

The effectiveness of pedometers to increase physical activity: a systematic review and meta-analysis.

Dan Mason (1), Laura Lamming, Ed Wilson,
Vijay Singh GC, Sally Pears, Katie Morton,
Maaïke Bijker, Stephen Sutton, Wendy
Hardeman.

(1) The Behavioural Science Group, Institute of Public Health, Cambridge, UK

Pedometers and physical activity

Small, inexpensive

Popular and usable



Current evidence

Systematic review of pedometers to increase physical activity

Bravata et al (2007) JAMA; 298:19; 2296-2304

- 8 RCTs: pedometers increased steps by 2419 ± 1394 per day
- 18 observational studies: increased steps by 2183 ± 613 per day
- Lots of different study designs
- Interventions typically multi-component; do not isolate pedometer effect

Case for a review

- A doubling of studies of pedometers and physical activity since 2007
 - Many more even if we only focus include RCTs
- More studies = greater power to examine heterogeneity
 - Isolate pedometer effect
 - Examine effects of different intervention components (e.g. step goals)

Additional vs residual components

Additional components	Substantial addition to pedometer e.g. PA counselling, access to PA website	Pedometer NOT isolated if these vary between groups
Residual components	<ul style="list-style-type: none">• Instructions to increase PA• Given a PA goal• Asked to record daily PA	Pedometer IS “isolated” if only these things vary between groups

Aims of the review

Aim #1: identify pooled effect size for pedometer intervention compared with non-pedometer control on free-living physical activity

Aim #2: identify pooled effect size as above, but for the case where the pedometer is isolated from other intervention components

Aim #3: identify whether effect size varies with the presence or otherwise of residual intervention components:

- Telling participants to increase their physical activity
- Giving participants a physical activity goal
- Asking participants to record their daily physical activity

Inclusion criteria

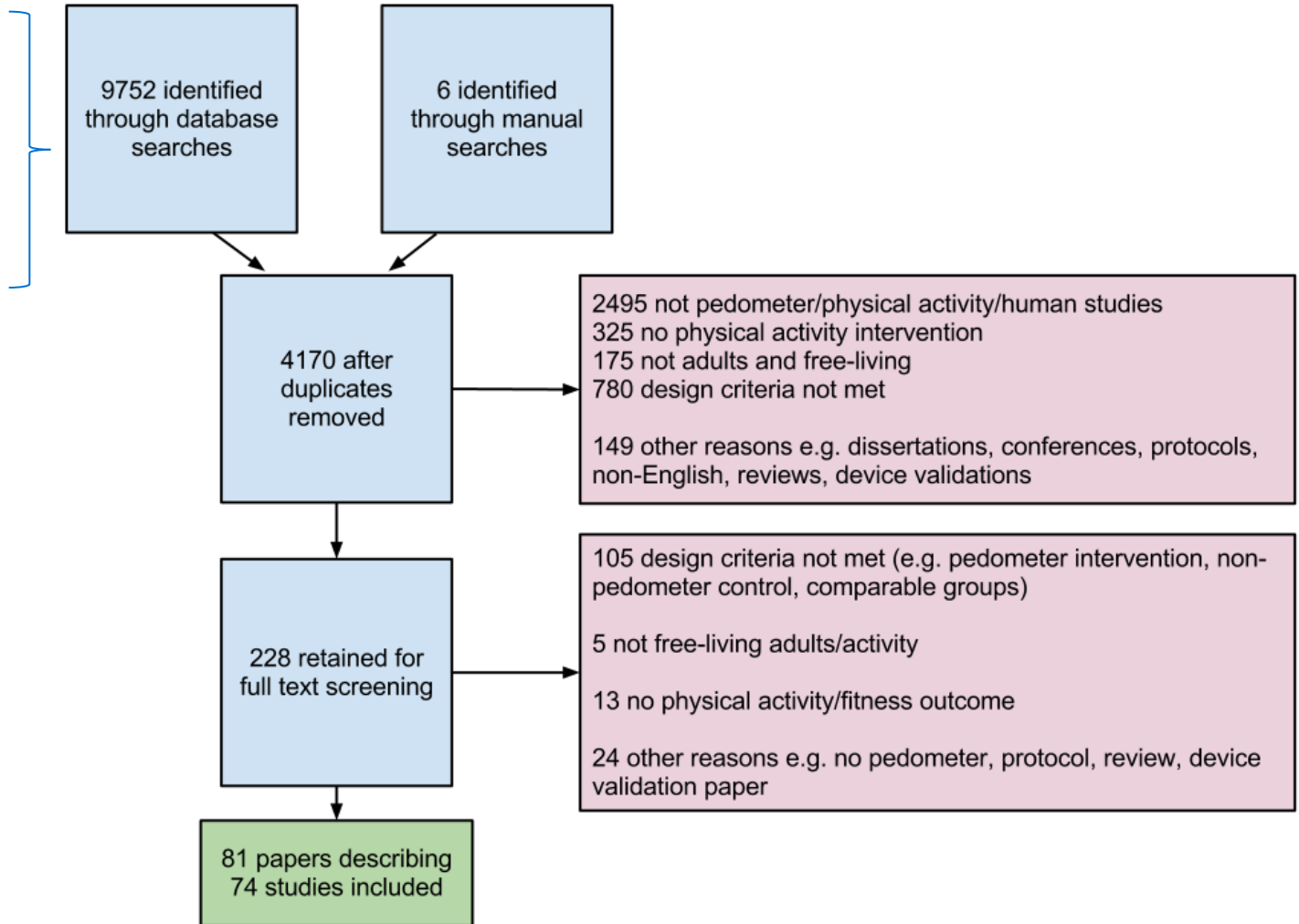
- Intervention group receives pedometer as intervention tool
- Participants are adults (>18yo)
- Free-living: pedometer worn in everyday life (e.g. not during prescribed exercise class; not inpatients; not lab studies)
- A physical activity or fitness outcome is reported
- More than one group; i.e. no cohort studies, no within-subjects experiments

