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Mediators of behaviour change maintenance in physical activity interventions for young and middle aged adults: a systematic review

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Supplementary file 3: Summary of interventions and mediator results.

Reference	Study design	Intervention and comparison group(s)/Theoretical framework	Follow-up	Mediators measured	PA outcome	Intervention effects on mediators	Association of mediators with PA	Formal mediation test results	Mediation tests as per study protocol?
Andersen, 2012 [1]	Two-arm, RCT.	<p>Intervention: N=89 5 months, group exercise sessions, group lectures, counselling session, written material, phone call/ SCT.</p> <p>Comparison: N=61 Received baseline results. Organised exercise, a group lecture and written material (post-intervention).</p>	Baseline, 5 and 11 months.	<p>PA self-efficacy: 7 items, scale 1-7.</p> <p>Social support (family): 6 items, scale 1-5.</p> <p>Social support (friends): 6 items, scale 1-5.</p> <p>Outcome expectancies: 6 items, scale 1-7.</p> <p>Perceived barriers to PA: 15 items, scale 0-5.</p>	<p>11 months</p> <p>Accelerometer MVPA mins/day +ve: p=0.003.</p>	<p>5 months</p> <p>Results not reported.</p> <p>11 months</p> <p>+ve: Social support (family) (p<0.01), Outcome expectancies (p<0.01), 6/15 Perceived barriers to PA (p<0.04).</p> <p>NS: PA self-efficacy, Social support (friends), 9/15 Perceived barriers to PA.</p>	<p>PA (baseline-11 months), all mediators (baseline-5 months).</p> <p>NS: all mediators.</p>	Mediation analysis not conducted due to NS association between mediators and PA.	Methods not stated in protocol.

Arroggi, 2017 [2]	Quasi-experiment.	<p>Intervention: N=246 3 months, Two face-to-face counselling sessions and three contacts by email/phone, PA monitoring and feedback, feedback on physical health measures, individually tailored PA plans, PA choices, evaluation and adjustment of PA goals, barrier identification, self-monitoring, tips for PA maintenance/ SDT.</p> <p>Control: N=54 Feedback on PA level and advice on PA recommendations.</p>	Baseline, 3 and 9 months.	<p>Autonomy: 4 items, scale 1-5.</p> <p>Competence: 4 items, scale 1-5.</p> <p>Relatedness: 4 items, scale 1-5.</p> <p>Total needs satisfaction: 12 items, scale 1-5.</p>	<p>9 months</p> <p>Pedometer average day steps/day +ve: 0.45, p<0.001.</p> <p>Pedometer weekday steps/day +ve: 0.48, p<0.001.</p>	<p>3 months</p> <p>+ve: Autonomy (p=0.02), Competence (p=0.01), Total needs satisfaction (p=0.03).</p> <p>NS: Relatedness.</p> <p>9 months</p> <p>+ve: Competence (p=0.02), Total needs satisfaction (p=0.05).</p> <p>NS: Autonomy, Relatedness.</p>	<p>Average day PA (baseline-9 months), all mediators (baseline-9 months).</p> <p>+ve: Autonomy (p<0.01), Competence (p<0.01), Total needs satisfaction (p<0.01).</p> <p>NS: Relatedness.</p> <p>Weekday PA (baseline-9 months), all mediators (baseline-9 months).</p> <p>+ve: Competence (p<0.05).</p> <p>NS: Autonomy, Relatedness.</p>	<p>Average day PA (baseline-9 months), all mediators (baseline-9 months), Weekday PA (baseline-9 months), all mediators (baseline-9 months).</p> <p>+ve: Autonomy (p<0.05), Competence (p<0.05), Total needs satisfaction (p<0.05).</p> <p>NS: Relatedness.</p>	Not published.
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							, Total needs satisfaction.		
Bennet, 2008 [3]	Two-arm, RCT.	<p>Intervention: N=35 6 months, Monthly 15-minute telephone calls with individually-tailored MI for PA, goal-setting, planning, information on safety, discussion on perceived exertion and problem-solving barriers/ TTM, SCT.</p> <p>Control: N=37 Monthly telephone calls asking about PA (no MI).</p>	Baseline and 6 months.	<p>PA self-efficacy: 6 items, scale 1-5.</p> <p>Stage of change for PA: 1 item, scale 1-5.</p>	<p>6 months</p> <p>CHAMPS: Total energy expenditure in PA kcal/week NS.</p>	<p>6 months</p> <p>+ve: PA self-efficacy (p=0.02).</p> <p>NS: Stage of change for PA.</p>	N/A	N/A	N/A
Buman, 2011 [4]	Two-arm, RCT.	<p>Intervention: N=41 16 weeks, weekly group sessions, building self-management skills for PA initiation and maintenance, encouragement and feedback, goal-setting, social support, problem solving, use of mental imagery, relapse prevention, pedometers, access to exercise facility/ SCT, SDT.</p>	Baseline, 16 weeks and 18 months (Self-determined behaviour beliefs only).	<p>Barrier self-efficacy: 13 items, scale 0%-100%.</p> <p>PA self-efficacy: 8 items, scale 0%-100%.</p> <p>Self-determined behaviour beliefs: 31 items, scale 1-6.</p>	<p>18 months</p> <p>LTEQ leisure-time MVPA mins/week +ve: p=0.04.</p>	<p>16 weeks</p> <p>+ve: Self-determined behaviour beliefs (p<0.05).</p> <p>NS: Barrier self-efficacy, PA self-efficacy.</p> <p>18 months</p> <p>+ve: Self-determined</p>	N/A	N/A	N/A

