donaldson et al 2009), one following heart surgery (Eder et al 2010), and one for inpatients with lower limb orthopaedic conditions (Peiris et al 2012a). Recent published research was consistent with previous research and reinforced the previous evidence that extra physiotherapy improved walking ability, activity and quality of life. For example, in regards to walking ability, the original review pooled data from 7 trials (n=665) to find that extra physiotherapy improved walking ability by SMD 0.37 (95%CI

0.05 to 0.69) and the updated review pooled data from 9 trials (n=737) to find that extra physiotherapy improved walking ability by SMD 0.42 (95%CI 0.14 to 0.70).

In Chapter 6, patient length of stay may have reduced by 2 days (95%CI 0 to 4) from a mean of 23 (SD 20) to 21 (SD 16) days. The 95% confidence interval reached zero meaning that it is possible that there was no difference in length of stay. This is a similar result to the systematic review (Peiris et al 2011) and a previous randomised controlled trial (Brusco et al 2007). In the sub-group analysis of patients in rehabilitation in the systematic review, extra physiotherapy services reduced length of stay by 4 days (95%CI 0 to 7) but the mean length of stay in this population was longer (Peiris et al 2011). In the Brusco study, extra Saturday physiotherapy may have reduced length of stay by 3 days (95%CI -1 to 7) from 24 (SD 16) days in the control group to 21 (SD 14) in the intervention group. In the randomised controlled trial in this thesis, the mean length of stay was considerably lower than the trials in Chapter 2 and had even reduced by 1 day when compared to the Brusco study, which was conducted in the same health service at one of the rehabilitation sites studied in Chapter 6 five years later. This overall reduction in length of stay may have resulted in less room for improvement. Even though the confidence interval in Chapter 6 includes zero, it still indicates that there may be a reduction in length of stay 19 out of 20 times which would have significant effects for the health service and for patients.

Patients who received additional rehabilitation had higher health-related quality of life scores on discharge (Peiris et al 2013b). These results are consistent with results of the systematic review (Peiris et al 2011) and updated review (Appendix 2) where extra physiotherapy services resulted in improved health-related quality of life by a moderate amount by pooling data from 6 trials (n = 524) in Appendix 2 (SMD 0.46, 95%CI 0.29 to 0.64) and 4 trials (n=424) in Chapter 2 (SMD 0.48, 95%CI 0.29 to 0.68). Most individual trials included in the review showed a trend towards patients who received additional therapy having higher health-related quality of life scores, but

these trials were underpowered to show any significant differences. Our randomised controlled trial was adequately powered to show a significant difference between groups.

Similar to the results of the majority of the individual trials in the systematic review, in the main randomised controlled trial of this thesis (Peiris et al 2013b) there were no significant differences between groups in terms of most secondary clinical outcomes, including the timed up and go test, Personal Care Participation Assessment and Resource Tool (PC-PART) and the modified Motor Assessment Scale. In the systematic review, 14 out of 16 results for walking ability and activity limitation across 10 trials did not show statistically significant differences between groups. This may be because in these trials, as with the trial in Chapter 6, interventions were focussed on improving overall functional independence to aid safe discharge and not specific activities such as walking speed or upper limb function. Additional rehabilitation may have increased self-selected walking speed for patients who received it (MD 0.03 m/s, 95%CI 0.00 to 0.06) (Peiris et al 2013b). However, considering the minimal clinically meaningful difference in walking speed is 0.1 m/s for patients with hip fracture (Palombaro et al 2006), stroke and geriatric conditions (Perera et al 2006) the difference between groups does not appear to be clinically significant. Previous research has reported similar results where patients following stroke (Glasgow Augmented Physiotherapy Study 2004, Partridge et al 2000) and patients in a mixed rehabilitation setting (Brusco et al 2007) did not have a faster walking speed with additional rehabilitation. However, patients following stroke who received additional rehabilitation that was specifically focussed on gait recovery had significantly faster walking speed compared to those receiving usual care physiotherapy (Richards et al 1993). This may reflect the importance of task-specific training and goals of rehabilitation.

There were no significant differences between groups on discharge in terms of personal care participation (PC-PART MD -1, 95%CI -3 to 1) in the main randomised controlled trial (Peiris et al 2013b). The PC-PART was designed to measure the level of participation restriction by

identifying problems in completion of 'personal activities of daily living' (basic self-care tasks such as washing and dressing) and 'instrumental activities of daily living' (more complex tasks such as meal preparation and money management); both of which are necessary for living in the community (Vertesi et al 2000). Despite being a measure of activities that occupational therapists would be assumed to focus on as part of their task-specific training for safe discharge, differences between groups did not reach statistical significance. This may be because the PC-PART is a relatively new tool that has not been well investigated in terms of its measurement properties. The PC-PART has been found to be clinically useful and there is positive evidence to support its content validity in inpatient, sub-acute settings, but there is inconclusive evidence for inter-rater reliability, construct validity and responsiveness (Darzins et al 2013).

Why did it work?

One explanation for the observed improvement in functional independence with additional Saturday rehabilitation may have been the higher physical activity levels observed with Saturday rehabilitation (Peiris et al 2012a). In Chapter 3, higher levels of physical activity were associated with improved functional outcomes for patients with lower limb orthopaedic conditions (Peiris et al 2013a). As physical activity can lead to improvements in musculoskeletal fitness, and musculoskeletal fitness is associated with improved functional independence (Warburton et al 2006), one could expect to see a similar association between higher levels of physical activity and functional independence in patients with other diagnoses. Patients post stroke who completed additional walking during rehabilitation by doing high-intensity treadmill training had improved walking capacity and walking speed compared to patients who received usual care (Kuys et al 2011). For frail older adults, physical activity interventions that improve musculoskeletal fitness are particularly important for improving functional independence (Warburton et al 2006). Additional weekend rehabilitation increased physical activity levels of

patients in inpatient rehabilitation (Peiris et al 2012a) and this additional physical activity may have contributed to the improved functional independence demonstrated in Chapter 6 (Peiris et al 2013b).

In addition to the effects of higher levels of physical activity, the extra rehabilitation may have directly contributed to improved functional independence. Patients reported that they felt the benefits of single rehabilitation therapy sessions, reporting *'when I came back* (from therapy) *I always felt much better'* (Peiris et al 2012b). Retrospective research has shown that an increased amount of physiotherapy and occupational therapy during inpatient rehabilitation contributes to increased functional gains following stroke (Bode et al 2004, Haines et al 2010) and for patients with orthopaedic conditions (Kirk-Sanchez and Roach 2001). Although the content of rehabilitation sessions was not monitored, rehabilitation provided in the studies of this thesis focused on functional task training and discharge planning which would help patients to make functional improvements within each rehabilitation session. Even though the amount of extra rehabilitation provided was relatively small (on average an extra 53 minutes per week) and was only provided once a week, these improvements may have carried over to increased functional independence outside of therapy and additional practice of tasks which would further help to improve function. This thesis provides indirect evidence that physiotherapy and occupational therapy interventions are effective in their aims of enabling patients to reach their optimal physical, intellectual, psychological and social independence.

Patients in the intervention group (Peiris et al 2013b) not only received more rehabilitation therapy overall but also had less consecutive days without rehabilitation therapy, which would have reduced the time needed for functional decline due to inactivity. Patients in the study reported in Chapter 5 stated that Saturday rehabilitation helped to maintain the flow of therapy so that they continued to improve and did not go backwards over the weekend (Peiris et al 2012b). Previous literature of retrospective studies investigating the distribution of services

across 7 days rather than 5 days is conflicting. In a non-randomised comparison study, distribution of physiotherapy rehabilitation services across 7-days of the week without an actual increase in the amount of rehabilitation did not alter clinical outcomes compared to 5-days per week in an acute orthopaedic setting (Holden and Daniele 1987). In a historical case-control study, where resources were increased to support a 7-day physiotherapy service in acute orthopaedics, there was a 1 day reduction in length of stay compared to a 5-day physiotherapy service (Hughes et al 1993). It is possible that a combination of increased overall amount of rehabilitation as well as a reduction in the amount of consecutive days without rehabilitation may have contributed to improved functional independence observed in the randomised controlled trial.

Allied health therapists often encourage patients to complete independent physical activity in the form of exercises or practice of specified functional tasks outside of therapy sessions and on weekends. However, patients do not appear to adhere to this advice and were least active outside of therapy (Peiris et al 2012a). This may be because patients are not mentally prepared or confident in their ability to exercise or practise functional tasks independently. Patients who received Monday to Friday rehabilitation reported feeling that weekends in rehabilitation were for resting and doing sedentary activities and not for completing therapy tasks, with one patient stating: *'in our minds, Saturdays and Sundays are days that you just don't do things like that'* (Peiris et al 2012b). Previous research shows that actual participation in the task, as opposed to verbal persuasion or education, is more effective at changing attitudes and increasing self-efficacy and confidence (Bandura et al 1969, McDonough et al 2013, Taylor et al 1985). Participating in additional Saturday rehabilitation seemed to change patients' perceptions of weekends in rehabilitation. When talking about doing rehabilitation on the weekend, Monday to Saturday rehabilitation patients had positive attitudes, with one patient stating: *'I tend to assume the more I get the better'*. The altered attitude demonstrated by patients who received Saturday rehabilitation was evident on Sundays when they were more active than Monday to Friday

rehabilitation patients even though neither group received rehabilitation (Peiris et al 2012a). Altered attitudes of patients receiving additional Saturday rehabilitation showed a shift towards patients having higher self-efficacy and being more active participants in their rehabilitation, which may have contributed to more self-directed physical activity and improved functional independence.

As well as having improved functional independence, patients who received additional weekend rehabilitation also had higher health-related quality of life at discharge compared to patients who received Monday to Friday rehabilitation (Peiris et al 2013b). The main theme that emerged from the qualitative study (Peiris et al 2012b) was that patients valued patient-therapist interactions. They also valued the socialisation and interactions that occurred with other patients and staff in the gym during therapy sessions. Patients in the intervention group spent more time with their therapists and more time in the gym environment socialising with other patients, which may have contributed to improvements in the anxiety/depression domain of health-related quality of life. Improvements in functional independence would also contribute to improvements in health-related quality of life, as the EuroQOL questionnaire of health-related quality of life (EQ-5D) takes into account functional domains such as mobility and self-care. In contrast, there were no significant differences between groups on the EuroQOL Visual Analogue Scale (EQ-VAS). This may be because the EQ-VAS does not specifically focus on functional domains of health-related quality of life (such as problems with mobility, pain and usual activities) but asks patients to give themselves a general health rating out of 100. The EQ-5D and the EQ-VAS have demonstrated similar levels responsiveness to change (Krabbe et al 2004), but the EQ-VAS may be less sensitive than other health-related quality of life measures (such as the SF-36) to differences between groups (Sculpher et al 1996).

Why were some benefits maintained?

Six and 12-month follow-up of functional independence and health-related quality of life was completed for patients in the randomised controlled trial (Peiris et al 2013b). Patients who received additional Saturday rehabilitation may have had some maintained benefits in functional independence and health-related quality of life at 6 months post discharge compared to patients who received Monday to Friday rehabilitation. At 6 months, patients who received additional Saturday rehabilitation may have had higher functional independence (MD 2.0, 95%CI 0.0 to 4.0) and were 19% (95%CI 6 to 34) more likely to have achieved a clinically significant improvement in health-related quality of life. During inpatient rehabilitation, patients who received additional weekend rehabilitation gained better functional independence and were better equipped to have a successful discharge and face the demands of living independently in the community and they maintained these improvements. Patients in both groups made small gains in functional independence from discharge to 6 months (which were maintained at 12 months), but the majority of improvement occurred during inpatient rehabilitation when therapy was being provided (Table 2, Peiris et al 2013b, Figure 7.1 below).

