Age and Ageing 2022; **51:** 1–10
https://doi.org/10.1093/ageing/afab154
Published electronically 24 July 2021

SYSTEMATIC REVIEW

Behaviour change interventions to increase physical activity in hospitalised patients: a systematic review, meta-analysis and meta-regression

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Abstract

Background: Low physical activity levels are a major problem for people in hospital and are associated with adverse outcomes.
Objective: This systematic review, meta-analysis and meta-regression aimed to determine the effect of behaviour change interventions on physical activity levels in hospitalised patients.
Methods: Randomised controlled trials of behaviour change interventions to increase physical activity in hospitalised patients were selected from a database search, supplemented by reference list checking and citation tracking. Data were synthesised with random-effects meta-analyses and meta-regression analyses, applying Grades of Recommendation, Assessment, Development and Evaluation criteria. The primary outcome was objectively measured physical activity. Secondary measures were patient-related outcomes (e.g. mobility), service level outcomes (e.g. length of stay), adverse events and patient satisfaction.
Results: Twenty randomised controlled trials of behaviour change interventions involving 2,568 participants (weighted mean age 67 years) included six trials with a high risk of bias. There was moderate-certainty evidence that behaviour change interventions increased physical activity levels (SMD 0.34, 95% CI 0.14–0.55). Findings in relation to mobility and length of stay were inconclusive. Adverse events were poorly reported. Meta-regression found behaviour change techniques of goal setting (SMD 0.29, 95% CI 0.05–0.53) and feedback (excluding high risk of bias trials) (SMD 0.35, 95% CI 0.11–0.60) were independently associated with increased physical activity.
Conclusions: Targeted behaviour change interventions were associated with increases in physical activity in hospitalised patients. The trials in this review were inconclusive in relation to the patient-related or health service benefits of increasing physical activity in hospital.

Keywords: Behaviour change, physical activity, systematic review, meta-analysis, inpatient, older people

Key Points

- Behaviour change techniques led to small to moderate increases in physical activity for hospitalised patients.
- Goal setting and providing feedback on performance were the behaviour change techniques that worked best in increasing physical activity.
- Despite their strong rationale there remains uncertainty about the broader benefits of behaviour change interventions for hospitalised patients.

Background

Reduced physical activity, characterised by reduced daily steps and increased periods of bed rest, is a major problem for older patients admitted to hospital [1–3]. Admission to hospital for treatment of many health conditions associated with impaired mobility and a period of bed rest can lead to reduced physical activity [3]. Hospitalised patients with acute medical or surgical conditions spend over 90% of their hospital stay sedentary, often completing less than 1,000 daily steps [4]. For example, after hip fracture, patients admitted to acute hospital average only 36 daily steps, [5] with low levels of physical activity persisting in the long-term [6]. Physical activity levels in older people undergoing inpatient rehabilitation are also low, with less than 10% of the 8-hour day spent walking [7], and steps averaging 400 daily [8]. For patients admitted to hospital with a neurological condition very low levels of physical activity have also been observed [9].

The low levels of physical activity observed during hospital admission predispose patients to the secondary consequences of inactivity and have been associated with deconditioning [10] and serious adverse events such as increased risk of venous thromboembolism, atelectasis, and aspiration [11, 12] leading to increased risk of mortality [13]. Low levels of physical activity can result in loss of muscle strength and functional performance [14, 15]. Periods of bed rest can result in loss of up to 30% of muscle mass within the first 10 days of critical illness [16].

Due to the low levels of physical activity observed in hospitalised patients and their serious health consequences, strategies to increase physical activity in this group are required. A recent international Delphi study recommended that hospitalised older people minimise time spent sitting and sedentary behaviours as their individual capability allows [17]. Increasing physical activity is widely understood to be a form of behaviour change, suggesting that behaviour change approaches should be used [18]. There is strong evidence from systematic reviews that behavioural techniques are effective in increasing physical activity in various populations and settings, including patients attending hospital outpatient clinics [19–22]. Behavioural strategies associated with increased physical activity across a broad range of health settings include use of goal setting, self-monitoring, providing feedback on performance and goal review [23].

Despite this strong rationale for their use we were unable to locate any systematic reviews that have synthesised the evidence on the effectiveness of behavioural change techniques in increasing physical activity in hospitalised patients. The majority of evidence on behaviour change techniques in physical activity comes from community or outpatient settings, and particularly in the management of chronic diseases, such as diabetes mellitus, where promotion of physical activity is first-line management [22, 24, 25]. The lack of attention to hospital inpatient settings may be explained by the emphasis on management of the acute health condition during hospitalisation. Synthesising the evidence from inpatient hospital settings will provide clinicians with guidance on how to promote physical activity to reduce the risk of the adverse consequences of inactivity in this vulnerable population.