		<p>Comparison: N=40 Standard community-based approach, pedometers, access to exercise facility, two educational sessions and a PA prescription, basic health education sessions (non-PA).</p>				behaviour beliefs (p=0.02).			
Calfas, 2000 [5,6]	Two-arm, RCT	<p>Intervention: N=170 15 weeks, weekly lecture, peer-led lab, benefits and risks, methods of behavioural self-management, mail and phone follow-up/ TTM, SCT.</p> <p>Comparison: N=168 Lectures and newsletters (non-PA).</p>	Baseline, 16 weeks, 12 and 24 months.	<p>PA self-efficacy: 12 items, scale 1-5.</p> <p>Social support (family): 13 items, scale 1-5.</p> <p>Social support (friends): 13 items, scale 1-5.</p> <p>Perceived benefits of PA: 14 items, scale 1-5.</p> <p>Perceived barriers to PA: 24 items, scale 0-4.</p> <p>Enjoyment: 18 items, scale 1-7.</p> <p>Experiential/Cognitive processes of change: 10 items, scale 1-5.</p> <p>Behavioural processes of change: 10 items, scale 1-5.</p>	12 and 24 months	<p>7-Day PAR: Moderate PA hours/week NS.</p> <p>16 weeks +ve (women): PA self-efficacy (p<0.01), Social support (family) (p=0.03), Social support (friends) (p<0.01), Perceived benefits of PA (p=0.04), Enjoyment (p=0.04), Experiential/Cognitive processes of change (p<0.01), Behavioural processes of change</p>	Regression analyses not conducted due to lack of variability in mediators and PA outcomes.	N/A	N/A

						<p>($p < 0.01$).</p> <p>+ve (men): Perceived barriers to PA ($p < 0.01$), Behavioural processes of change ($p < 0.01$).</p> <p>NS (women): Perceived barriers to PA.</p> <p>NS (men): PA self-efficacy, Social support (family), Social support (friends), Perceived benefits of PA, Enjoyment, Experiential/ Cognitive processes of change.</p> <p><u>12 and 24 months</u></p> <p>+ve</p>			
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						<p>(women): Behavioural processes of change (p<0.03), Experiential/Cognitive Processes of Change (p<0.03).</p> <p>NS (women): all other mediators.</p> <p>NS (Men): all mediators.</p>			
Carroll, 2010 [7]	Two-arm, cluster RCT	<p>Intervention: N=187 6 months, 4 personalised PA reports, tips for increasing activity, questions to ask physicians, activity prescription/ TTM.</p> <p>Comparison: N=207 Same protocol (non-PA).</p>	Baseline and 6 months.	<p>Behavioural processes of change: 12 items, scale 1-5.</p> <p>Experiential/Cognitive processes of change: 12 items, scale 1-5.</p> <p>PA self-efficacy: items unclear, scale 1-5.</p> <p>Decisional balance (pros/cons): 6 items, scale 1-5.</p>	<p>6 months</p> <p>7-Day PAR: Total PA mins/week NS.</p>	<p>6 months</p> <p>+ve: Behavioural processes of change (p<0.01), Experiential/Cognitive processes of change (p=0.04).</p> <p>NS: PA self-efficacy, Decisional balance (pros/cons).</p>	N/A	N/A	N/A
Dallow, 2003 [8]	Two-arm, RCT.	<p>Intervention: N=29 24 weeks, goal-setting,</p>	Baseline, 24 and 48	<p>Stage of change for PA: 5 items.</p>	<p>24 and 48 weeks</p>	<p>24 weeks</p>	N/A	N/A	N/A