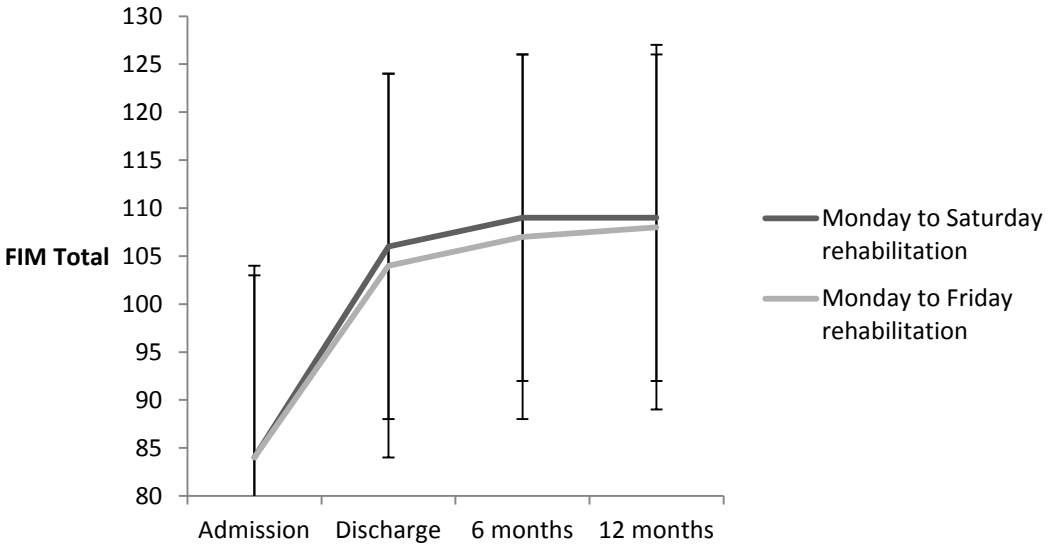

Figure 7.1. FIM total change

Previous trials on functional outcomes following rehabilitation for stroke (Lincoln et al 1999, Richards et al 1993, Sutbeyaz et al 2007, Yavuzer et al 2008) and hip fracture (Jones et al 2002) have found that most functional gains were made between admission and discharge from rehabilitation with results maintained (but not improved upon) at 6- or 12-month follow-up. Similar to functional independence, the majority of improvement in health-related quality of life occurred during inpatient rehabilitation with little changes in mean scores following discharge. Clinicians may often assume that the most important goal of rehabilitation is to discharge a patient home safely and that, in their own environments, patients will continue to make improvements. It may be assumed that the additional demands of living in the community would be sufficient stimulus for further improvement in functional independence; however, results of Chapter 6 and previous research (Jones et al 2002, Lincoln et al 1999, Richards et al 1993, Sutbeyaz et al 2007, Yavuzer et al 2008) do not support this. Therefore, it cannot be assumed that patients are going to get better on their own following discharge from rehabilitation, highlighting the importance of optimising functional gains while in rehabilitation.

Dose-response relationship: if 6 days is good – is 7 days better?

The results of this thesis suggest that providing 6 days a week of rehabilitation increased functional independence and health-related quality of life with some improvements maintained up to 6 months after discharge. It would be tempting to assume that providing even more rehabilitation would elicit further benefits; however, previous literature does not support the hypothesis of an unlimited positive linear relationship between rehabilitation amount and patient health outcomes. In a quasi-controlled trial (Ruff et al 1999) there were no differences in functional independence between patients who received 6-days per week of rehabilitation compared to those who received 7-days per week of rehabilitation following stroke. Like physical activity, where the most significant gains to health are made when increasing physical

activity from sedentary levels to low or moderately active (Wen et al 2011), the clinical effects of increasing rehabilitation services may be dependent on the amount already provided. In addition, patients receiving inpatient rehabilitation may need an uninterrupted day to rest and have visitors.

One recent suggestion for patients with stroke is that the relationship between amount of physiotherapy provided and clinical outcomes (such as functional independence) may be one of 'diminishing marginal returns' whereby improvement in function decreases with further increases in physiotherapy provision (Haines et al 2010). In Haines' observational study of patients with stroke in inpatient rehabilitation, the clinical effect of increasing physiotherapy resources depended on the amount of physiotherapy already provided. Similar to physical activity, larger clinical gains may occur when increasing therapy time from a low amount, with diminishing returns when increasing the amount of therapy from a dose that is already sufficient. However, there is no consensus on the optimal amount of rehabilitation that should be provided and there is limited data available on the dose-response relationship of amount of rehabilitation and functional outcomes.

7.3 Translating research into practice

Patients can cope with additional rehabilitation

Despite some patient concerns on recruitment that they might not be able to cope with additional rehabilitation, those who received it were accepting and positive about it and were inclined to advocate for even more rehabilitation. Patients who received extra Saturday rehabilitation reported that they felt it was '*a good idea'* and that they get '*plenty of rest*' anyway (Peiris et al 2012b). Patients coped well with the additional rehabilitation and, as shown in Chapter 4, rested

less on Sundays compared to patients in the Monday to Friday rehabilitation group (Peiris et al 2012a). Additional Saturday rehabilitation services were safe for patients admitted to inpatient rehabilitation. No serious adverse events occurred during Saturday rehabilitation and there was a trend towards there being 19% fewer adverse events in the intervention group (RR = 0.81, 95%CI 0.61 to 1.08) compared to the control group (Peiris et al 2013b).

Barriers to implementing weekend rehabilitation

Most rehabilitation facilities would say 'we already provide weekend rehabilitation' but there is a distinct difference between having a physiotherapist and/or an occupational therapist available on the weekends to see only high-priority patients and actually providing rehabilitation therapy to all patients. In fact, a recent survey found that only 30% of rehabilitation facilities in Australia reported providing any form of weekend physiotherapy (Shaw et al 2012). In acute settings in Canada it is recognised that weekend physiotherapy staffing is reduced by almost 90% on weekends and is only available to patients at risk of deterioration or scheduled for admission or discharge over the weekend (Campbell et al 2010). Rehabilitation settings appear to have similar guidelines to limit patients who are eligible to receive weekend rehabilitation and similar staffing reductions on weekends. A feature of the trial reported in Chapter 6 is that a full rehabilitation service for physiotherapy and occupational therapy was provided for patients allocated to the intervention group. This full service included having physiotherapy and occupational therapy staffing levels at weekday levels, and providing rehabilitation in the same setting as during the week, for example by having patients portered to the gym on Saturdays. Having an inadequate understanding of the meaning of weekend rehabilitation is the first barrier to its implementation.

Weekend allied health staffing costs more money; money which may not be in a hospital budget. At the sites where the trial was run, therapists are paid 1.5 times their usual rates when they

work on the weekends. This 50% increase in staffing costs for a service with, for example, 6 therapists (comprising 2 senior therapists, 2 junior therapists, and 2 allied health assistants) would cost upwards of an extra $AUD500 per day compared to weekdays. Indeed, one of the facilities in this trial has reverted back to their traditional weekend model of reduced staffing and ad-hoc therapy once funding that supported the trial was completed. This thesis provides clinical evidence with a low risk of bias from a fully powered randomised controlled trial for the provision of additional weekend allied health rehabilitation. However, the decision to implement these services cannot be based on clinical outcomes alone. Health service managers need to consider the cost of providing the additional services in conjunction with the clinical benefits and potential cost benefits to decide whether the provision of additional services is economically feasible. Additional Saturday rehabilitation helped patients to get better in a shorter period of time (Peiris et al 2013b) indicating a higher level of service efficiency. This efficiency means that health services may be able to treat more patients throughout the year which may lead to significant cost benefits. It also means that patients may not have to wait as long for a rehabilitation bed when they need one because patient flow would be increased.

7.4 Limitations and Strengths

A potential limitation of the studies in this thesis is that they were completed in general rehabilitation populations. This has implications from a health service perspective, where managers often have to provide a service for all patients in their rehabilitation wards, but may not be as easily applied to individual patients with specific diagnoses. In Chapter 6, the overall effects of weekend rehabilitation on functional independence and health-related quality of life were clear. As sub-group analyses for diagnoses (e.g. orthopaedic, stroke) were not initially planned for this trial, such post-hoc analyses would not be sufficiently powered and may

therefore produce misleading results and false-negatives. Therefore, such sub-group analyses are not recommended (Schulz and Grimes 2006). In addition, it has been suggested that the most reliable estimate for a sub-group is the overall effect (of all sub-groups combined) rather than the observed effect on that sub-group alone (Schulz and Grimes 2006). Considering the similarities among patients with different diagnoses, patients with neurological and orthopaedic health conditions for example, one hypothesis could be that both groups of patients benefited similarly from additional weekend rehabilitation. Both groups have low physical activity levels in rehabilitation, poor functional recovery following hospitalisation, similar attitudes to weekend rehabilitation and similar increases in physical activity with additional rehabilitation.

Another limitation is that patients who received additional Saturday rehabilitation did not receive the planned amount of additional rehabilitation. Patients in the intervention group received 13% more rehabilitation than usual care (rather than the planned 20% extra rehabilitation). This may mean that the dose was not sufficient to detect changes in secondary outcomes. Despite this, the amount of additional rehabilitation was sufficient to detect differences in the primary outcomes of functional independence and health-related quality of life. Patients in the intervention group may not have received the prescribed amount of additional rehabilitation due to missed sessions of therapy as a consequence of feeling unwell, day leave or because they were admitted late in the week (i.e. patients admitted on Fridays may not have completed informed consent and baseline assessments before randomisation could occur and they could be added to the weekend roster).

This thesis did not involve a formal cost analysis but a health economic analysis is planned as part of the broader project (Taylor et al 2010b) and will be reported elsewhere. In order for health services to determine whether providing additional weekend rehabilitation is economically viable, a formal cost analysis must be considered. The results (Peiris et al 2013b) indicate that extra weekend rehabilitation may reduce length of stay by 2 days and considering

length of stay is the largest contributor to costs in rehabilitation (Jorgensen et al 1997, Saxena et al 2007), additional weekend rehabilitation may have potential cost benefits.

One of the strengths of this thesis was the main randomised controlled trial (Peiris et al 2013b). This trial was conducted at two rehabilitation sites, had no exclusions based on cognition or language spoken, had a high recruitment rate and allocated almost 1,000 participants. This means that the recruited participants are a good representation of patients in metropolitan rehabilitation centres, which makes the results generalisable to inpatient rehabilitation settings. This trial also included blinded assessors and 6 and 12 month follow-up of the primary outcomes to assess for a maintained effect.