Exclude if:

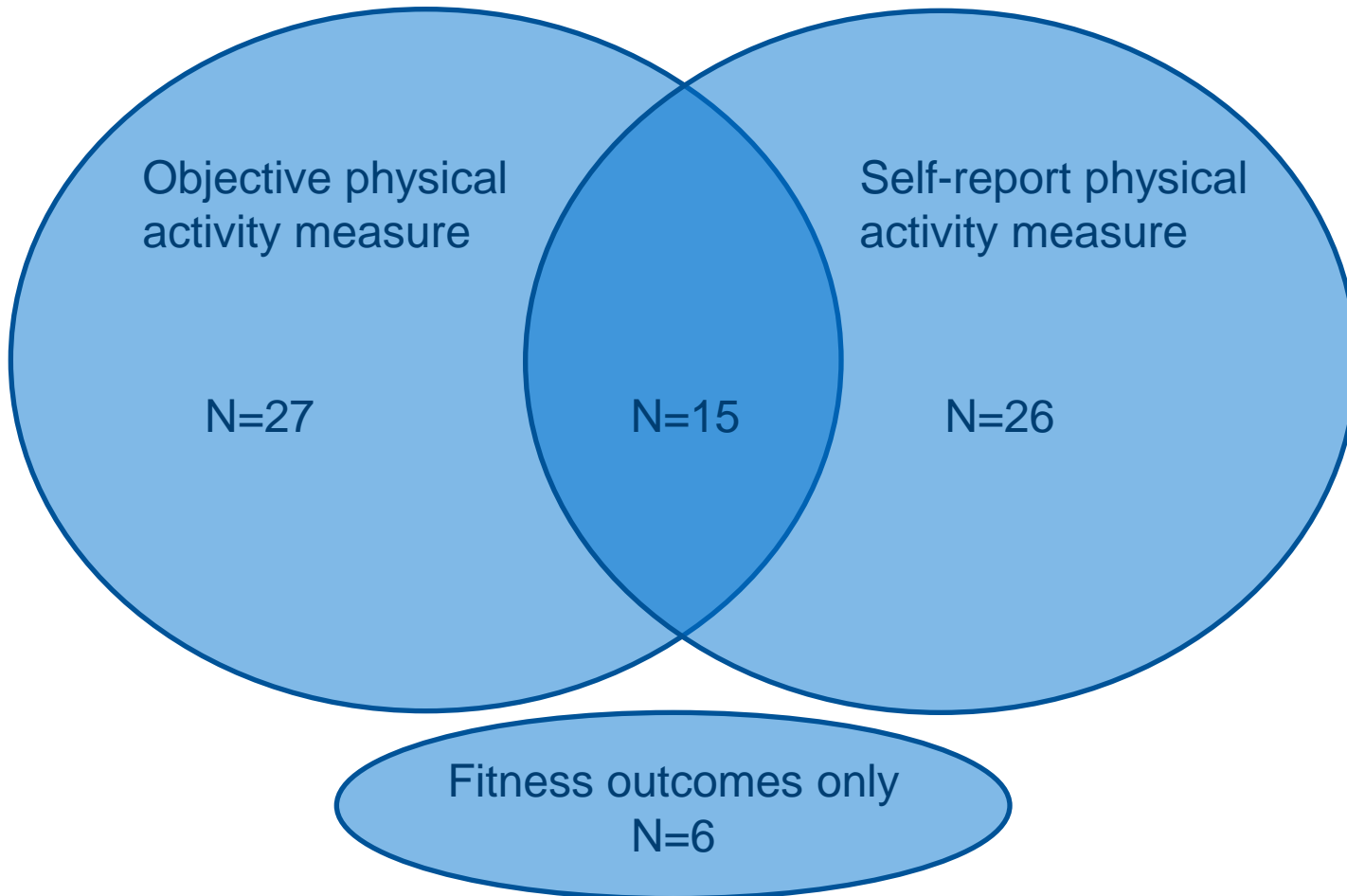
- “Controls” wear an open pedometer throughout the intervention period