Therefore, the primary aim of this systematic review was to determine if behaviour change interventions are effective in increasing levels of physical activity in hospitalised patients. The secondary aims were to determine: the effect on behaviour change interventions on patient outcomes, health service outcomes, safety and the patient experience; and the association between specific behavioural change techniques and increased physical activity in hospitalised patients.

Methods

This review is reported consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) [26] (Appendix 1). Review methods were registered prospectively on PROSPERO (CRD42020170445).

The electronic databases MEDLINE, EMBASE, PsychINFO, CINAHL, The Cochrane Central Register of Controlled Trials (CENTRAL) and PEDro were searched from the earliest time until21 May 2021. The search strategy included key words and medical subject headings describing participants (hospitalised patients), outcome (objective measures of physical activity) and the research design (controlled trials). Synonyms for participants and outcomes were combined using the OR operator. Database-specific filters for controlled trials were used where available. The search results of participants, outcomes and research design were then combined using the AND operator (Appendix 2). For all included trials, reference lists were searched, and citation tracking completed (Google scholar) to identify trials not found through the database searches.

Randomised controlled trials were considered for inclusion provided objective data on levels of physical activity were reported on the effect of a behavioural intervention designed to increase physical activity of hospitalised patients (Appendix 3). Physical activity was defined as daily energy expenditure [27] and included measures such as daily steps, metabolic equivalent of tasks, activity counts and daily minutes of at least moderate-intensity physical activity during hospital admission. Measures of physical activity needed to be objective (e.g. accelerometer); measures obtained by self-report were not included. Behavioural interventions included those described in the 40-item taxonomy of behaviour change techniques [18]. Trials that included follow-up periods beyond admission were included provided the intervention was applied during admission and physical activity data were reported separately during hospital admission. Secondary outcomes were quality of care measures [28] including patient outcomes (e.g. functional independence, health-related quality of life) and health service outcomes (e.g. length of stay); safety (e.g. adverse events); and patient experience (e.g. satisfaction).

Using Covidence to manage data, titles and abstracts retrieved were reviewed by two reviewers independently to identify trials that potentially met inclusion criteria. Full text copies of potentially eligible trials were retrieved and assessed for eligibility by two reviewers independently. Any disagreements about trial eligibility were resolved through discussion with a third reviewer. Agreement between reviewers was assessed using kappa (κ) with κ of $\geq$0.81 regarded as almost perfect agreement, 0.80–0.61 substantial, 0.41–0.60 moderate, 0.21–0.40 fair, and 0.00–0.20 slight [29]. A standardised form was used to extract data from included trials. Data extraction for each included trial was completed by two reviewers independently with any disagreements resolved through discussion with a third reviewer. Extracted information included: study population demographics and baseline characteristics; details of the experimental and control interventions described according to the TIDieR (Template for Intervention Description and Replication) checklist [30]; description of outcome measures; and outcomes (physical activity and quality of care). Behaviour change techniques for each trial were coded independently by two reviewers according to the 40-item taxonomy of behaviour change techniques [18]. A third reviewer checked all coded behaviour change techniques for accuracy and resolved any conflicts between the first two reviewers.

Two reviewers independently assessed risk of bias in included studies using the Cochrane risk of bias tool (version 2 RoB2) [31]. Any disagreements between reviewers were resolved with discussion with a third reviewer. An overall risk-of-bias judgement was applied to each trial based on: low risk of bias if low risk of bias for all domains; some concerns if at least one domain has some concerns but not domains judged to be at high risk of bias; and high risk of bias if high risk of bias in any domains or some concerns in multiple domains.

Trials were considered clinically homogeneous for population (hospitalised patients) and interventions (behaviour change techniques). Trials with similar outcome data (e.g. a measure of physical activity) were combined using a random-effects meta-analysis with standardised mean differences or weighted mean differences for continuous outcomes from post-intervention means and standard deviations. Where physical activity was reported using more than one method, daily steps were used. Average daily physical activity during inpatient admission until day of discharge was included. Where a daily average was not reported, physical activity measurement was taken on the days closest to discharge. Statistical heterogeneity was assessed using the I^2 statistic, with values greater than 50% considered indicative of substantial heterogeneity [32]. When at least 10 trials were included in a meta-analysis evidence of publication bias was assessed using a funnel plot. The Grades of Recommendation, Assessment, Development and Evaluation (GRADE) approach was applied to each meta-analysis to determine the certainty of evidence [33]. Downgrading the evidence one place (e.g. high to moderate certainty) occurred if: (i) the overall risk of bias was high for the majority of trials in the meta-analysis, (ii) there was at least a moderate level of statistical heterogeneity between the trials, (iii) there were large confidence intervals indicating a small number of participants and (iv) there was evidence of publication bias as assessed by funnel plot asymmetry assessed with Egger's test [34] and the trim and fill method [35, 36]. Providing there were sufficient data, subgroup analyses were completed for setting (acute versus rehabilitation). Data were reported descriptively if not able to be pooled in a meta-analysis.