Another strength of this thesis is the mixed methods approach used to investigate the effects of additional weekend rehabilitation. A mixed methods approach combines both quantitative and qualitative research methods to better understand a health problem or a response to a health intervention (Klassen et al 2013). The integration of both quantitative and qualitative research methods helps to maximise the strengths and minimise the weaknesses of each. An explanatory sequential mixed method design was used in this thesis so that one research project built on the results of another (Klassen et al 2013). For example, qualitative data collected in Chapter 5 helped to explain the mechanisms underlying the quantitative data collected in Chapters 3, 4 and 6. The systematic review and randomised controlled trials provide high quality evidence on the effects of the intervention, while the use of qualitative and observational research methods provided additional insights into possible explanations as to why the intervention was beneficial.

Research for this thesis has been reported in reference to published guidelines: PRISMA (Chapter 2), STROBE (Chapter 3) and CONSORT (Chapters 4 and 6) for the high-quality reporting of reviews, observational studies and randomised controlled trials (respectively). The two randomised controlled trials score highly on the PEDro scale for risk of bias – both scoring 8 out of 10. Random allocation was generated electronically and allocation was concealed in

sealed, opaque envelopes that were only opened after the participant was enrolled in the trial and had completed baseline testing. Clinical and demographic characteristics were similar at baseline in the intervention and control groups in both studies. Assessors in both studies were blinded to group allocation at baseline and at discharge, as were 6 and 12 month outcome assessors in Chapter 6. There were no drop-outs in Chapter 4 and data were available for at least 1 primary outcome for all participants at the primary endpoint (discharge) in Chapter 6. Intention-to-treat analysis principles were used in both studies as data from all participants were analysed according to original group allocation. Between-group differences in the form of mean differences and 95% confidence intervals were reported in both studies, as were point estimates and estimates of variability (means and standard deviations). These trials did not score 10/10 because they did not have participant or therapist blinding, which is rarely possible for physiotherapy and occupational therapy intervention trials.

7.5 Directions for future research

This thesis focussed on additional physiotherapy and occupational therapy during rehabilitation. Weekend provision of other allied health disciplines such as speech therapy, dietetics, neuropsychology, podiatry and social work may also have a beneficial effect on patient outcomes and efficiency of rehabilitation and warrant further investigation. For example, more intensive speech therapy for patients post stroke with aphasia may improve functional communication ability (Bhogal et al 2003) and additional weekend social work may facilitate more efficient discharge planning and organisation of community resources. Future research may also investigate whether it is the amount of rehabilitation or the timing of rehabilitation (designed to reduce consecutive days where no rehabilitation is provided) that affects outcomes.

Dose-response relationships in regards to both amount of physical activity and amount of rehabilitation are other areas where there has been relatively little investigation. Future research should consider maximum tolerable physical activity levels and should be designed to analyse the relationships between physical activity and functional outcomes, as well as the relationship between amount of rehabilitation and functional outcomes on dose-response relationship curves to guide optimal, safe dosage prescription. Methods for conducting such trials, particularly for determining safe and effective drug dosage, have been described previously (Bretz et al 2008). For example, research may commence with a dose trial to determine how much physical activity can be safely prescribed during rehabilitation by gradually escalating the dose of physical activity between cohorts of patients and closely monitoring for adverse reactions using an algorithm-based design such as a 3+3 design (Gao et al 2008, Lin and Shih 2001). This would help to guide the statement that people with limited capacity should be as physically active as their conditions allow (WHO 2011). Once a maximum tolerable dose of physical activity has been determined a randomised controlled trial could compare different doses of physical activity (up to and including the maximum tolerable dose) in relation to functional outcomes to determine the optimal dose of physical activity. Similar research methods could be used to determine maximum tolerable dose and optimal dose of rehabilitation therapy.

7.6 Conclusion

Additional Saturday rehabilitation increases physical activity levels, improves functional independence and health-related quality of life and may reduce length of stay during inpatient rehabilitation and should be provided as part of standard practice.

Appendix 1

ETHICS APPROVAL STATEMENTS

Studies in Chapters 3, 4, 5 and 6 were all considered in the same ethics approval statements as participants were recruited from the main study cohort in Chapter 6.

Ethics approval for the project to proceed

Eastern Health:	E58/0910
La Trobe University:	FHEC10/14

5 Arnold Street, Box Hill
Victoria 3128 Australia
PO Box 94, Box Hill 3128
Tel (03) 9895 3259
Fax (03) 9895 3176
info@easternhealth.org.au
ABN 68 223 819 017

www.easternhealth.org.au

19 January 2010

Eastern Health Research and Ethics Committee
Ph: 03 9895 3398
Fax: 03 9895 3575
Email: ethics@easternhealth.org.au
Website:
http://www.easternhealth.org.au/research/ethics/ethicsresearch.aspx

Professor Nick Taylor
Professor of Physiotherapy
Level 2
5 Arnold Street
Box Hill Vic 3128

Dear Prof Taylor

E58/0910 Do additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes?

The above study was considered by the Eastern Health Research and Ethics Committee to be conducted at Peter James Centre and Angliss Hospital at its meeting on 17 December 2009 and was approved subject to the amendments and clarifications. Following receipt of amended documents and additional information, **final approval** can now be given for the study to proceed.

The following documents have been approved:

- Module 1 – Revised sections C 1.14(b), 1.30 and 1.30(d)
- Participant Information and Consent Form Version 2 dated 24 December 2009
- Person Responsible Information and Consent Form Version 2 dated 24 December 2009
- Economic Data Questionnaire at 6 months Version 2 dated 24 December 2009
- Economic Data Questionnaire at 12 months Version 2, dated 24 December 2009.

In addition the following documents have been reviewed:

- Final Report from previous pilot study EH05/2004 dated 15 June 2006
- Australian Journal of Physiotherapy 2007 Vol 53 entitled " A Saturday physiotherapy service may decrease length of stay in patients undergoing rehabilitation in hospital: a randomised controlled trial". Publication from pilot study EH05/2004
- Demographic data sheet
- Quality of life: EUROQOL – 5D
- Functional Independence Measure
- Modified Motor Assessment Scale (MMAS)
- Medicare Consent Form
- PC PART – Personal Care Participation Assessment & Resource Tool

Please note, an annual progress report is due in January 2011- **continuing approval is subject to the timely submission of a satisfactory progress report.**

The Eastern Health Research and Ethics Committee is constituted and functions in accordance with the National Health and Medical Research Council Guidelines (National Statement on Ethical Conduct in Human Research 2007). No member of the Committee adjudicates on research in which that member has any conflict of interest including any personal involvement or participation in the research, any financial interest in the outcome or any involvement in competing research.

N:\02-03&current\Ethics - Eastern Health\All Correspondence\0910 studies\E58-0910 Final Approval 19Jan2010.doc

easternhealth

5 Arnold Street, Box Hill
Victoria 3128 Australia
PO Box 94, Box Hill 3128
Tel (03) 9895 3259
Fax (03) 9895 3176
info@easternhealth.org.au
ABN 68 223 819 017

www.easternhealth.org.au

E58/0910 Do additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes?

Please refer to the National Statement on Ethical Conduct in Human Research (2007) http://www.nhmrc.gov.au/publications/synopses/e35syn.htm and Module 1.38 for researchers' obligations. **Continuing approval is subject to the adherence of these guidelines and the fulfilment of researchers' obligations.**

Please quote our reference number ***E58/0910*** in all future correspondence.

Yours sincerely

B. Kent Prof. Beidie Kent
Acting Chair

pp.
Dr Patricia Molloy
Chair
Eastern Health Research and Ethics

Encl: Committee Composition letter

N:\02-03&current\Ethics - Eastern Health\All Correspondence\0910 studies\E58-0910 Final Approval 19Jan2010.doc

La Trobe University
Faculty of Health Sciences
MEMORANDUM

TO: Prof Nick Taylor — School of Physiotherapy
MS Natasha Brusco, Ms Jenny Watts
Dr Nora Shields, Ms Natalie Sullivan,
Dr Genevieve Kennedy, Dr Kwong Teo
Ms Allison Farley, Ms Kylee Lockwood,
Ms Camilla Radia-George

SUBJECT: *Reference:* **FHEC10/14**

Student or Other Investigator:

Title: **Do additional allied health services for rehabilitation reduce length of stay without comprising patient outcomes?**

DATE: 15 March, 2010

The Faculty Human Ethics Committee's (FHEC) reviewers have considered and approved the above project. You may now proceed.

Please note that the Informed Consent forms need to be retained for a minimum of 5 years. Please ensure that each participant retains a copy of the Informed Consent form. Researchers are also required to retain a copy of all Informed Consent forms separately from the data. The data must be retained for a period of 15 years.

Please note that any modification to the project must be submitted in writing to FHEC for approval. You are required to provide an annual report (where applicable) and/or a final report on completion of the project. A copy of the progress/final report can be downloaded from the following website: http://www.latrobe.edu.au/rgso/forms-resources/forms/ethic-prog-final.rtf

Please return the completed form to The Secretary, FHEC, Faculty of Health Sciences Office, La Trobe University, Victoria 3086.

If you have a student/s involved in this project, a copy of this memorandum is enclosed for you to forward to the student(s) concerned.

Neil McDonald
Secretary
Faculty Human Ethics Committee
Faculty of Health Sciences

ADDITIONAL ETHICS DOCUMENTS

Ethics approval for student investigator, Casey Peiris, to be involved in the project

Eastern Health request	24 May 2010
Eastern Health approval	8 June 2010
La Trobe University request	25 May 2010
La Trobe University initial approval	31 May 2010
La Trobe University final approval	19 August 2010

easternhealth

EASTERN HEALTH RESEARCH AND ETHICS COMMITTEE

REQUEST FOR APPROVAL OF AMENDMENT

Date: 24/5/2010

Please use this form for all amendments including protocol, Participant Information & Consent Forms and updated Investigator Brochures.

Amended documents must have an updated Version number and date.

Ethics Committee Reference No: E58/0910

Project Title: Do additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes?

If amendments relate to more than one study, please insert details below.

- *List Ethics Reference Number*
- *Followed immediately by the Project Title for EACH additional project*

Principal Researcher/s:	**Study Co-ordinator/s:**
Nicholas Taylor	
Contact Details:	**Contact Details:**
Nicholas.Taylor@easternhealth.org.au	
(Please include a current email address.)	*(Please include a current email address.)*

List of documents included:

Participant Information and Consent Form version 3, dated May 24, 2010 clean

Participant Information and Consent Form version 3, dated May 24, 2010 marked

Person responsible Information and Consent Form version 3, dated May 24, 2010 clean

Person responsible Information and Consent Form version 3, dated May 24, 2010 marked

Schedule of survey questions at discharge, version 1, dated May 24, 2010

Demographic data collection sheet, version 2, dated May 24, 2010

What changes have occurred or are intended? (*Please specify in full*)

1. PhD student Casey Peiris and Project Officers Renita Yap and Clarissa Koukounas have been added to the list of researchers, students and project officers at the front of the Information and Consent forms

2. In section 3 of the PICF we have explained to the participant (or their person responsible) that as part of assessing walking and general function an activity monitor, a small lightweight device that can measure the number of steps taken and the amount of time standing or walking, may be placed on their thigh during their stay in hospital.

3. In section 3 of the PICF we have explained that we would like to survey the participants near the end of their stay in hospital to find out how they felt about their rehabilitation and the amount of therapy they received. Particpants who required a person responsible to acknowledge participation in the project will not be asked to complete this survey. A schedule of survey questions is attached.