Search

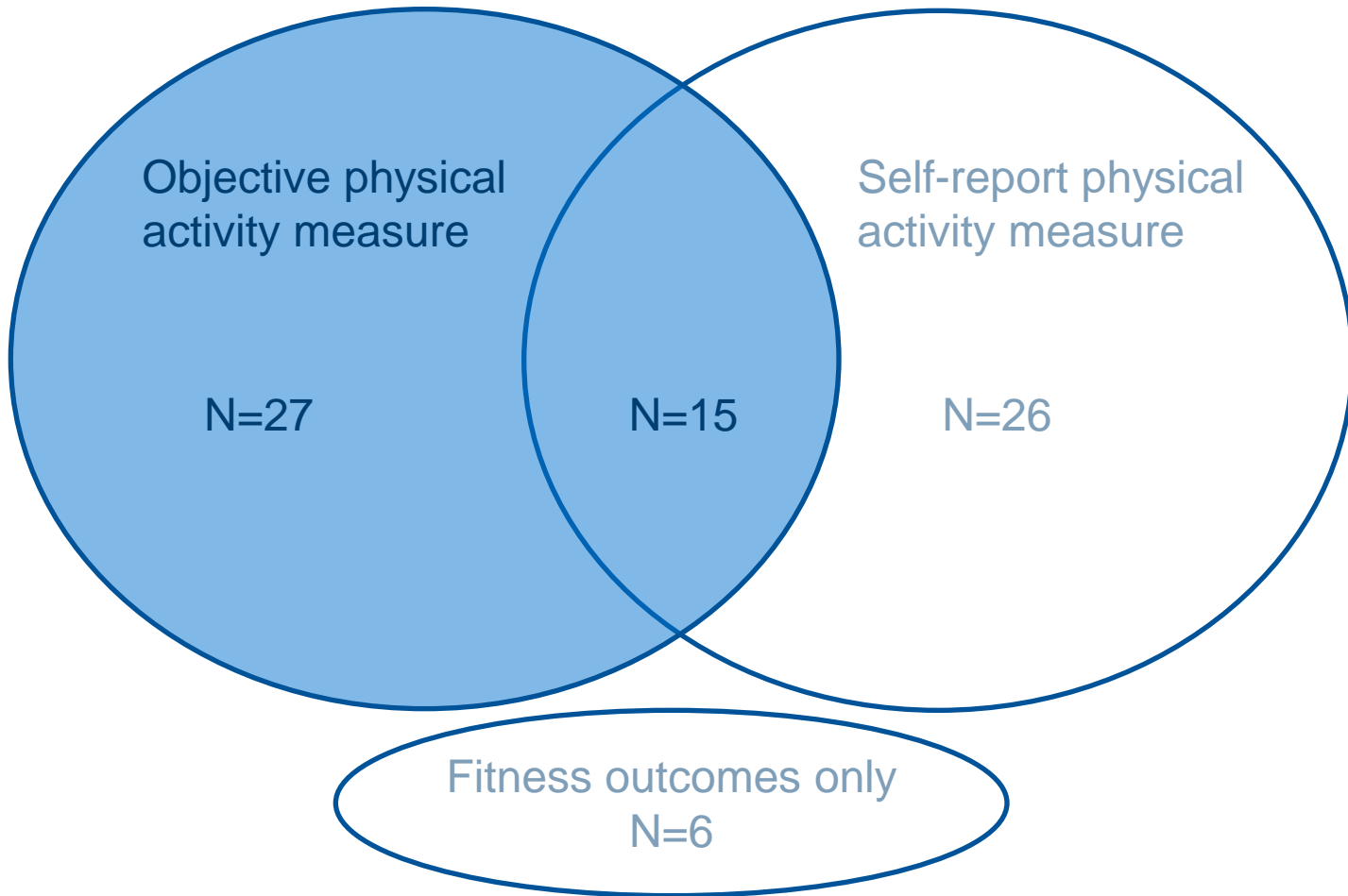
MEDLINE: 1471
PsycINFO: 760
SCI-EXPANDED/SSCI/CPCI-S/CPCI-SSH: 1791
EMBASE: 1540
Cochrane: 371
ERIC: 34
CINAHL: 678
SCOPUS: 3107