Moderator analysis was conducted using meta-regression analyses to identify associations between behaviour change techniques used in more than three trials. The metafor package was used to carry out the meta-regression analyses in the R statistical software version 3.6.1 [37, 38]. The metafor package was also used to carry out sensitivity analyses using the log ratio of means instead of the standardised mean difference [39] and to assess impact of potential publication bias.

Results

From an initial database yield of 2,693 articles, 87 were reviewed in full text after application of eligibility criteria to titles and abstracts. Reapplication of eligibility to full texts resulted in 20 selected trials for review [7, 40–58]. One of the 20 selected trials [52] was identified by checking reference lists or citation tracking (Figure 1). Agreement between reviewers was fair for initial screening of titles and abstracts (κ = 0.336, 95%CI 0.261–0.411) and substantial for screening full texts (κ = 0.704, 95%CI 0.534–0.874).

The 20 trials reported the results of 2,568 hospitalised patients allocated to the experimental behaviour change group (n = 1,277) or comparison usual care group (n = 1,291) (Table 1). The weighted mean age of participants was 66.7 years and 56.2% (n = 1,444) were women. The most common primary diagnosis was stroke (n = 4 trials). Fourteen trials were in acute wards (n = 10 surgical, n = 3 medical, n = 1 mixed medical/surgical) [41–43, 45–48, 50, 51, 53–57] and six trials in rehabilitation wards [7, 40, 44, 49, 52, 58].

A total of 23 behaviour change techniques were used across the 20 trials, with most trials using more than one technique (Appendix 4). Fifteen behaviour change techniques were used by more than one trial. The only techniques used by more than three trials were goal setting (n = 10 trials), feedback on performance (n = 8 trials), reviewing behavioural goals (four trials) and instructing on how to perform a behaviour (four trials). The most common items of equipment used were accelerometers for feedback (n = 7 trials) and written information (n = 7 trials). Where reported, all interventions included a face-to-face interaction with individual patients. Physiotherapists (n = 10 trials) and nurses (n = 5 trials) commonly provided the intervention, which for 13 trials was at least daily during the hospital

Table 1. Study characteristics

Author	Country	Number exp (N)	Number comp (N)	Age: Exp, mean (SD) Median [IQR]	Age: Comp, mean (SD) Median [IQR	Sex: Exp, N female (%)	Sex: Comp, N female (%)	Primary diagnosis	Quality of care outcomes
Atkins [40]	Australia	42	43	74 (17)	78 (18)	19 (49)	27 (69)	Mixed	LOS, DEMMI, FIM, 10 m walk
Au [41]	Canada	21	21	61 (8)	58 (6)	0 (0)	0 (0)	Radical prostatectomy	
Dall [42]	Denmark	72	69	74 (13)	72 (14)	22 (49)	25 (52)	Respiratory conditions	LOS
Despond [43]	Switzerland	28	29	51 (11)	50 (15)	13 (46)	14 (48)	Elective surgery (hernia, vascular stripping or hysterectomy)	LOS
Dorsch [44]	USA/intl	78	73	62 (16)	65 (13)	31 (40)	28 (40)	Stroke	LOS, 15 m walk test, 3MWT, SIS
Fiore [45]	Canada	50	50	65 [51–71]	63 [48–72]	15 (30)	28 (57)	Colorectal surgery	Surgery impact scale, Time for readiness for discharge, 30-day complication index, SF-36
Herman [57]	Israel	128	128	33 (6)	33 (7)	128 (100)	128 (100)	High risk caesarean	Complications, analgesic consumption, pain score (0–10), physical recovery score (0–10), mental recovery score (0–10), patient satisfaction
Jonsson [46]	Sweden	54	53	69 (8)	68 (8)	22 (44)	27 (61)	Suspected lung cancer	LOS, 6MWT, dyspnoea scale
Kanai [47]	Japan	27	28	67 (10)	63 (9)	8 (35)	12 (48)	Stroke	LOS, Self-efficacy
Lieberman [48]	USA	69	77	56	53	69 (100)	77 (100)	Gynaecological conditions	LOS, walking difficulty scale
Mansfield [49]	Canada	29	31	64 (19)	62 (13)	9 (13)	12 (43)	Stroke	Walking speed, step length symmetry, self-efficacy, goal attainment, falls
Moreno [50]	Brazil	33	35	69 (7)	69 (7)	17 (52)	11 (31)	Respiratory conditions	LOS, DEMMI, grip strength
Papaspyros [51]	UK	48	52	65 (11)	63 (11)	16 (31)	18 (33)	Cardiac surgery (CABG, valve replacement)	LOS
Peel [7]	Australia	128	127	82 (9)	83 (8)	79 (61)	71 (55)	Mixed	SPPB, EQ-5D, adverse events
Pfeiffer [58]	Germany	57	58	83 (7)	82 (7)	44 (77)	43 (74)	Hip and pelvic fracture	LOS, Short FES-I, PAMF, Phone-FITT, SPPB
Swank [52]	USA	37	36	61 (17)	61 (15)	19 (51)	15 (42)	Stroke	LOS
Taraldsen [53]	Norway	198	199	83 (6)	84 (6)	126 (71)	112 (78)	Hip fracture	Cumulated ambulation score, SPPB
Teodoro [54]	USA	22	26	64 (14)	63 (18)	14 (27)	16 (31)	Mixed	a
Van der Walt [55]	Australia	100	102	68 (9)	67 (9)	37 (44)	46 (56)	Hip and knee joint replacement	KOOS, EQ5D,
Wolk [56]	Germany	56	54	Open 61 (10) Lap 59 (11)	Open 56 (11) Lap 59 (12)	Open 11 (41) Lap 13 (45)	Open 8 (19) Lap 14 (52)	Colorectal surgery	LOS