4. In section 3 of the PICF we have also clarified that the survey to assess the amount and type of health services accessed will only take place at 6 months and 12 months after leaving hospital

5. On the advice of our steering committee we have decided not to collect data on the Functional Reach Test and the Step Test, to reduce the burden of testing on patients. We have also reformatted the demographic data collection sheet.

Please Note:

Investigator Brochures

The Eastern Health Research & Ethics Committee requires a brief, clear and simple explanation from the Principal Investigator as to what the changes are, what they mean, why they have occurred and whether they impinge in any way on the conduct of the trial at our site/s and/or on our patients.

Please explain the reasons for these changes: (*Please specify and provide comments as necessary for clarity. State how the amendment will affect study conduct at Eastern Health*)

We are in the set up phase of the project and plan to commence data collection on July 1, 2010. The proposed amendments have resulted from meetings of the project steering committee that will ensue that the project proceeds as planned.

1. PhD student Casey Peiris, and Project offficers Renita Yap and Clarissa Koukounas are named as they will have contact with participants in the trial.

2. As part of the assessment of walking, balance and general function, we have clarified for the participant that this could include placing a small, lightweight activity monitor on their thigh. This is important for the project as our main research question is whether increasing the intensity of rehabilitation therapy improves outcomes. Assessing activity during the rehabilitation stay is a way of measuring if participants allocated to the Saturday rehabilitation group were, in fact, more active.

3. We would like to expand on the exisiting survey about how happy the participant is with different aspects of their life by asking some questions about how they felt about their rehabilitation and the amount of therapy they received. This is important because the success of providing additional rehabilitation should also take account of the participants' perceptions.

4. We have clarified that the telephone survey to assess the amount and type of health services accessed will only take place at 6 months and 12 months after leaving hospital.

5. On the advice of our steering committee we have decided not to collect data on the Functional Reach Test and the Step Test, to reduce the burden of testing on patients. We already have three tests that adequately capture whether patients have met goals of therapy during rehabiltiation: the 10m walk test, timed up and go test and the MMAS. An amended demographic data collection sheet is attached. The demographic and data collection sheet has been reformatted to make it easier for project personnel to use, the first sheet will be completed by the project officer, the second sheet will be completed by the occupational therapist, and the third sheet will be completed by the physiotherapist.

Do you believe these changes raise any ethical issues in relation to study conduct?

Yes ☐ No ☒

If yes, please identify and discuss

Does the Participant Information and Consent Form require revision?

Yes ☒ No ☐

If yes,

(Please provide one "strikethrough" and one clean copy of the amended Participant Information and Consent Form. This is a requirement for all studies not just sponsored trials.)

Have you provided a strike through copy of the amended version? Yes ☒ No ☐

Have you provided a clean copy of the amended version? Yes ☒ No ☐

If there has been a change to the Protocol:

*(Please provide one Summary of Changes document **or** one "strikethrough" protocol **with** one fully amended {clean copy} protocol. This is a requirement for all studies not just sponsored trials.)*

Have you provided a strike through copy of the amended protocol? Yes ☐ No ☐

Have you provided a Summary of Changes document? Yes ☐ No ☐

Have you provided a clean copy of the amended protocol? Yes ☐ No ☐

Does the amendment include additional and/or different drugs or devices (or involve a new indication for any drug)?

☐ **Yes, CTN form attached** ☐

☒ **No**

Does the amendment involve additional ionised radiation procedures?

☐ **Yes, Use of Ionizing Radiation Form is required - attached** ☐

A medical physicist report may also be required – attached ☐

☒ **No**

Does the amendment involve the services of an Eastern Health department, additional to those approved in the original protocol?

☐ **Yes, Supporting Department sign off attached** ☐

☒ **No**

Please add details if required:

Principal Investigator: (*print*) Nicholas Taylor

(*sign*) **Date**

Principal Investigator: *(print)*

(sign) **Date**

Please note:

Protocol Amendment attracts a fee. Payment must be enclosed at the time of document submission.

Please see web-page for current payment schedule and a template *Compliant Tax Invoice*: http://www.easternhealth.org.au/ethics/fees.shtml.

Payment enclosed: ☐ **Please give details:** *(Remittance details should be provided for EFT payments)*

Compliant Tax Invoice completed and attached: ☐

Payment does not apply: ☒ **Please give details: Eastern Health investigator intitiated project**

Submission Checklist:

- ONE paper version of this form, fully completed and signed ☒
- Amendments including mark-up and clean copies ☒

The following may be required:

- Supporting documents ☒
- Payment ☐
- Compliant Tax Invoice ☐

easternhealth

5 Arnold Street, Box Hill
Victoria 3128 Australia
PO Box 94, Box Hill 3128
Tel (03) 9895 3259
Fax (03) 9895 3176
info@easternhealth.org.au
ABN 68 223 819 017

www.easternhealth.org.au

Eastern Health Research and
Ethics Committee
Ph: 03 9895 3398
Fax: 03 9895 3575
Email:
ethics@easternhealth.org.au
Website:
www.easternhealth.org.au/ethics

08 June 2010

Prof Nick Taylor
Professor of Physiotherapy
C/o Level 2
5 Arnold Street
Box Hill Vic 3128

Dear Prof Taylor

E58 /0910 Do additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes?

Principal Investigators: Prof Nick Taylor

Eastern Health Site: The Angliss Hospital and Peter James Centre

Thank you for the submission for the project above.

The following documents have been reviewed and **APPROVED** by the Sub-Committee at its meeting on 07 June 2010:

- Request For Approval of Amendment form dated 24 May 2010
  - Person Responsible Information and Consent Form Version 3 dated 24 May 2010
  - Participant Information and Consent Form Version 3 dated 24 May 2010
  - Demographic Data Sheet Version 2 24 May 2010
  - Survey Version 1 dated 24 May 2010

Yours Sincerely

Ms Virginia Ma
Administrative Assistant
Eastern Health Research and Ethics
(On behalf of Ms Lai Wan Reid, Manager)

Members of Eastern Health

Angliss Hospital Tel (03) 9764 6111
Box Hill Hospital Tel (03) 9895 3333
Healesville & District Hospital Tel (03) 5962 4300
Maroondah Hospital Tel (03) 9871 3333
Peter James Centre Tel (03) 9881 1888
Wantirna Health Tel (03) 9955 1200
Yarra Ranges Health Tel (03) 9091 8888
Yarra Valley Community Health Service Tel 1300 130 381

LA TROBE UNIVERSITY

Research Services
Human Research Ethics

MODIFICATION FORM
FOR HUMAN RESEARCH

1. HEC Approval Number / Project Title:	FHEC/1014: Do additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes?
2. Chief Investigator / Supervisor: (academic staff members only)	Name: Nicholas Taylor Position: Professor of Physiotherapy Department / School: Physiotherapy
Student (if appropriate)	Name: Casey Peiris Course of Study: PhD Department / School: Physiotherapy
3. Project Duration: (subject to annual review)	Project commences: 1/7/2010 Project concludes: 1/12/2013

YOU ARE REMINDED THAT THE MODIFICATIONS PROPOSED IN THIS APPLICATION MUST NOT COMMENCE WITHOUT PRIOR WRITTEN APPROVAL FROM THE UHEC OR APPROPRIATE FHEC

4 MODIFICATIONS PROPOSED: modifications may include minor changes to the aims, direction, procedures, personnel, duration, method of recruitment or numbers of subjects as well as the consent form or project information sheet. The UHEC or FHEC will review the proposed modifications and may determine that a new application is required. Please itemise the changes you are requesting. For new personnel please complete an Investigator Template (at the end of this form) for each new investigator.

1. PhD student Casey Peiris and Project Officers Renita Yap and Clarissa Koukounas have been added to the list of researchers, students and project officers at the front of the Information and Consent forms
2. In section 3 of the PICF we have explained to the participant or their person responsible that as part of assessing walking and general function an activity monitor, a small lightweight device that can measure the number of steps taken and the amount of time standing or walking, may be placed on their thigh during their stay in hospital.
3. In section 3 of the PICF we have explained that we would like to survey the participants near the end of their stay in hospital to find out how they felt about their rehabilitation and the amount of therapy they received. Participants who required a person responsible to acknowledge participation in the project will not be asked to complete this survey. A schedule of survey questions is attached.
4. In section 3 of the PICF we have also clarified that the survey to assess the amount and type of health services accessed will only take place at 6 months and 12 months after leaving hospital.
5. On the advice of our steering committee we have decided not to collect data on the Functional Reach Test and the Step Test, to reduce the burden of testing on patients. We have also reformatted the demographic data collection sheet.

5 REASONS FOR THE MODIFICATION: please indicate whether to date any ethically significant incidents have arisen or any complaints have been received in connection with this project.

Data collection for the project is scheduled to start on July 1, 2010. Therefore no incidents or complaints have been received in connection with this project

1. PhD student Casey Peiris, and Project officers Renita Yap and Clarissa Yap are named as they will have contact with participants in the trial.
2. As part of the assessment of walking, balance and general function, we have clarified for the participant that this could include placing a small, lightweight activity monitor on their thigh. This is important for the project as our main research question is whether increasing the intensity of rehabilitation therapy improves outcomes. Assessing activity during the rehabilitation stay is a way of measuring if participants allocated to the Saturday rehabilitation group were, in fact, more active.
3. We would like to expand on the existing survey about how happy the participant is with different aspects of their life by asking some questions about how they felt about their rehabilitation and the amount of therapy they received. This is important because the success of providing additional rehabilitation should also take account of the participants' perceptions.
4. We have clarified that the telephone survey to assess the amount and type of health services accessed will only take place at 6 months and 12 months after leaving hospital.
5. On the advice of our steering committee we have decided not to collect data on the Functional Reach Test and the Step Test, to reduce the burden of testing on patients. We already have three tests that adequately capture whether patients have met goals of therapy during rehabilitation: the 10m walk test, timed up and go test and the MMAS. An amended demographic data collection sheet is attached. The demographic and data collection sheet has been reformatted to make it easier for project personnel to use, the first sheet will be completed by the project officer, the second sheet will be completed by the occupational therapist, and the third sheet will be completed by the physiotherapist.

Investigator Template:

Investigator: For database purposes please ensure that all details are up to date and correct.			
Name:	Casey Peiris	Phone:	0415676541
		Email:	Casey.Peiris@easternhealth.org.au
School/Inst	Physiotherapy/ Eastern Health	Staff No:	
		Student No:	16377008
Academic Title / Qualification:	B Physiotherapy (Hons)	Signature	
Position / Other Affiliations Relevant to this Application. If Student provide Details on Level	PhD student		

Investigator Template:

Investigator: For database purposes please ensure that all details are up to date and correct.			
Name:	Renita Yap	Phone:	0401043776/97646146
		Email:	Renita.Yap@easternhealth.org.au
School/Inst	Eastern Health	Staff No:	N/A
		Student No:	N/A
Academic Title / Qualification:	B Physiotherapy	Signature	
Position / Other Affiliations Relevant to this Application. If Student provide Details on Level	Project Officer		

Investigator Template:

Investigator: For database purposes please ensure that all details are up to date and correct.			
Name:	Clarissa Koukounas	Phone:	0402484607
		Email:	Clarissa.Koukounas@easternhealth.org.
School/Inst	Eastern Health	Staff No:	N/A
		Student No:	N/A
Academic Title / Qualification:	B Occ Therapy	Signature	
Position / Other Affiliations Relevant to this Application. If Student provide Details on Level	Project Officer		

6 SUBMITTED BY:

Name: Nicholas Taylor

LTU Title/Position: Professor of Physiotherapy **Date: 25/5/10**

Telephone Number: 9479 5860 or 9091 8874 **E-mail Address: N.Taylor@latrobe.edu.au**

LODGING THIS FORM

Please send this form via e-mail to the Committee which initially approved your application. Contact details for Committees can be found in the La Trobe Human Research Ethics Guidelines, available on the La Trobe University Human Ethics Web Site.