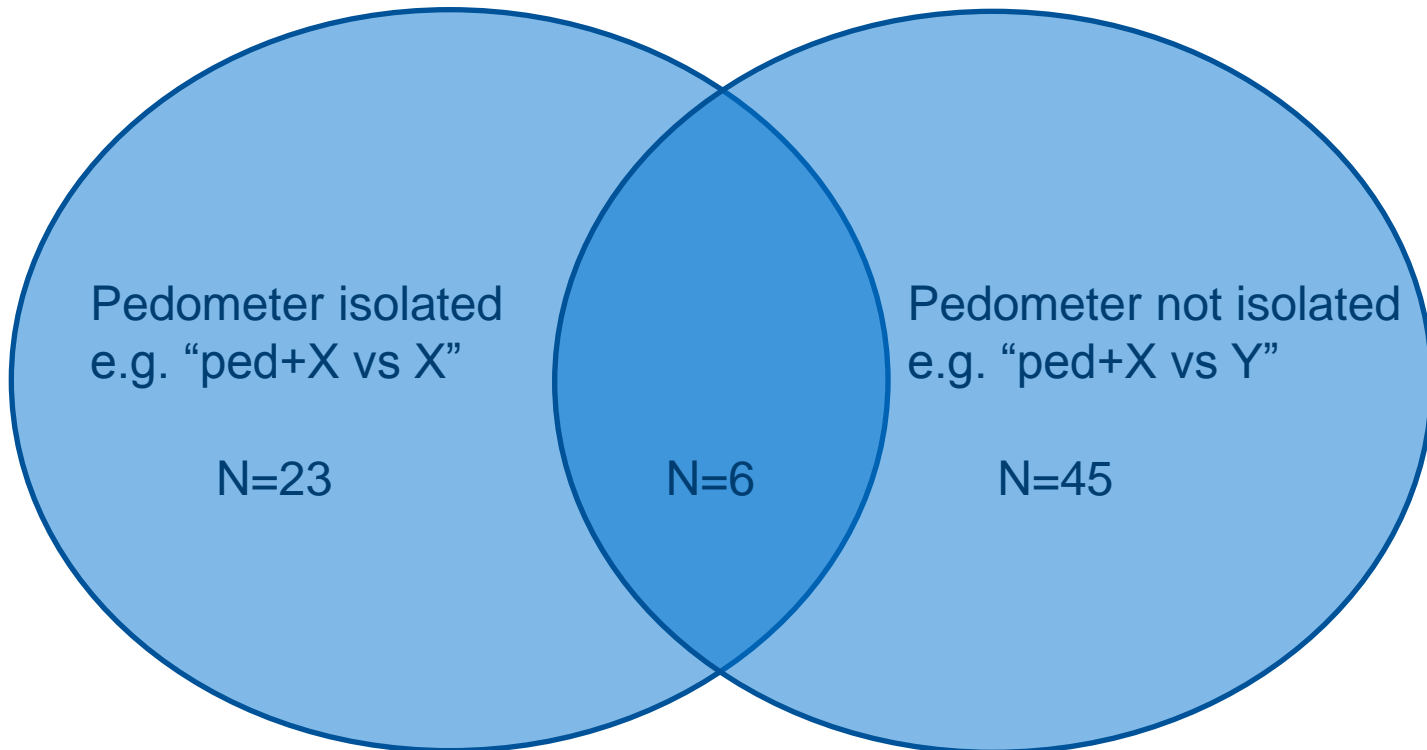
Preliminary subgroup: select by measurement