LOS, length of stay; DEMMI, De Morton Mobility Index; MWT, minute walk test; SF-36 and EQ5D quality of life scales; SIS, Stroke Impact scale; SPPB, Short Physical Performance Battery; KOOS, Knee Injury Osteoarthritis Outcome Score, Lap, laparoscopy. [a]No quality of care outcomes.

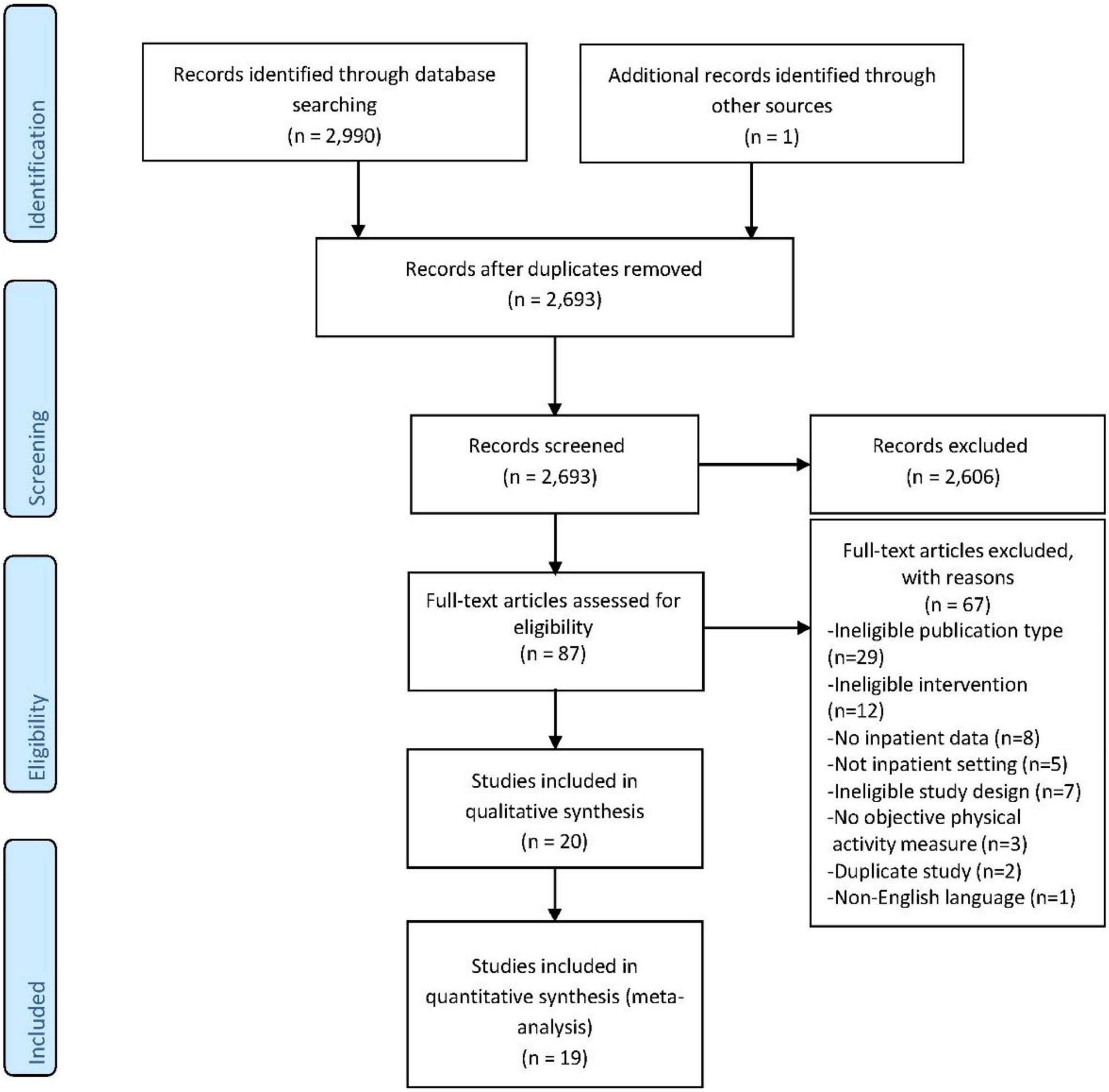

Figure 1. Study flow chart.

admission. Ten trials did not report adherence to intervention. The most commonly described comparator interventions were usual care ($n = 9$ trials) and activity monitors without access to feedback on step counts ($n = 6$ trials), although not all studies clearly described comparator interventions (Appendix 5).

Five trials were assessed as having a low risk of bias for all items [7, 47, 49, 50, 58] and a further nine trials were rated to have 'some concerns' on one or two items but did not have any items assessed as being of high risk of bias [40, 41, 43–46, 48, 52, 57]. Six trials were assessed as high risk of bias [42, 51, 53–56]. The item that contributed most to the assessment of high risk of bias was measurement of outcome by assessors not blinded to allocation ($n = 4$ trials) (Appendix 6).

Effect of intervention

Primary outcome: physical activity

Meta-analysis of 18 trials provided moderate-certainty evidence that use of behaviour change techniques was associated with a small to moderate effect (SMD 0.34, 95%CI 0.14–0.55) increasing physical activity compared to usual care for hospitalised patients (Figure 2). A larger effect was observed in the 12 trials in an acute setting (SMD 0.46, 95%CI 0.16–0.75) than in the six trials in a rehabilitation setting

Study or Subgroup	Intervention Mean	Intervention SD	Intervention Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.1 Acute								
Au et al 2019	442.48	169.82	19	324.94	169.82	19	4.3%	0.68 [0.02, 1.33]
Dall et al 2019	51	76.56	45	47	146.37	48	5.9%	0.03 [-0.37, 0.44]