La Trobe University
Faculty of Health Sciences
MEMORANDUM

TO: Prof Nick Taylor
MS Natasha Brusco, Ms Jenny Watts
Dr Nora Shields, Ms Natalie Sullivan,
Dr Genevieve Kennedy, Dr Kwong Teo
Ms Allison Farley, Ms Kylee Lockwood,
Ms Camilla Radia-George
School of Physiotherapy

SUBJECT: *Reference:* **FHEC10/14**

Other Investigators/ Students

Title: **Do additional allied health services for rehabilitation reduce length of stay without comprising patient outcomes?**

DATE: 31 May, 2010

The Faculty Human Ethics Committee's (FHEC) reviewers have considered the above project and have minor queries. FHEC needs to receive the following information/or modifications:

Please provide a copy of Eastern Health's HREC's approval of these amendments on receipt.

Please provide your amendments in a memorandum. It is not necessary to resubmit the entire application again.

If you have a student/s involved in this project, a copy of this memorandum is enclosed for you to forward to the student(s) concerned.

Neil McDonald
Secretary
Faculty Human Ethics Committee
Faculty of Health Sciences

La Trobe University
Faculty of Health Sciences
MEMORANDUM

TO: Prof Nick Taylor — School of Physiotherapy
MS Natasha Brusco, Ms Jenny Watts
Dr Nora Shields, Ms Natalie Sullivan,
Dr Genevieve Kennedy, Dr Kwong Teo
Ms Allison Farley, Ms Kylee Lockwood,
Clarissa Koukounas, Renita Yap

SUBJECT: *Reference:* **FHEC10/14**

Student or Other Investigator: Camilla Radia-George, Casey Peiris

Title: **Do additional allied health services for rehabilitation reduce length of stay without comprising patient outcomes?**

DATE: 19 August, 2010

The Faculty Human Ethics Committee's (FHEC) reviewers have considered and approved the modification to the above project. You may now proceed.

Please note that the Informed Consent forms need to be retained for a minimum of 5 years. Please ensure that each participant retains a copy of the Informed Consent form. Researchers are also required to retain a copy of all Informed Consent forms separately from the data. The data must be retained for a period of 15 years.

Please note that any modification to the project must be submitted in writing to FHEC for approval. You are required to provide an annual report (where applicable) and/or a final report on completion of the project. A copy of the progress/final report can be downloaded from the following website: http://www.latrobe.edu.au/rgso/forms-resources/forms/ethic-prog-final.rtf

Please return the completed form to The Secretary, FHEC, Faculty of Health Sciences Office, La Trobe University, Victoria 3086.

If you have a student/s involved in this project, a copy of this memorandum is enclosed for you to forward to the student(s) concerned.

Neil McDonald
Secretary
Faculty Human Ethics Committee
Faculty of Health Sciences

Appendix 2

UPDATE OF SYSTEMATIC REVIEW 2010 TO 2012

OBJECTIVES

To update research completed for the systematic review in Chapter 2 (where the search was conducted up to May 2010) to ensure all current evidence on the effects of providing additional physiotherapy services has been evaluated.

METHOD

Using the same search strategy that was used in the published systematic review the search was repeated in 5 electronic databases: Medline, CINAHL, AMED, EMBASE and PEDro from January 1, 2010 to November 29, 2012. Additional trials were identified by scanning reference lists and citation tracking of included trials on Google scholar.

Randomised controlled trials evaluating the effect on health outcomes of providing additional physiotherapy intervention to patients with acute or sub-acute health conditions were included in this review. Previously used inclusion and exclusion criteria were applied when determining the eligibility of trials for inclusion.

Data were extracted using the predefined data extraction form from Chapter 2 and methodological quality was assessed using the PEDro scale.

Where new data fitted into previously used functional outcome categories (length of stay, walking ability, activity, self-care and quality of life) updated meta-analyses were completed by combining data from Chapter 2 with new published data. Pooled analyses with random effects model to calculate standardised mean differences and 95% confidence intervals were used in meta-analyses.

RESULTS

Searching identified 2,535 new articles, of which, 4 trials with 236 participants were selected for inclusion in the updated systematic review (Figure A.1). Two trials analysed the effects of extra physiotherapy following stroke (Cooke et al 2010, Donaldson et al 2009), one following heart surgery (Eder et al 2010), and one for inpatients with lower limb orthopaedic conditions (Peiris et al 2012a) (Table A.1).

Data from 2 of the selected trials did not fit into previously defined categories. Outcomes in one trial were related to physical activity levels of patients (Peiris et al 2012a); this is the trial presented in Chapter 4. The other used outcomes to assess upper limb function only and found no significant differences between conventional physiotherapy and additional physiotherapy in treatment of the upper limb following stroke (Donaldson et al 2009). Data from the other 2 trials fitted into the categories of walking ability, activity and quality of life so these meta-analyses were updated. Compared to a standard amount of physiotherapy, extra physiotherapy improved walking ability (SMD 0.42, 95%CI 0.14 to 0.7, I^2 65%) (Figure A.2), activity (SMD 0.21, 95%CI 0.07 to 0.35, I^2 0%) (Figure A.3) and quality of life (SMD 0.46, 95%CI 0.29 to 0.64, I^2 0%) (Figure A.4). These results are similar to the results in the original systematic review (Table A.2).

CONCLUSIONS

Recent research is consistent with results from Chapter 2. Again, results of the individual trials often did not reach statistical significance but when pooled into the meta-analysis, add strength to the review.

Table A.1. Study Characteristics

Authors	Patient health condition	Setting	Extra OT (Y/N)	PEDro score	Use of ITT (Y/N)	Number of participants (exp/comp)	Men: Women (exp/comp)	Mean age (exp/comp)	Extra therapy	Extra PT (mins/ day)	Outcomes
Cooke et al 2010	Stroke	Sub-Acute inpatient rehabilitation	No	8	Yes	35/38	22:13 / 21:17	67.5/66.4	Extra conventional physiotherapy, 1hour/day, 4days/week	20	Walking speed Strength Rivermead Mobility Index HRQOL
Donaldson et al 2009	Stroke	Sub-Acute inpatient	No	8	Yes	10/10	5:5/ 5:5	73.3/72.6	Extra conventional physiotherapy, 1hour/day, 4days/week	16	Upper limb: Function Dexterity Strength
Eder et al 2010	Heart surgery	Acute inpatient	No	4	No	19/19	32:28	73.1	Extra walking	14	6MWT HRQOL
Peiris et al 2012a	Lower limb orthopaedic	Inpatient rehabilitation	Yes	8	Yes	51/54	14:37 / 19:35	75/73	Additional session of OT and PT on Saturday	21	Steps per day Upright time per day

Note. OT=occupational therapy, ITT=intention to treat, Y=yes, N=no, Exp=experimental group, comp=comparison group, PT=physical therapy

Table A.2. Standardised mean difference (95%CI) for effect of extra physiotherapy on walking ability, activity and quality of life from original and updated systematic reviews.

Outcome	Peiris et al 2011	Updated
Walking ability	0.37 (0.05 to 0.69), I^2 71%	0.42 (0.14 to 0.7), I^2 65%
Activity	0.22 (0.07 to 0.37), I^2 4%	0.21 (0.07 to 0.35), I^2 0%
Quality of life	0.48 (0.29 to 0.68), I^2 0%	0.46 (0.29 to 0.64), I^2 0%