		<p>weekly then fortnightly meetings, group discussions, identifying barriers, using the processes of change, field trips/ TTM, Theory of Self-efficacy.</p> <p>Control: N=29 Usual care, exercise prescription, goal-setting, free gym membership, four educational group classes.</p>	weeks.	<p>Cognitive processes of change: 20 items, scale 1-5.</p> <p>Behavioural processes of change: 20 items, scale 1-5.</p> <p>PA self-efficacy: 5 items, scale 1-5.</p>	<p>7-Day PAR: energy expenditure in PA kcal/kg/day +ve: p<0.05.</p>	<p>+ve: 2/5 Cognitive processes of change (p<0.05).</p> <p>NS: 3/5 Cognitive processes of change, 5/5 Behavioural processes of change, PA self-efficacy.</p> <p>48 weeks</p> <p>NS: 5/5 Cognitive processes of change, 5/5 Behavioural processes of change, PA self-efficacy.</p> <p>NB. Significance of intervention effect on Stage of change for PA not reported.</p>			
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Estabrooks, 2011 [9]	Two-arm, RCT	<p>Intervention: N=56 8 weeks, educational handouts, action plans, friendly competitions, group discussions and goals (telephone and group contact)/ Group dynamics principles.</p> <p>Comparison: N=59 Self-help guide to personal action planning for PA, reference guides with local resources for PA, one telephone contact.</p>	Baseline, 3 and 9 months.	<p>PA self-efficacy: 14 items, scale 0%-100%.</p> <p>Outcome expectancies: 9 items, scale 0%-100%.</p> <p>Outcome satisfaction: 9 items, scale 1-5.</p> <p>Goal setting: 4 items, scale 1-5.</p> <p>Social support (institutional): 6 items, scale 1-5.</p>	<p>9 months</p> <p>BRFSS: MVPA mins/week +ve: p<0.05.</p>	<p>3 and 9 months</p> <p>NS: all mediators.</p>	<p>PA (3 months-9 months), All mediators (3 months-9 months).</p> <p>NS: all mediators.</p>	N/A	N/A
Friederichs , 2016 [10,11]	Three-arm, RCT.	<p>Intervention: N=1,423 (I MOVE), N=1,452 (ACTIVE PLUS). 3 months, Four automated text-based sessions, tailored feedback, short videos, action planning, coping planning, autonomy support (I MOVE), Web-based, tailored advice, texts, pictures, short videos (ACTIVE PLUS)/ SDT, MI, TPB, SCT, SRT, TTM.</p> <p>Control: N=1,427. Waiting list.</p>	Baseline, 6 weeks, 3 and 6 months.	<p>Intrinsic motivation: 4 items, scale 1-7.</p> <p>Identified regulation: 4 items, scale 1-7.</p> <p>Competence: 6 items, scale 1-7.</p> <p>Perceived choice: 7 items, scale 1-7.</p>	<p>6 months</p> <p>SQUASH: MVPA mins/week +ve: p=0.005.</p> <p>SQUASH: weekly days with ≥30 mins PA +ve: p<0.001.</p>	<p>3 months</p> <p>+ve: Intrinsic motivation (p<0.001), Identified regulation (p=0.004), Competence (p<0.001).</p> <p>NS: Perceived choice.</p>	<p>MVPA mins/week PA (baseline-6 months), all mediators (baseline-3 months).</p> <p>NS: All mediators.</p> <p>Weekly days with ≥30 mins PA (baseline-6 months), all mediators (baseline-3 months).</p>	<p>MVPA mins/week PA (baseline-6 months), all mediators (baseline-3 months).</p> <p>+ve: Multiple mediation model with all mediators (p<0.05).</p> <p>NS: Intrinsic motivation, Identified</p>	Methods not stated in protocol.

							<p>+ve: Competence (p=0.03).</p> <p>NS: Intrinsic motivation, Identified regulation, Perceived choice.</p>	<p>regulation, Competence, Perceived choice.</p> <p>Weekly days with ≥30 mins PA (baseline-6 months), all mediators (baseline-3 months).</p> <p>+ve: Competence (p<0.05), Multiple mediation model with all mediators (p<0.05).</p> <p>NS: Intrinsic motivation, Identified regulation, Perceived choice.</p>	
Graham-Clark, 1994 [12]	Three-arm, RCT	Intervention: N=270 (Video), N=233 (Video + self-help), cardiovascular risk assessment and tailored video (Lifestyle	Baseline, 4 and 12 months.	Intention to change PA: 1 item, scale 1-4.	<u>12 months</u> Risk Factor Prevalence Survey: Energy expenditure	<u>4 months</u> -ve (combined intervention group):	N/A	N/A	N/A