Fiore et al 2017	1,033.3	1,696.51	26	671.55	703.7	20	4.8%	0.26 [-0.32, 0.85]
Herman 2020	5,918	3,116	108	4,161	2,532	107	6.8%	0.62 [0.34, 0.89]
Jonsson et al 2019	49	47	50	37	34	44	5.9%	0.29 [-0.12, 0.69]
Kanai et al 2018	5,180.5	2,314.9	23	3,113.6	1,150.9	25	4.6%	1.13 [0.51, 1.74]
Liebermann et al 2013	249.82	507.38	61	332.81	757.9	68	6.4%	-0.13 [-0.47, 0.22]
Moreno et al 2019	4,945	2,117	33	3,971	1,706	33	5.4%	0.50 [0.01, 0.99]
Papaspyros et al 2008	1,000.79	411.8824	18	347.01	171.66	28	3.8%	2.22 [1.46, 2.98]
Teodoro et al 2016	290.6	238.7	22	155.5	103.3	26	4.7%	0.75 [0.16, 1.33]
VanderWalt et al 2018	1,242.8	743.43	80	999	788.8	82	6.6%	0.32 [0.01, 0.63]
Wolk et al 2019	927	829.4	27	1,496.6	1,212.3	27	5.0%	-0.54 [-1.08, 0.00]
Subtotal (95% CI)			**512**			**527**	**64.2%**	**0.46 [0.16, 0.75]**
Heterogeneity: Tau² = 0.21; Chi² = 56.22, df = 11 (P < 0.00001); I² = 80%								
Test for overall effect: Z = 3.04 (P = 0.002)								
1.1.2 Rehabilitation								
Atkins et al 2019	526	1,155	39	341	891	39	5.7%	0.18 [-0.27, 0.62]
Dorsch et al 2015	15.1	13.1	58	16.6	14.3	67	6.3%	-0.11 [-0.46, 0.24]
Mansfield et al 2015	75.9	33.65	29	71.5	29.79	28	5.2%	0.14 [-0.38, 0.66]
Peel et al 2016	24.6	16.45	128	17.3	17	127	7.0%	0.44 [0.19, 0.68]
Pfeiffer 2020	32.1	19.75	52	36.7	27.19	51	6.1%	-0.19 [-0.58, 0.19]
Swank et al 2020	657.7	655.8	37	396.2	419.7	36	5.5%	0.47 [0.00, 0.93]
Subtotal (95% CI)			**343**			**348**	**35.8%**	**0.16 [-0.08, 0.40]**
Heterogeneity: Tau² = 0.05; Chi² = 11.67, df = 5 (P = 0.04); I² = 57%								
Test for overall effect: Z = 1.28 (P = 0.20)								
Total (95% CI)			**855**			**875**	**100.0%**	**0.34 [0.14, 0.55]**
Heterogeneity: Tau² = 0.14; Chi² = 71.26, df = 17 (P < 0.00001); I² = 76%								
Test for overall effect: Z = 3.26 (P = 0.001)								
Test for subgroup differences: Chi² = 2.40, df = 1 (P = 0.12), I² = 58.3%								