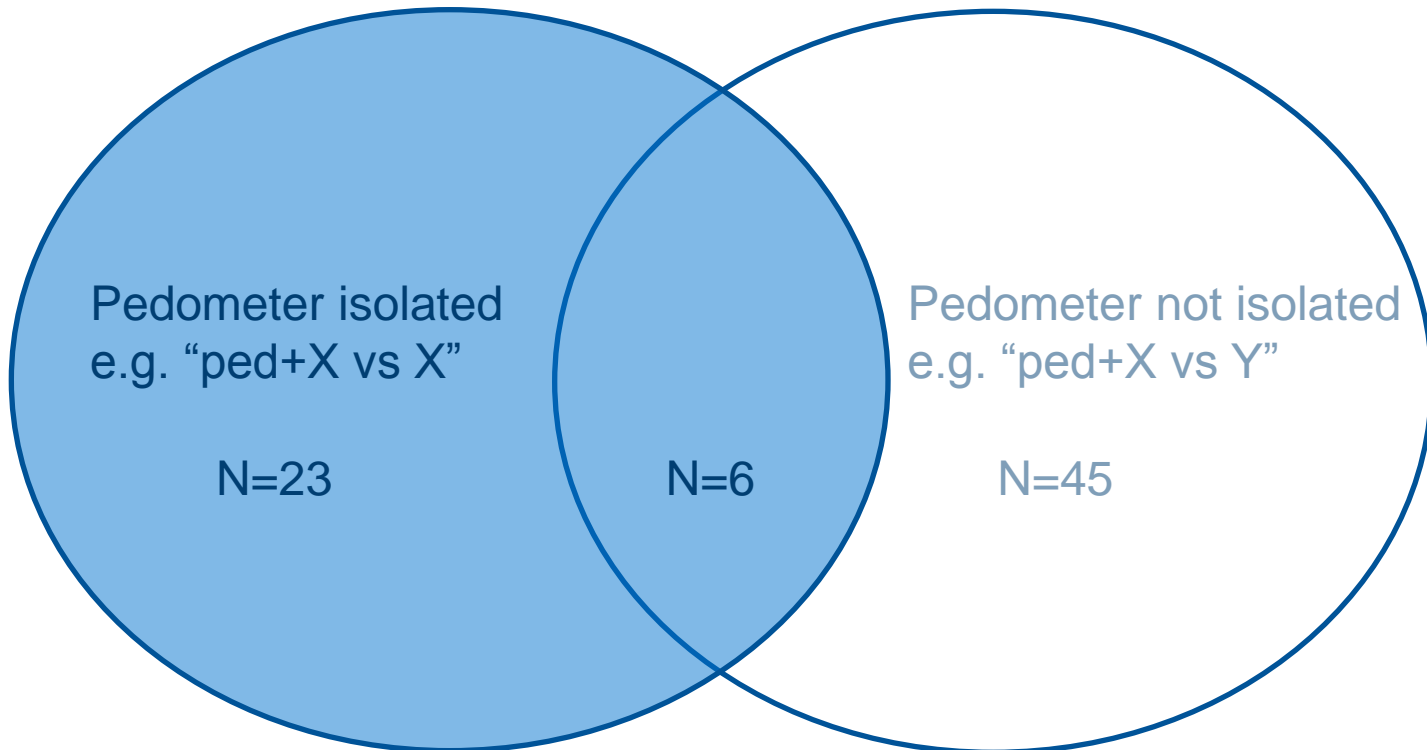
Preliminary subgroup: select by measurement