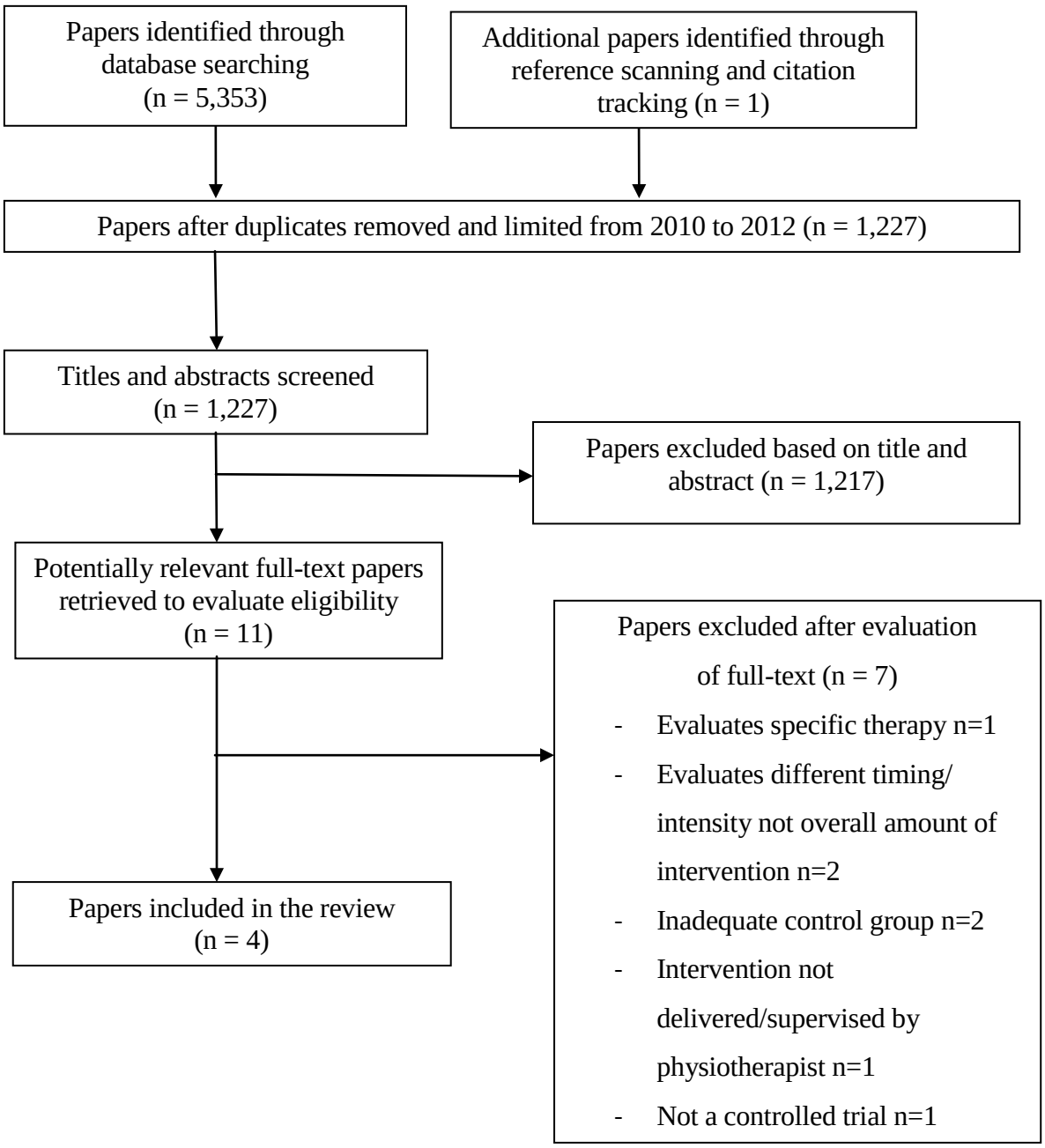

Figure A.1. Flow of trials through the review

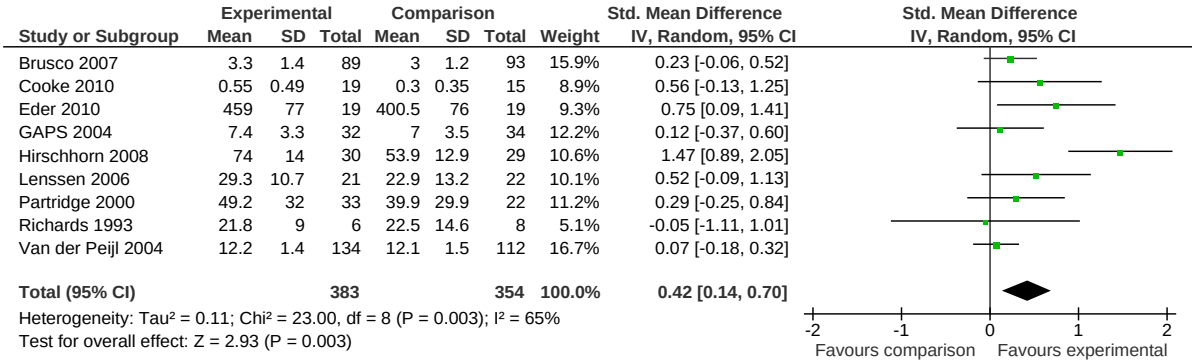

Figure A.2. SMD (95%CI) for the effect of extra physiotherapy on walking ability by pooling data from 9 trials (n=737)

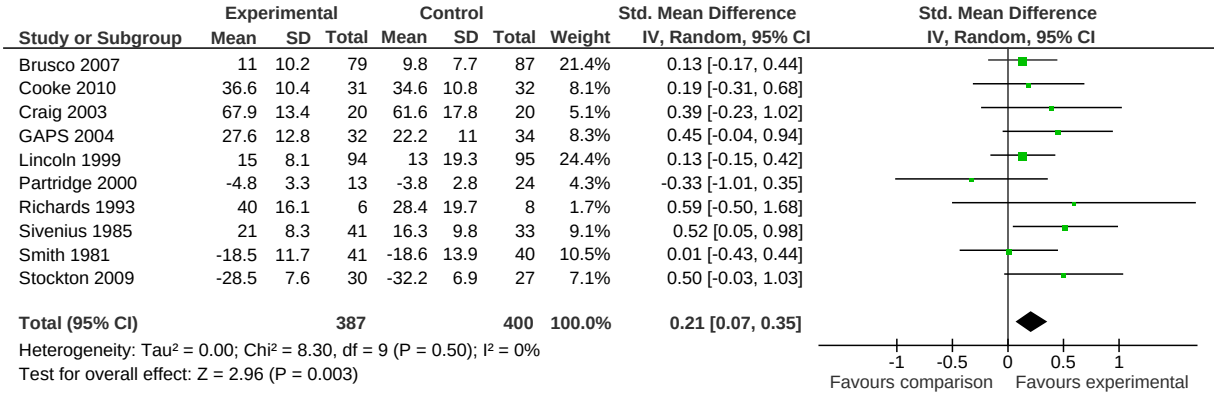

Figure A.3. SMD (95%CI) for the effect of extra physiotherapy on activity by pooling data from 10 trials (n=787)

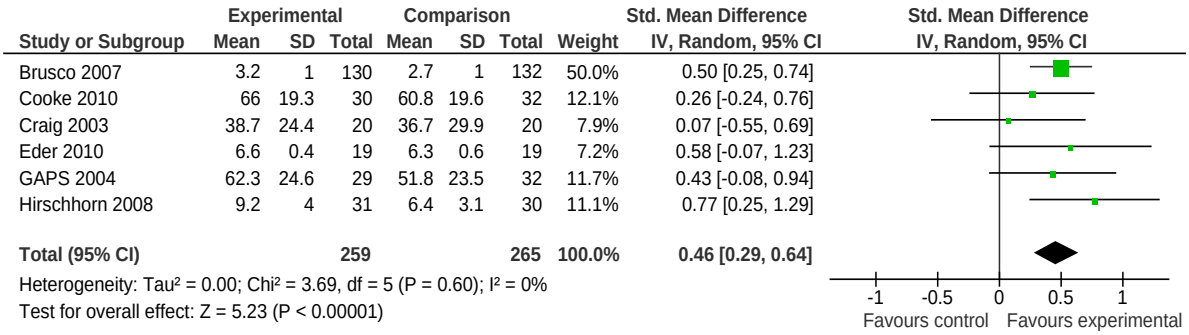

Figure A.4. SMD (95%CI) for the effect of extra physiotherapy on quality of life by pooling data from 6 trials (n=524)

Appendix 3

PUBLICATION STATEMENTS

STUDY ONE

Statement from the authors confirming the authorship contribution of the PhD Candidate:

"As co-authors of the paper '**Peiris CL**, Taylor NF and Shields N (2011): Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. *Archives of Physical Medicine and Rehabilitation* 92: 1490-1500' we confirm that Casey Peiris made the following contributions:

- Conception and design of the research
- Collection of data
- Analysis of data
- Interpretation of findings
- Writing the paper
- Critical appraisal of the content and
- Response to reviewers"

Professor Nicholas F Taylor..... ..... Date 20/9/13

Associate Professor Nora Shields. ..... Date 20/9/13

STUDY TWO

Statement from the authors confirming the authorship contribution of the PhD Candidate:

"As co-authors of the paper '**Peiris CL**, Taylor NF and Shields N (2012): Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopaedic conditions: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation* 93: 1365-1370' we confirm that Casey Peiris made the following contributions:

- Conception and design of the research
- Collection of data
- Analysis of data
- Interpretation of findings
- Writing the paper
- Critical appraisal of the content and
- Response to reviewers"

Professor Nicholas F Taylor..... ..... Date 20/9/13

Associate Professor Nora Shields.. ..... Date 20/9/13

STUDY THREE

Statement from the authors confirming the authorship contribution of the PhD Candidate:

"As co-authors of the paper '**Peiris CL**, Taylor NF and Shields N (2012): Patients value patient-therapist interactions more than the amount or content of therapy during rehabilitation: a qualitative study. *Journal of Physiotherapy* 58: 261-268' we confirm that Casey Peiris made the following contributions:

- Conception and design of the research
- Collection of data
- Analysis of data
- Interpretation of findings
- Writing the paper
- Critical appraisal of the content and
- Response to reviewers"

Professor Nicholas F Taylor..... ..... Date 20/9/13

Associate Professor Nora Shields... ..... Date 20/9/13

STUDY FOUR

Statement from the authors confirming the authorship contribution of the PhD Candidate:

"As co-authors of the paper '**Peiris CL**, Taylor NF and Shields N (2013): Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions do much less physical activity than recommended in guidelines for healthy older adults: an observational study. *Journal of Physiotherapy* 59: 39-44' we confirm that Casey Peiris made the following contributions:

- Conception and design of the research
- Collection of data
- Analysis of data
- Interpretation of findings
- Writing the paper
- Critical appraisal of the content and
- Response to reviewers"

Professor Nicholas F Taylor..... ..... Date 20/9/13

Associate Professor Nora Shields..... ..... Date 20/9/13

STUDY FIVE

Statement from the authors confirming the authorship contribution of the PhD Candidate:

"As co-authors of the paper '**Peiris CL**, Shields N, Brusco NK, Watts JJ and Taylor NF (2013): Additional Saturday rehabilitation reduces length of stay and improves function and quality of life: a randomised controlled trial' we confirm that Casey Peiris made the following contributions:

- Conception and design of the research
- Collection of data
- Analysis of data
- Interpretation of findings
- Writing the paper
- Critical appraisal of the content and
- Response to reviewers"

Professor Nora Shields..	.....	Date 20/9/13
Natasha K Brusco.....	.....	Date 27/5/13
Jennifer J Watts.....	.....	Date 30/5/2013
Professor Nicholas F Taylor..	.....	Date 29/5/13

REFERENCES

AAPM&R (2011) American Academy of Physical Medicine and Rehabilitation: Standards for assessing medical appropriateness criteria for admitting patients to rehabilitation hospitals or units. http://www.aapmr.org/advocacy/health-policy/medical-necessity/Pages/MIRC-Task-Force-Report.aspx [Accessed April 4, 2013].

Ada L, Mackey F, Heard R, Adams R (1999) Stroke rehabilitation: does the therapy area provide a physical challenge? *Australian Journal of Physiotherapy* 45: 33-38.

AIHW (2011) Australian Institute of Health and Welfare: Australia's hospitals at a glance 2009-2010. http://www.aihw.gov.au/australias-hospitals-at-a-glance-2009-10/ [Accessed January 7, 2013].

Alzahrani MA, Dean CM, Ada L, Dorsch S, Canning CG (2011) Mood and balance are associated with free-living physical activity of people after stroke residing in the community. *Stroke Research and Treatment* 2012: 470648.

Appelros P, Nydevik I, Viitanen M (2003) Poor outcome after first-ever stroke: predictors for death, dependency, and recurrent stroke within the first year. *Stroke* 34: 122-126.

AROC (2013) The Australasian Rehabilitation Outcomes Centre Annual Report: the state of rehabilitation in Australia in 2011. https://ahsri.uow.edu.au/aroc/annualreports/index.html [Accessed April 16, 2013].

Bachmann S, Finger C, Huss A, Egger M, Stuck AE, Clough-Gorr KM (2010) Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomised controlled trials. *British Medical Journal* 340: c1718.

Bandura A, Blahard EB, Ritter B (1969) Relative efficacy of desensitization and modelling approaches for inducing behavioural, affective, and attitudinal changes. *Journal of Personality & Social Psychology* 13: 173-199.

Basmajian JV (1984) Therapeutic Exercise (4th edn). Baltimore: Williams and Wilkins.

Bear-Lehman J, Bassile CC, Gillen G (2001) A comparison of time use on an acute rehabilitation unit: subjects with and without a stroke. *Physical & Occupational Therapy in Geriatrics* 20: 17-27.

Bell CM, Redelmeier DA (2005) Enhanced weekend service: an affordable means to increased hospital procedure volume. *Canadian Medical Association Journal* 172: 503-504.

Beringer TR, Clarke J, Elliott JR, Marsh DR, Heyburn G, Steele IC (2006) Outcome following proximal femoral fracture in Northern Ireland. *Ulster Medical Journal* 75: 200-206.

Bhogal SK, Teasell R, Speechley M (2003) Intensity of aphasia therapy, impact on recovery. *Stroke* 34: 987-993.

Bode RK, Heinemann AW, Semik P, Mallinson T (2004) Relative importance of rehabilitation therapy characteristics on functional outcomes for persons with stroke. *Stroke* 35: 2537-2542.

Bretz F, Hsu J, Pinheiro J, Liu Y (2008) Dose finding - a challenge in statistics. *Biometrical Journal* 50: 480-504.

Brown CJ, Redden DT, Flood KL, Allman RM (2009) The underrecognized epidemic of low mobility during hospitalization of older adults. *Journal of the American Geriatrics Society* 57: 1660-1665.