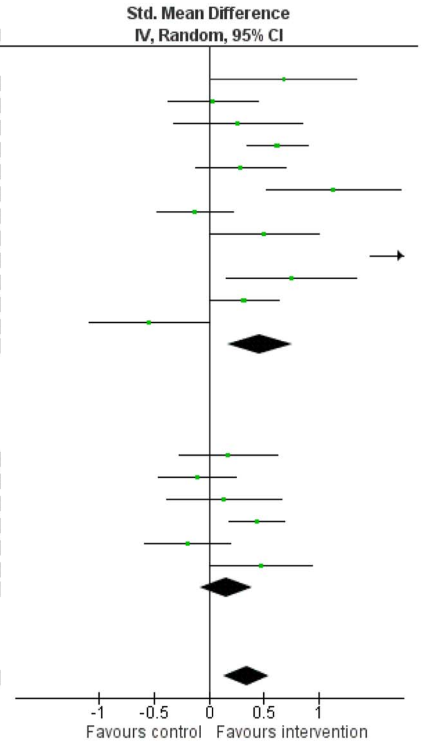

Figure 2. Meta-analysis: physical activity. Note: Certainty of evidence downgraded one level due to at least moderate levels of statistical heterogeneity.

(SMD 0.16, 95%CI −0.08 to 0.40). Although the test against equality of variances was insignificant overall (mean ratio 1.34, 95% CI 0.89–2.02), heterogeneity was significant suggesting potential violation for some studies. Therefore, as a sensitivity analysis, we also conducted a meta-analysis on the ratio of means. Results were similarly significant (mean ratio of means = 1.30, 95% CI 1.12–1.51), and did not suggest any concerns of bias in using SMDs.

Inspection of the funnel plot indicated mild asymmetry (Appendix 7). Egger's test for funnel plot asymmetry was significant ($P = 0.018$); however, this was due to a single study with large SMD and high risk of bias [51]. Removal of this study resulted in Egger's test $P = 0.40$. Use of the trim and fill method as a sensitivity analysis for potential publication bias estimated zero missing studies and a test against zero missing studies was non-significant ($P = 0.50$). Due to the relatively high I^2 value ($I^2 = 76\%$) a sensitivity analysis was completed excluding trials with a high risk of bias. Meta-analysis of 13 trials without a high risk of bias provided moderate-certainty evidence that behaviour change techniques resulted in a small to moderate effect (SMD 0.30, 95%CI 0.11–0.49, $I^2 = 64\%$) increasing physical activity compared to usual care (Appendix 8).

Patient outcomes

Meta-analysis provided high-certainty evidence that use of behaviour change techniques was not associated with improved mobility-related function, as assessed with the De Morton Mobility Index (two trials, MD 2.0 units, 95%CI −2.9 to 7.0) (Appendix 9), Short Physical Performance Battery score (three trials, MD 0.12 units, 95%CI −0.62 to 0.86) (Appendix 10) or walking speed (three trials, MD 0.02 m/s, 95%CI −0.04 to 0.07) (Figure 3). Other patient-level outcomes, including health-related quality of life outcomes, that could not be included in meta-analyses due to clinical heterogeneity, were characterised by non-significant between-group differences in individual trials. The only between-group differences in other patient-level outcomes in a single study were in four of eight domains of the Stroke Impact Scale at discharge favouring the experimental group [52].