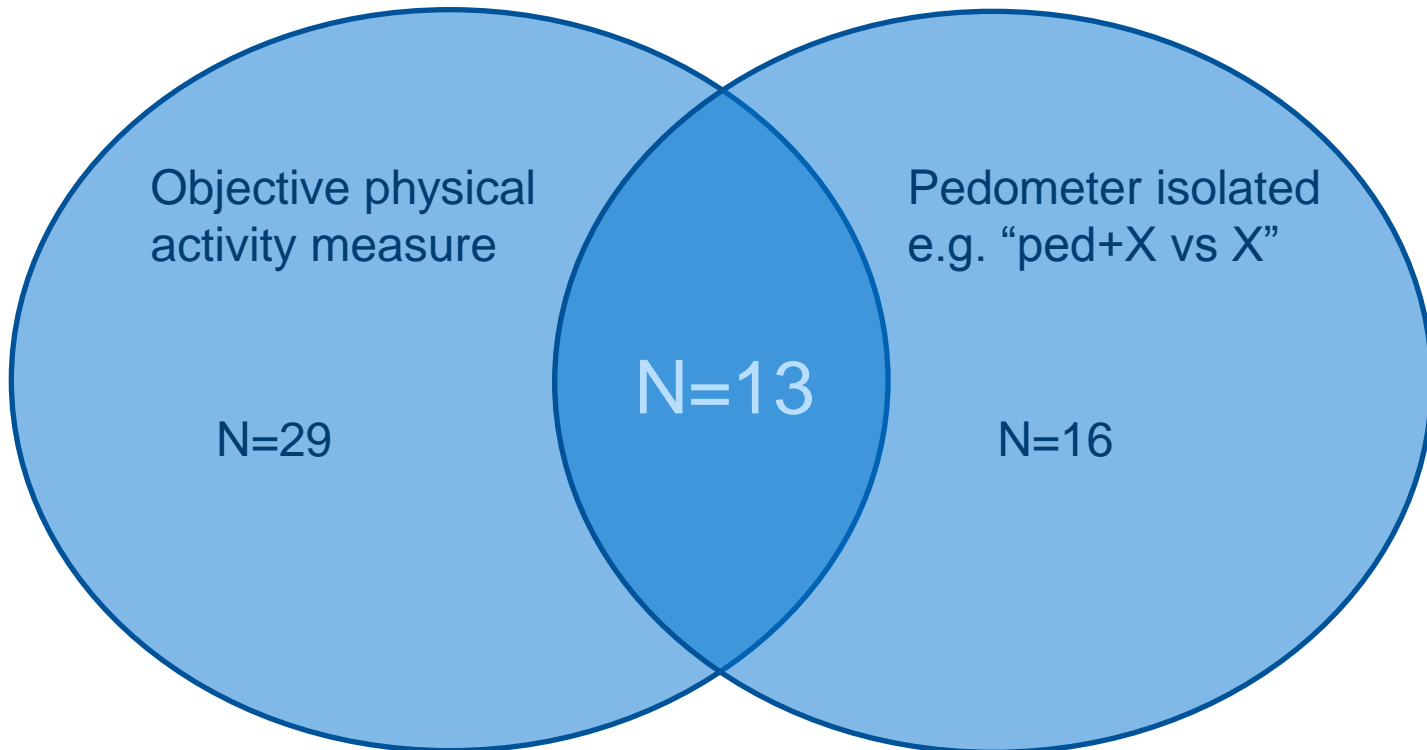
Preliminary subgroup: select by design



Preliminary subgroup: select by design



Preliminary subgroup: final selection N=13



Study characteristics

- 13 studies had objective measures and isolated the pedometer
- 1397 participants randomised, 1053 analysed
- Mean age 55.2yo; study means from 20.6 to 77.3yo, but mostly >40yo
- 88.6% female (6 studies only recruited women)
- Follow-up for physical activity outcome typically around 4-12 weeks; some longer term

Note: very preliminary, no double coding beyond initial selection of 74 studies

Residual intervention components

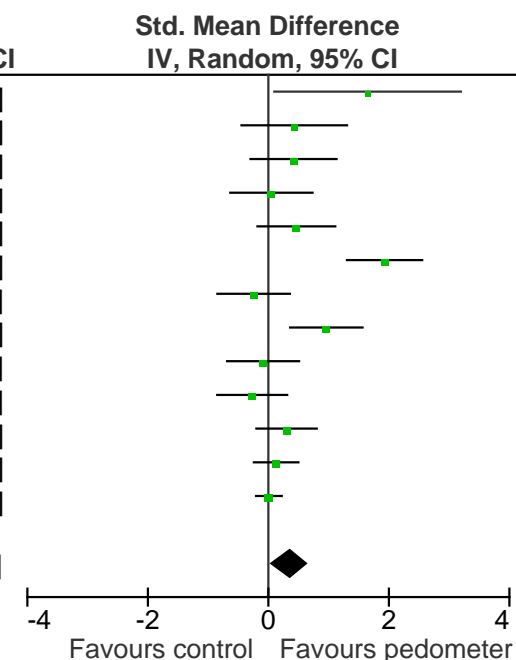
	Instructions vary	Logging PA varies	Goals vary
Baker 2011			
Carr 2008	X	X	X
Du Vall 2004	X	X	X
Gray 2009	X		X
Hultquist 2007			
McMurdo 2010			
Ornes 2007		X	
Samuels 2011			
Sugden 2008			
Vallance 2007		X	
Yates 2009			
Eastep 2004		X	
Strath 2011		X	X

Results – pedometer effect isolated, N=13

Study or Subgroup	Pedometer			Control			Weight	Std. Mean Difference IV, Random, 95% CI	Std. Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carr 2008	9,668	1,556	5	6,618	1,779	5	2.9%	1.65 [0.10, 3.20]	
Eastep 2004	63,421	23,265	12	52,505	25,787	9	5.9%	0.43 [-0.45, 1.31]	
Strath 2011	5,754	1,756	16	5,000	1,756	15	7.1%	0.42 [-0.29, 1.13]	
DuVall 2004	322.93	88	17	318.33	88	16	7.3%	0.05 [-0.63, 0.73]	
Samuels 2011	8,877	2,394	14	7,921	1,808	29	7.6%	0.47 [-0.18, 1.11]	
Ornes 2007	8,890	1,172	30	6,673	1,093	29	7.8%	1.93 [1.30, 2.55]	
Hultquist 2007	8,491	2,187	23	9,073	2,513	20	7.9%	-0.24 [-0.85, 0.36]	
Gray 2009	10,182	4,081	24	6,709	2,918	24	8.0%	0.96 [0.36, 1.56]	
Sugden 2008	108,738	54,728	27	113,822	62,337	18	8.0%	-0.09 [-0.68, 0.51]	
Baker 2011	9,573	2,587	23	10,279	2,615	23	8.1%	-0.27 [-0.85, 0.31]	
Yates 2009	8,995	2,402	33	7,922	4,424	29	8.8%	0.30 [-0.20, 0.81]	
McMurdo 2010	147,142	56,458	60	139,714	57,041	53	9.8%	0.13 [-0.24, 0.50]	
Vallance 2007	8,109	4,302	172	8,070	3,606	166	10.8%	0.01 [-0.20, 0.22]	
Total (95% CI)			456			436	100.0%	0.36 [0.05, 0.67]	