Brusco NK, Taylor NF, Watts JJ and Shields N (2013) Economic evaluation of adult rehabilitation: a systematic review and meta-analysis of randomized controlled trials in a variety of settings. *Archives of Physical Medicine and Rehabilitation* Epub ahead of print, doi: 10.1016/j.apmr.2013.03.017

Brusco NK, Shields N, Taylor NF, Paratz J (2007) A Saturday physiotherapy service may decrease length of stay in patients undergoing rehabilitation in hospital: a randomised controlled trial. *Australian Journal of Physiotherapy* 53: 75-81.Campbell H (1999) What percentage of time, out of their day, do stroke patients spend in active rehabilitation? [dissertation]. Glasgow: Glasgow Caledonian University.

Campbell L, Bunston R, Colangelo S, Kim D, Nargi J, Hill K, Brooks D (2010) The provision of weekend physiotherapy services in tertiary-care hospitals in Canada. *Physiotherapy Canada* 62: 347-354.

Capdevila X, Dadure C, Bringuier S, Bernard N, Biboulet P, Gaertner E, Macaire P (2006) Effect of patient-controlled perineural analgesia on rehabilitation and pain after ambulatory orthopedic surgery: a multicenter randomized trial. *Anesthesiology* 105: 566-573.

Caspersen CJ, Powell KE, Christenson GM (1985) Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports* 100: 126-131.

Chen CC, Heinemann AW, Granger CV, Linn RT (2002) Functional gains and therapy intensity during subacute rehabilitation: a study of 20 facilities. *Archives of Physical Medicine & Rehabilitation* 83: 1514-1523.

Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, Minson CT, Nigg CR, Salem GJ, Skinner JS (2009) American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Medicine & Science in Sports & Exercise* 41: 1510-1530.

Clarke A, Rosen R (2001) Length of stay. How short should hospital care be? *European Journal of Public Health* 11: 166-170.

Clissett P (2001) The effect of recreational activities on older people's rehabilitation. *Nursing Standard* 15: 39-42.

Cooke EV, Tallis RC, Clark A, Pomeroy VM (2010) Efficacy of functional strength training on restoration of lower-limb motor function early after stroke: phase I randomized controlled trial. *Neurorehabilitation & Neural Repair* 24: 88-96.

Craik RL (1994) Disability following hip fracture. *Physical Therapy* 74: 387-398.

Darzins S, Imms C, Di Stefano M (2013) Measurement properties of the Personal Care Participation Assessment and Resource Tool: a systematic review. *Disability & Rehabilitation* 35: 265-281.

Dawes H (2008) The role of exercise in rehabilitation. *Clinical Rehabilitation* 22: 867-870.

De Weerdt W, Nuyens G, Feys H, Vangronsveld P, Van de Winckel A, Nieuwboer A, Osaer J, Kiekens C (2001) Group physiotherapy improves time use by patients with stroke in rehabilitation. *Australian Journal of Physiotherapy* 47: 53-61.

Disotto-Monastero M, Chen X, Fisch S, Donaghy S, Gomez M (2012) Efficacy of 7 days per week inpatient admissions and rehabilitation therapy. *Archives of Physical Medicine & Rehabilitation* 93: 2165-2169.

Donaldson C, Tallis R, Miller S, Sunderland A, Lemon R, Pomeroy V (2009) Effects of conventional physical therapy and functional strength training on upper limb motor recovery after stroke: a randomized phase II study. *Neurorehabilitation & Neural Repair* 23: 389-397.

Eder B, Hofmann P, Von DS, Brandt D, Schmid J, Pokan R, Wonisch M (2010) Early 4-week cardiac rehabilitation exercise training in elderly patients after heart surgery. *Journal of Cardiopulmonary Rehabilitation & Prevention* 30: 85-92.

English CK, Hillier SL, Stiller KR, Warden-Flood A (2007) Circuit class therapy versus individual physiotherapy sessions during inpatient stroke rehabilitation: a controlled trial. *Archives of Physical Medicine & Rehabilitation* 88: 955-963.

Faulkner M, Aveyard B (2002) Is the hospital sick role a barrier to patient participation? *Nursing Times* 98: 35-36.

Fierens J, Broos PLO (2006) Quality of life after hip fracture surgery in the elderly. *Acta Chirurgica Belgica* 106: 393-396.

Franklin PD, McLaughlin J, Boisvert CB, Li W, Ayers DC (2006) Pilot study of methods to document quantity and variation of independent patient exercise and activity after total knee arthroplasty. *Journal of Arthroplasty* 21: 157-163.

Gao F, Trinkaus K, Maher JP (2008) Early phase clinical trials: phase I and II. In Rao CR, Miller JP, Rao DC (Eds) Handbook of Statistics vol 27. Amsterdam: Elsevier, pp 513-541.

Glasgow Augmented Physiotherapy Study (2004) Can augmented physiotherapy input enhance recovery of mobility after stroke? A randomized controlled trial. *Clinical Rehabilitation* 18: 529-537.

Granger CV, Markello SJ, Graham JE, Deutsch A, Ottenbacher KJ (2009) The uniform data system for medical rehabilitation: report of patients with stroke discharged from comprehensive medical programs in 2000-2007. *American Journal of Physical Medicine & Rehabilitation* 88: 961-972.

Granger CV, Markello SJ, Graham JE, Deutsch A, Reistetter TA, Ottenbacher KJ (2010) The uniform data system for medical rehabilitation: report of patients with lower limb joint replacement discharged from rehabilitation programs in 2000-2007. *American Journal of Physical Medicine & Rehabilitation* 89: 781-794.

Granger CV, Reistetter TA, Graham JE, Deutsch A, Markello SJ, Niewczyk P, Ottenbacher KJ (2011) The Uniform Data System for Medical Rehabilitation: report of patients with hip fracture discharged from comprehensive medical programs in 2000-2007. *American Journal of Physical Medicine & Rehabilitation* 90: 177-189.

Grant PM, Granat MH, Thow MK, Maclaren WM (2010) Analysing free-living physical activity of older adults in different environments using body-worn activity monitors. *Journal of Aging & Physical Activity* 18: 171-184.

Haines TP, Kuys S, Clarke J, Morrison G, Bew P (2010) Dose-response relationship between physiotherapy resource provision with function and balance improvements in patients following stroke: a multi-centre observational study. *Journal of Evaluation in Clinical Practice* 17: 136-142.

Halbert J, Crotty M, Whitehead C, Cameron I, Kurrle S, Graham S, Handoll H, Finnegan T, Jones T, Foley A, Shanahan M, Hip Fracture Rehabilitation Trial Collaborative Group (2007) Multi-disciplinary rehabilitation after hip fracture is associated with improved outcome: A systematic review. *Journal of Rehabilitation Medicine* 39: 507-512.

Hankey GJ, Jamrozik K, Broadhurst RJ, Forbes S, Anderson CS (2002) Long-term disability after first-ever stroke and related prognostic factors in the Perth Community Stroke Study, 1989-1990. *Stroke* 33: 1034-1040.

Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, Bauman A, American College of Sports Medicine, American Heart Association (2007) Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 116: 1081-1093.

Hellweg S, Johannes S (2008) Physiotherapy after traumatic brain injury: a systematic review of the literature. *Brain Injury* 22: 365-373.

Higgs J, Refshauge K, Ellis E (2001) Portrait of the physiotherapy profession. *Journal of Interprofessional Care* 15: 79-89.

Holden MK, Daniele CA (1987) Comparison of seven- and five-day physical therapy coverage in patients with acute orthopedic disorders. *Physical Therapy* 67: 1240-1246.

Hughes K, Kuffner L, Dean B (1993) Effect of weekend physical therapy treatment on postoperative length of stay following total hip and total knee arthroplasty. *Physiotherapy Canada* 45: 245-249.

Janssen H, Ada L, Bernhardt J, McElduff P, Pollack M, Nilsson M, Spratt N (2012) Physical, cognitive and social activity levels of stroke patients undergoing rehabilitation within a mixed rehabilitation unit. *Clinical Rehabilitation.* Epub ahead of print, doi: 10.1177/0269215512466252.

Janssen H, Ada L, Bernhardt J, McElduff P, Pollack M, Nilsson M, Spratt NJ (2013) An enriched environment increases activity in stroke patients undergoing rehabilitation in a mixed rehabilitation unit: a pilot non-randomized controlled trial. *Disability and Rehabilitation* Epub ahead of print, doi: 10.3109/09638288.2013.788218

Jones GR, Miller TA, Petrella RJ (2002) Evaluation of rehabilitation outcomes in older patients with hip fractures. *American Journal of Physical Medicine & Rehabilitation* 81: 489-497.

Jorgensen HS, Nakayama H, Raaschou HO, Olsen TS (1997) Acute stroke care and rehabilitation: an analysis of the direct cost and its clinical and social determinants. The Copenhagen Stroke Study. *Stroke* 28: 1138-1141.

Keith RA, Cowell KS (1987) Time use of stroke patients in three rehabilitation hospitals. *Social Science & Medicine* 24: 529-533.

Kirk-Sanchez NJ, Roach KE (2001) Relationship between duration of therapy services in a comprehensive rehabilitation program and mobility at discharge in patients with orthopedic problems. *Physical Therapy* 81: 888-895.

Klassen AC, Creswell J, Plano Clark VL, Smith KC, Meissner HI (2013) Best practices in mixed methods for quality of life research. *Quality of Life Research* 21: 377-380.

Kortebein P (2009) Rehabilitation for hospital-associated deconditioning. *American Journal of Physical Medicine & Rehabilitation* 88: 66-77.

Koval KJ, Zuckerman JD (1994) Functional recovery after fracture of the hip. *Journal of Bone & Joint Surgery - American Volume* 76: 751-758.

Krabbe PF, Peerenboom L, Langenhoff BS, Ruers TJ (2004) Responsiveness of the generic EQ-5D summary measure compared to the disease-specific EORTC QLQ C-30. *Quality of Life Research* 13: 1247-1253.

Kuys SS, Brauer SG, Ada L (2011) Higher-intensity treadmill walking during rehabilitation after stroke is feasible and not detrimental to walking pattern or quality: a pilot randomized trial. *Clinical Rehabilitation* 25: 316-326.

Kwakkel G, van Peppen R, Wagenaar RC, Wood Dauphinee S, Richards C, Ashburn A, Miller K, Lincoln N, Partridge C, Wellwood I, Langhorne P (2004) Effects of augmented exercise therapy time after stroke: a meta-analysis. *Stroke* 35: 2529-2539.

Lenssen AF, Crijns YH, Waltje EM, van Steyn MJ, Geesink RJ, van den Brandt PA, de Bie RA (2006) Efficiency of immediate postoperative inpatient physical therapy following total knee arthroplasty: an RCT. *BMC Musculoskeletal Disorders* 7: 71-79.

Lin Y, Shih WJ (2001) Statistical properties of the traditional algorithm-based designs for phase I cancer clinical trials. *Biostatistics* 2: 203-215.

Lincoln NB, Parry RH, Vass CD (1999) Randomized, controlled trial to evaluate increased intensity of physiotherapy treatment of arm function after stroke. *Stroke* 30: 573-579.

Mackey F, Ada L, Heard R, Adams R (1996) Stroke rehabilitation: are highly structured units more conducive to physical activity than less structured units? *Archives of Physical Medicine & Rehabilitation* 77: 1066-1070.