Health service outcomes

Meta-analysis of nine trials provided high-certainty evidence that use of behaviour change techniques were not associated with reduced length of stay in the acute setting (MD −0.03 days, 95% CI −0.28 to 0.22) (Figure 4). Mean acute length of stay ranged from a minimum of 1.5 days to a maximum of 16.3 days. Meta-analysis of four trials provided high-certainty evidence that behaviour change techniques did not reduce length of stay in rehabilitation (MD −0.07 days, 95% CI −2.18 to 2.05). Mean rehabilitation length of stay ranged from a minimum of 25.0 to a maximum of 28.8 days (Appendix 11).

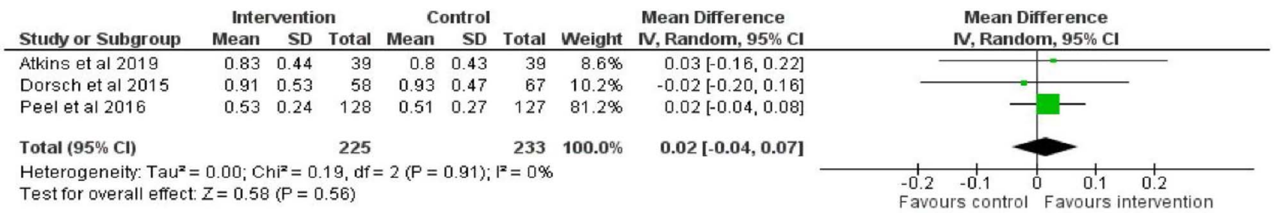

Figure 3. Meta-analysis: walking speed. Note: GRADE certainty of evidence rated high.

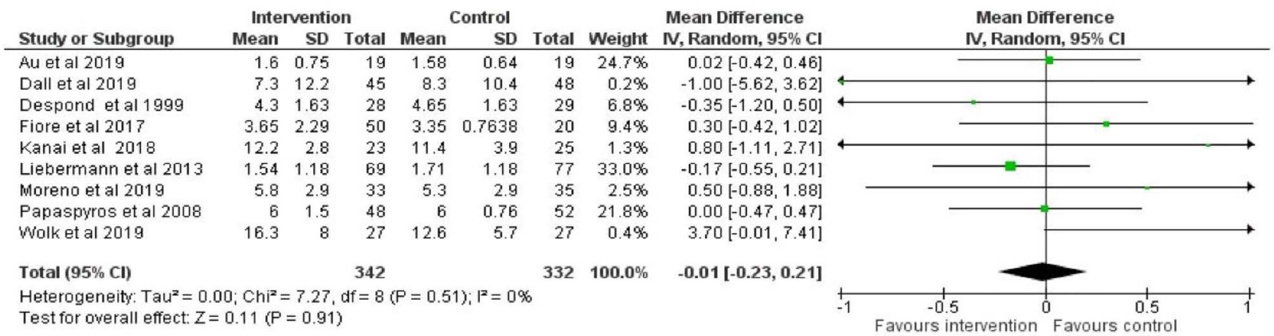

Figure 4. Meta-analysis: length of stay (days) in acute settings. Note: GRADE certainty of evidence rated high.

Adverse events and patient satisfaction

One trial reported that one participant fell during the intervention [49], another reported fewer fallers in the intervention group during rehabilitation (4%) compared to usual care (19%)(P = 0.002, 58]; and two trials reported no adverse events [7, 50]. The presence of absence of adverse events was not reported in the other trials. The only trial to report on patient satisfaction found no difference in satisfaction with surgical outcomes at 6 months in the intervention group compared to the control group [55].

Moderator analysis

Analysis of 10 trials found the behaviour change technique of goal setting (behaviour) was independently associated with an increase in physical activity compared to usual care (SMD 0.29, 95% CI 0.05–0.53, $P = 0.018$), which was confirmed with a sensitivity analysis excluding trials with a high risk of bias (seven trials, SMD 0.34, 95% CI 0.06–0.61). Analysis of eight trials found the behaviour change technique of providing feedback on performance was not significantly associated with a change in physical activity (SMD 0.25, 95% CI −0.02 to 0.53). However, a sensitivity analysis excluding trials with a high risk of bias (five trials, SMD 0.41, 95% CI 0.08–0.75) was statistically significant ($P = 0.016$). The behaviour change techniques of reviewing of behavioural goals (four trials, SMD 0.24, 95% CI −0.12 to 0.61) and providing instruction on how to perform a behaviour (four trials, SMD 0.24, 95% CI −0.12 to 0.59) were not independently associated with increasing physical activity compared to usual care. Meta-regression of the total number of behaviour change techniques in a trial was not independently associated with increasing physical activity (SMD per unit increase in number of behaviour change techniques −0.02, 95% CI −0.11 to 0.08), which was confirmed with a sensitivity analysis excluding trials with a high risk of bias (SMD per unit increase in number of behaviour change techniques 0.02, 95%CI 0.01–0.07).