Heterogeneity: Tau² = 0.22; Chi² = 49.25, df = 12 (P < 0.00001); I² = 76%

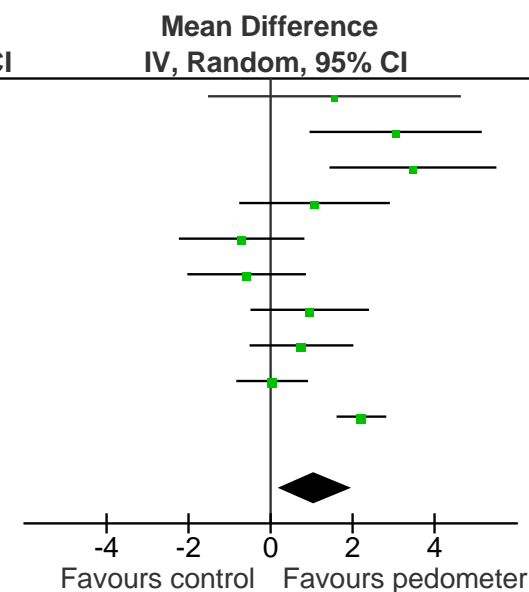
Test for overall effect: Z = 2.30 (P = 0.02)



Results – pooled steps per day (1000s), N=10

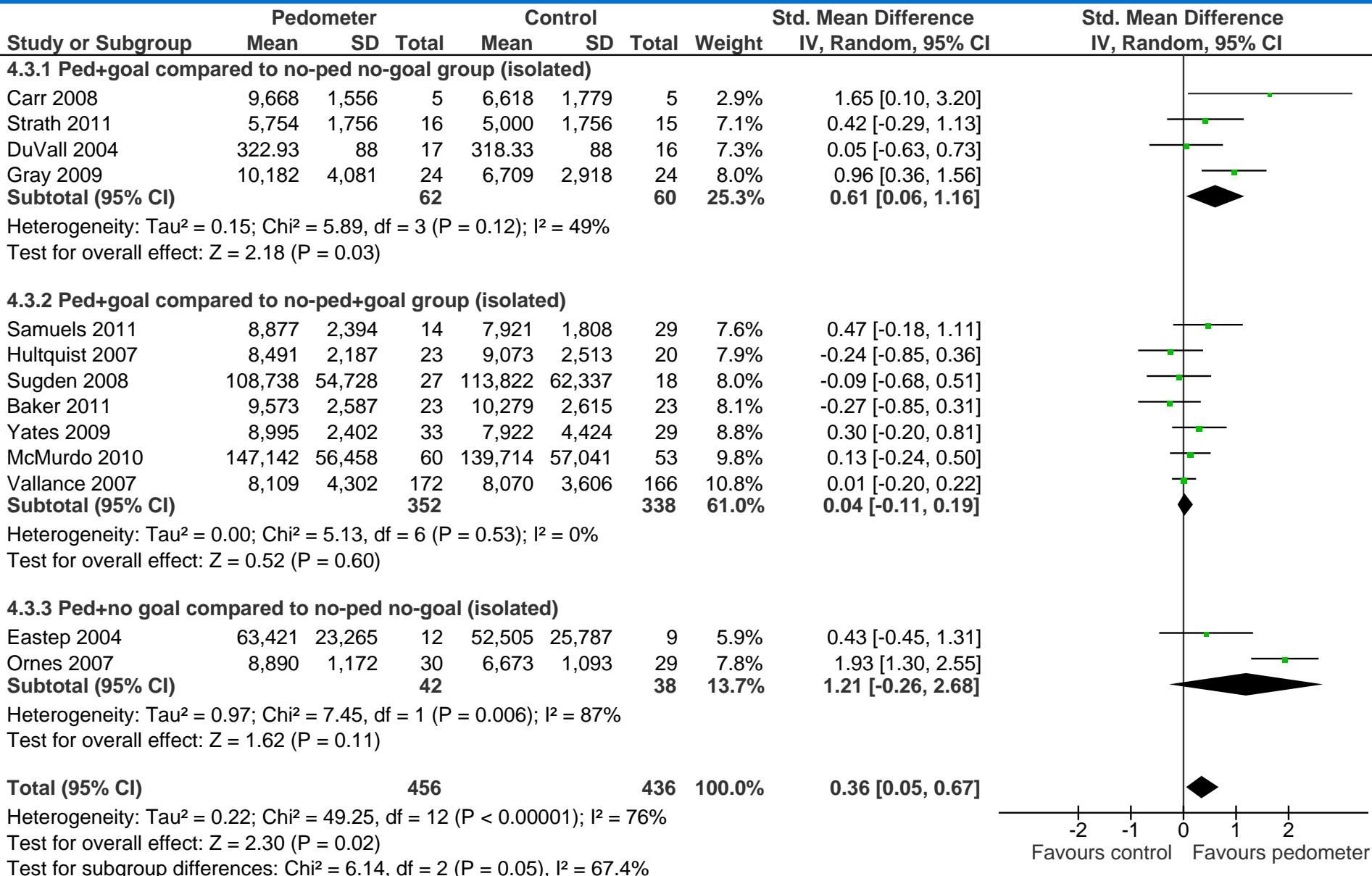
Study or Subgroup	Pedometer			Control			Weight	Mean Difference IV, Random, 95% CI	Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Eastep 2004	9.06	3.324	12	7.501	3.684	9	5.3%	1.56 [-1.50, 4.61]	
Carr 2008	9.668	1.556	5	6.618	1.779	5	8.1%	3.05 [0.98, 5.12]	
Gray 2009	10.182	4.081	24	6.709	2.918	24	8.3%	3.47 [1.47, 5.48]	
Yates 2009	8.995	2.402	33	7.922	4.424	29	9.1%	1.07 [-0.73, 2.88]	
Baker 2011	9.573	2.587	23	10.279	2.615	23	10.2%	-0.71 [-2.21, 0.80]	
Hultquist 2007	8.491	2.187	23	9.073	2.513	20	10.6%	-0.58 [-2.00, 0.84]	
Samuels 2011	8.877	2.394	14	7.921	1.808	29	10.6%	0.96 [-0.46, 2.37]	
Strath 2011	5.754	1.756	16	5	1.756	15	11.3%	0.75 [-0.48, 1.99]	
Vallance 2007	8.109	4.302	172	8.07	3.606	166	12.8%	0.04 [-0.81, 0.88]	
Ornes 2007	8.89	1.172	30	6.673	1.093	29	13.7%	2.22 [1.64, 2.80]	
Total (95% CI)			352			349	100.0%	1.08 [0.19, 1.96]	