MacRae PG, Asplund LA, Schnelle JF, Ouslander JG, Abrahamse A, Morris C (1996) A walking program for nursing home residents: effects on walk endurance, physical activity, mobility, and quality of life. *Journal of the American Geriatrics Society* 44: 175-180.

Marks R (2011) Physical activity and hip fracture disability: a review. *Journal of Aging Research* 2011: Article ID 741918.

McDonough SM, Tully MA, Boyd A, O'Connor SR, Kerr DP, O'Neill SM, Delitto A, Bradbury I, Tudor-Locke C, Baxter GD, Hurley DA (2013) Pedometer-driven walking for chronic low back pain: a feasibility randomized controlled trial. *The Clinical Journal of Pain.* Epub ahead of print, doi: 10.1097/AJP.0b013e31827f9d81.

Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, Macera CA, Castaneda-Sceppa C (2007) Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation* 116: 1094-1105.

Newall JT, Wood VA, Hewer RL, Tinson DJ (1997) Development of a neurological rehabilitation environment: an observational study. *Clinical Rehabilitation* 11: 146-155.

Norrenberg M, Vincent JL (2000) A profile of European intensive care unit physiotherapists. European Society of Intensive Care Medicine. *Intensive Care Medicine* 26: 988-994.

Ohman A (2005) Qualitative methodology for rehabilitation research. *Journal of Rehabilitation Medicine* 37: 273-280.

Owen N, Healy GN, Matthews CE, Dunstan DW (2010) Too much sitting: the population health science of sedentary behavior. *Exercise & Sport Sciences Reviews* 38: 105-113.

Partridge C, Mackenzie M, Edwards S, Reid A, Jayawardena S, Guck N, Potter J (2000) Is dosage of physiotherapy a critical factor in deciding patterns of recovery from stroke: a pragmatic randomized controlled trial. *Physiotherapy Research International* 5: 230-240.

Patterson F, Blair V, Currie A, Reid W (2005) An investigation into activity levels of older people on a rehabilitation ward: an observational study. *Physiotherapy* 91: 28-34.

Peiris C, Taylor NF, Shields N (2013a) Patients receiving inpatient rehabilitation for lower limb orthopaedic conditions do much less physical activity than recommended in guidelines for healthy older adults: an observational study. *Journal of Physiotherapy* 59: 39-44.

Peiris CL, Taylor NF, Shields N (2011) Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. *Archives of Physical Medicine & Rehabilitation* 92: 1490-1500.

Peiris CL, Taylor NF, Shields N (2012a) Additional Saturday allied health services increase habitual physical activity among patients receiving inpatient rehabilitation for lower limb orthopedic conditions: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation* 93: 1365-1370.

Peiris CL, Taylor NF, Shields N (2012b) Patients value patient-therapist interactions more than the amount or content of therapy during inpatient rehabilitation: a qualitative study. *Journal of Physiotherapy* 58: 261-268.

Peiris CL, Shields N, Brusco NK, Watts JJ and Taylor NF (2013b): Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial. *BMC Medicine* 11: 198 doi: 10.1186/1741-7015-11-198

Poulos CJ (2010) Evaluating inpatient public rehabilitation in Australia using a utilization review tool developed in North America. *Journal of Rehabilitation Medicine* 42: 246-253.

Resnick B, Galik E, Boltz M, Hawkes W, Shardell M, Orwig D, Magaziner J (2011) Physical activity in the post-hip-fracture period. *Journal of Aging & Physical Activity* 19: 373-387.

Rice K, Kennedy G, Taylor NF (2012) Patients on a neurorehabilitation ward are inactive for a large part of each day. Proceedings of the 7th World Congress of NeuroRehabilitation. Melbourne, pp. 185.

Richards CL, Malouin F, Wood-Dauphinee S, Williams JI, Bouchard JP, Brunet D (1993) Task-specific physical therapy for optimization of gait recovery in acute stroke patients. *Archives of Physical Medicine & Rehabilitation* 74: 612-620.

Rodaro E, Pasqualini M, Iona LG, Di Benedetto P (2004) Functional recovery following a second hip fracture. *Europa Medicophysica* 40: 179-183.

Rogers SL (2005) Portrait of occupational therapy. *Journal of Interprofessional Care* 19: 70-79.

Ruff RM, Yarnell S, Marinos JM (1999) Are stroke patients discharged sooner if in-patient rehabilitation services are provided seven v six days per week? *American Journal of Physical Medicine & Rehabilitation* 78: 143-146.

Saxena SK, Koh GC, Ng TP, Fong NP, Yong D, Koh GCH (2007) Determinants of length of stay during post-stroke rehabilitation in community hospitals. *Singapore Medical Journal* 48: 400-407.

Schmalzried TP, Szuszczewicz ES, Northfield MR, Akizuki KH, Frankel RE, Belcher G, Amstutz HC (1998) Quantitative assessment of walking activity after total hip or knee replacement. *Journal of Bone & Joint Surgery - American Volume* 80: 54-59.

Schnohr P, Scharling H, Jensen JS (2003) Changes in leisure-time physical activity and risk of death: an observational study of 7,000 men and women. *American Journal of Epidemiology* 158: 639-644.

Schoenfelder DP, Rubenstein LM (2004) An exercise program to improve fall-related outcomes in elderly nursing home residents. *Applied Nursing Research* 17: 21-31.

Schulz KF, Grimes DA (2006) The Lancet Handbook of essential concepts in clinical research. Michigan: Elsevier, pp. 201-206.

Sculpher MJ, Dwyer N, Byford S, Stirrat GM (1996) Randomised trial comparing hysterectomy and transcervical endometrial resection: effect on health related quality of life and costs two years after surgery. *British Journal of Obstetrics & Gynaecology* 103: 142-149.

Shaw KD, Taylor NF, Brusco NK (2012) Physiotherapy services provided outside of business hours in Australian hospitals: a national survey. *Physiotherapy Research International*. Epub ahead of print, doi: 10.1002/pri.1537.

Silva M, McClung CD, Dela Rosa MA, Dorey FJ, Schmalzried TP (2005) Activity sampling in the assessment of patients with total joint arthroplasty. *Journal of Arthroplasty* 20: 487-491.

Smith P, Galea M, Woodward M, Said C, Dorevitch M (2008) Physical activity by elderly patients undergoing inpatient rehabilitation is low: an observational study. *Australian Journal of Physiotherapy* 54: 209-213.

Steultjens EM, Dekker J, Bouter LM, Leemrijse CJ, van den Ende CH (2005) Evidence of the efficacy of occupational therapy in different conditions: an overview of systematic reviews. *Clinical Rehabilitation* 19: 247-254.

Stroke Unit Trialists' Collaboration (2007) Organised inpatient (stroke unit) care for stroke. *Cochrane Database of Systematic Reviews*: CD000197.

Sutbeyaz S, Yavuzer G, Sezer N, Koseoglu BF (2007) Mirror therapy enhances lower-extremity motor recovery and motor functioning after stroke: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation* 88: 555-559.

Talkowski JB, Lenze EJ, Munin MC, Harrison C, Brach JS (2009) Patient participation and physical activity during rehabilitation and future functional outcomes in patients after hip fracture. *Archives of Physical Medicine & Rehabilitation* 90: 618-622.

Taylor CB, Bandura A, Ewart CK, Miller NH, DeBusk RF (1985) Exercise testing to enhance wives' confidence in their husbands' cardiac capability soon after clinically uncomplicated acute myocardial infarction. *American Journal of Cardiology* 55: 635-638.

Taylor NF, Barelli C, Harding KE (2010a) Community ambulation before and after hip fracture: a qualitative analysis. *Disability & Rehabilitation* 32: 1281-1290.

Taylor NF, Brusco NK, Watts JJ, Shields N, Peiris C, Sullivan N, Kennedy G, Teo CK, Farley A, Lockwood K, Radia-George C (2010b) A study protocol of a randomised controlled trial incorporating a health economic analysis to investigate if additional allied health services for rehabilitation reduce length of stay without compromising patient outcomes. *BMC Health Services Research* 10: 308-314.

Taylor NF, Dodd KJ, Damiano DL (2005) Progressive resistance exercise in physical therapy: a summary of systematic reviews. *Physical Therapy* 85: 1208-1223.

Taylor NF, Dodd KJ, Shields N, Bruder A (2007) Therapeutic exercise in physiotherapy practice is beneficial: a summary of systematic reviews 2002-2005. *Australian Journal of Physiotherapy* 53: 7-16.

Tinson DJ (1989) How stroke patients spend their days. An observational study of the treatment regime offered to patients in hospital with movement disorders following stroke. *International Disability Studies* 11: 45-49.

Tomlinson CL, Patel S, Meek C, Herd CP, Clarke CE, Stowe R, Shah L, Sackley C, Deane KH, Wheatley K, Ives N (2012) Physiotherapy intervention in Parkinson's disease: systematic review and meta-analysis. *British Medical Journal* 345: e5004.

Tudor-Locke C, Bassett DR, Jr. (2004) How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine* 34: 1-8.

Tudor-Locke C, Craig CL, Aoyagi Y, Bell RC, Croteau KA, De Bourdeaudhuij I, Ewald B, Gardner AW, Hatano Y, Lutes LD, Matsudo SM, Ramirez-Marrero FA, Rogers LQ, Rowe DA, Schmidt MD, Tully MA, Blair SN (2011) How many steps/day are enough? For older adults and special populations. *International Journal of Behavioral Nutrition & Physical Activity* 8: 80-98.

van der Peijl ID, Vliet Vlieland TP, Versteegh MI, Lok JJ, Munneke M, Dion RA (2004) Exercise therapy after coronary artery bypass graft surgery: a randomized comparison of a high and low frequency exercise therapy program. *Annals of Thoracic Surgery* 77: 1535-1541.

Vertesi A, Darzins P, Lowe S, McEvoy E, Edwards M (2000) Development of the Handicap Assessment and Resource Tool (HART). *Canadian Journal of Occupational Therapy* 67: 120-127.

Warburton DE, Nicol CW, Bredin SS (2006) Health benefits of physical activity: the evidence. *Canadian Medical Association Journal* 174: 801-809.

WCPT (1999) World Confederation for Physical Therapy policy statement: Description of physical therapy. http://www.wcpt.org/policy/ps-descriptionPT [Accessed April 1, 2013].

Wen CP, Wai JP, Tsai MK, Yang YC, Cheng TY, Lee MC, Chan HT, Tsao CK, Tsai SP, Wu X (2011) Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. *Lancet* 378: 1244-1253.

WFOT (2010) World Federation of Occupational Therapists: Definitions of occupational therapy. http://www.wfot.org/ResourceCentre.aspx [Accessed April 1, 2013].

WHO (2011) World Health Organisation: Global recommendations on physical activity for health: 65 years and above. http://www.who.int/dietphysicalactivity/physical-activity-recommendations-65years.pdf [Accessed September 14, 2011].

WHO (2013) World Health Organisation health topics: Rehabilitation. http://www.who.int/topics/en/ [Accessed March 8, 2013].

Yavuzer G, Selles R, Sezer N, Sutbeyaz S, Bussmann JB, Koseoglu F, Atay MB, Stam HJ (2008) Mirror therapy improves hand function in subacute stroke: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation* 89: 393-398.