Discussion

This systematic review of 20 randomised controlled trials ($n = 2{,}568$) found moderate-certainty evidence that behaviour change interventions were associated with increased physical activity levels for hospitalised patients (SMD 0.34, 95% CI 0.14–0.55) when compared with usual care. There was high-certainty evidence that these programs were not associated with improved length of hospital stay or other secondary outcomes including mobility outcomes. Sixteen of the 20 trials (80%) did not report any information relating to adverse events. Almost one-third of the included trials were of high risk of bias but sensitivity analyses excluding those trials at high risk of bias made little difference to the primary outcome that behaviour change interventions were associated with increased physical activity levels.

Meta-regression analyses indicated goal setting was independently associated with an increase in physical activity (SMD 0.29, 95% CI 0.05–0.53). This is consistent with findings from a meta-analysis of goal setting interventions to increase physical activity across all settings, [59] suggesting supporting patients to set and review physical activity goals should be prioritised as an effective, low-cost intervention to increase physical activity in hospitals. Providing feedback on performance was also independently associated with an increase in physical activity, when trials with a high risk of bias were excluded (SMD 0.41, 95% CI 0.08–0.75). Feedback has been an effective behaviour change intervention in other populations. [60] The increasing use of activity monitors to provide physical activity feedback is consistent with the importance of informing patients whether goals have been met. It may not be the total number of behaviour change interventions that is important, but more their targeted use to set and achieve goals.

Previous observational studies have reported an association between increased physical activity and shorter length of stay, [61] admission to a care home and pressure sores [62]. In contrast, although our review demonstrated that behaviour change techniques were associated with increased physical activity, these improvements did not translate into reduced length of stay or improved mobility. These differences may be due to the observational study design of previously reported studies. Observational designs are more subject to bias, a concern that can be addressed by the use of randomised controlled designs. It is also possible the short duration of behaviour changes interventions within inpatient settings is insufficient to provide stimulus to promote changes in other outcomes. Our review was also limited to trials with objective measures of physical activity.

Significant heterogeneity in how researchers measure and define physical activity among hospital inpatients has been highlighted leading to recommendations that objective measures, such accelerometers, should be used [3]. However, few validation studies have been undertaken to establish the accuracy of different devices in measuring physical activity in hospitalised older people and some devices may be less accurate with slow gait speed [63]. In our review, we made the decision to only include trials with an objective measure due to limited agreement between self-report and objective measures of physical activity [64].

Strengths and limitations

To our knowledge, this is the first systematic review examining the effectiveness of behaviour change interventions to increase physical activity of hospital inpatients. We preregistered our protocol, included only randomised controlled trials, and used an internationally recognised taxonomy to identify the behaviour change techniques utilised [18]. Most trials described the intervention in some detail, but frequently missing were data regarding fidelity and intervention modifications and details regarding the comparator intervention [30].

There are a number of limitations. Despite using rigorous search methods, we did not search for grey literature and, therefore, our review may not be representative of all relevant research in the field. There are other interventions, besides behaviour change, that could increase physical activity such as supervised exercise and activity programs [65]. In a review of reviews, there was no evidence that multi-component interventions targeting behaviour change among health care professionals were more effective than single component programs [66]. We chose to focus on one type of intervention to reduce clinical heterogeneity but other interventions targeting physical activity could benefit from further research, including whether they are more effective and cost-effective in isolation to or when combined with behaviour change to help providers to make decisions about how to invest limited resources.

Conclusion

There is moderate-certainty evidence that behaviour change interventions are associated with increased physical activity levels among older hospitalised patients. There remains uncertainty about the benefits of implementing behaviour change interventions to increase physical activity for hospitalised patients as there were no associations with patient-related and health service benefits.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

Declaration of Sources of Funding: This review was not supported by external funding. VG and KW are supported by the National Institute for Health Research (NIHR) Applied Research Collaboration South West Peninsula and East of England, respectively. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

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Received 19 March 2021; editorial decision 17 June 2021