Heterogeneity: Tau² = 1.41; Chi² = 40.02, df = 9 (P < 0.00001); I² = 78%
 Test for overall effect: Z = 2.38 (P = 0.02)



Estimate 1080 steps per day
advantage with pedometer

Results – step goal subgroup analysis, N=13 x 3 subgroups



Discussion

- Identified 74 studies with ped vs no-ped RCT designs
- Mix of self-report and objective measures
- Wide variety of interventions
- Sufficient numbers to isolate pedometer effect... but not without allowing some residual intervention components
- **Preliminary** analysis suggests overall increase in physical activity in pedometer groups when (somewhat) isolated against a non-pedometer control
- Subgroup analyses possible on PA goals, PA logs, goal review etc.
 - But these components are all correlated to some extent...

Next steps

- Data extraction on the full set ongoing
 - Extracting info on intervention intensity and mode of delivery
 - “Additional” intervention components (e.g. counselling)
 - “Residual” intervention components (e.g. step goals)
- Further analyses will include:
 - Self-report measures
 - Studies that only have pedometer groups with “additional” components i.e. not isolated

Acknowledgements

This presentation presents independent research funded by the National Institute for Health Research (NIHR) under its Programme Grants for Applied Research Programme (Grant Reference Number RP-PG-0608-10079). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.

Search

Disjunction of	Examples	Notes
Device terms	pedometer\$, accelerometer\$, “activity monitor\$”	Based on previous pedometer review
Physical activity terms	(physical* NEAR/5 activ*), (life-style* NEAR/5 activ*), inactiv*, walk*	Based on previous Cochrane physical activity review (Foster et al 2009)
Design terms	“clinical trial”, random*	Based on Haynes et al (2005) “scientifically strong studies” filter

Search in: MEDLINE, PsycINFO, SCI-EXPANDED, SSCI, CPCI-S,
CPCI-SSH, EMBASE, Cochrane Library, ERIC, CINAHL, SCOPUS

Intervention examples

Study	Group	Intervention details
Gray 2009	Intervention (pedometer)	12 week pedometer walking programme plus an individualised walking schedule to gradually increase daily step count by 3000s/d on 5 days pw, by week 6, then maintain for a further 6 weeks.
	Control (no pedometer)	Asked to maintain normal walking levels
Hultquist 2007	Intervention (pedometer)	Instructed to take 10,000 steps per day, keeping daily PA log, reporting to lab weekly for log (step count) collection over 4 weeks
	Control (no pedometer)	Instructed to take 30min walk per day, keeping daily PA log, reporting to lab weekly for log (minutes) collection over 4 weeks

Intervention examples

Study	Group	Intervention details
Vallance 2007	SR (standard recommendation)	Received standard recommendation to perform 30min MVPA on 5d pw; those already hitting this were advised to increase
	PM (print materials)	Received SR plus a guidebook "exercise for health" specific to breast cancer survivors
	PED (pedometer)	Received SR plus a pedometer to wear during waking hours and 12 week step calendar to record daily steps
	COM (combination pedometer and print materials)	Received SR plus guidebook as PM group and pedometer and step calendar as PED group