		<p>counselling using videos arm), self-help instructional materials (Lifestyle counselling using videos and self-help instructional materials)/ TTM.</p> <p>Comparison: N=255 Cardiovascular risk assessment and feedback.</p>			<p>kcal/kg/hour NS.</p>	<p>Intention to change PA (p=0.02).</p> <p>12 months</p> <p>NS (combined intervention group): Intention to change PA.</p>			
Hallam, 2004 [13]	Two-arm, controlled trial.	<p>Intervention: N=60 2 weeks, Four one-hour sessions with homework assignments, self-regulation and time management, goal-setting and goal revision, identifying expected outcomes, social support, reinforcement contingencies, relapse prevention, access to on-site exercise facility/ SCT.</p> <p>Comparison: N=120 Orientation to fitness facility, instruction on use of the equipment, all members of the fitness facility were offered a personal</p>	Baseline, 6 weeks, 6 and 12 months.	<p>Self-regulatory skill use for PA: 43 items, scale 1-5.</p> <p>PA self-efficacy: 14 items, scale 0-100.</p> <p>Outcome expectancies: 19 items, scale 1-5.</p>	<p>6 and 12 months</p> <p>7-Day PAR: Total PA days/week +ve: p<0.001.</p>	<p>6 weeks, 6 and 12 months</p> <p>+ve: Self-regulatory skill use for PA (p=0.01).</p> <p>NS: PA self-efficacy, Outcome expectancies.</p>	<p>PA (baseline-12 months), all mediators (baseline-12 months).</p> <p>+ve: Self-regulatory skill use for PA (p<0.01).</p> <p>NS: PA self-efficacy, Outcome expectancies.</p>	<p>PA (baseline-12 months), all mediators (baseline-12 months).</p> <p>+ve: self-regulation.</p> <p>NS: PA self-efficacy, Outcome expectancies.</p>	Not published.

		exercise program and personal fitness evaluation.							
Harris, 2017 [14]	Three-arm, cluster RCT.	<p>Intervention: N=339 (Postal), N=346 (Nurse). 12 weeks, Pedometers, handbook and diary with a 12 week walking programme, targets (Postal/Nurse), Three practice nurse consultations (Nurse)/ unclear theoretical underpinnings.</p> <p>Control: N=338. Usual care.</p>	Baseline, 3 and 12 months.	PA self-efficacy: 10 items, scale 1-4.	3 and 12 months Accelerometer steps/day +ve (both intervention groups): p<0.001.	<p>3 months</p> <p>Postal +ve: PA self-efficacy (p=0.01).</p> <p>Nurse +ve: PA self-efficacy (p<0.001).</p> <p>12 months</p> <p>Postal NS: PA self-efficacy.</p> <p>Nurse +ve: PA self-efficacy (p=0.01).</p>	N/A	N/A	N/A

Hunter, 2013 [15]	Quasi-experiment: controlled, pre-post design.	Intervention: N=207 12 weeks, PA tracking, web-based monitoring, feedback, goal setting, financial rewards/ Learning Theory. Comparison: N=199 PA tracking, web-based monitoring, feedback.	Baseline, 12 weeks and 6 months.	PA self-efficacy: 5 items, scale 1-5.	6 months GPAQ: MVPA mins/week NS: p=0.48.	12 weeks and 6 months NS: PA self-efficacy.	N/A	N/A	N/A
Isaacs, 2007 [16]	Three-arm, RCT	Intervention: N=317 (Leisure centre), N=311 (Walking). 10 weeks, leisure centre classes or walking program/ TTM, Implementation-intention theory. Comparison: N=315 Tailored advice and information on PA (waiting list).	Baseline, 10 weeks and 6 months.	Stage of Change for PA: 1 item, scale 1-5. Perceived barriers to PA: 18 items, scale unclear. PA self-efficacy: unclear items, unclear scale. Decisional balance (pros/cons): unclear items, unclear scale.	6 months 7-Day PAR: MVPA mins/week +ve: p<0.01 (Walking vs. Comparison). NS: Leisure centre vs. Comparison.	10 weeks and 6 months +ve: Stage of change for PA (both arms) (p<0.05). NS (both arms): Perceived barriers to PA, PA self-efficacy, Decisional balance (pros/cons).	N/A	N/A	N/A
Kamada, 2013 [17,18]	Four-arm, cluster RCT	Intervention: N=1,107 (Aerobic), N=1,107 (Flexibility and muscle-strengthening), N=1,122 (Aerobic, flexibility and muscle-strengthening).	Baseline and 12 months.	Awareness of PA benefits: 1 item, scale 1-2. Perceived benefits of PA: 1 item, scale 1-2.	12 months Engaging in regular PA (i.e. 150 mins/week walking, daily flexibility	12 months +ve (combined intervention groups): Awareness of	PA: engaging in regular PA (baseline-12 months), all mediators (12	N/A	N/A

		<p>12 months, delivery of information flyers, leaflets, posters and banners, outreach health education program, promotion by health professionals, social support from community leaders and lay health workers/ unclear theoretical underpinning.</p> <p>Comparison: N=1,078 No intervention.</p>		<p>Intention to change PA: 1 item, scale 1-2.</p>	<p>activity or 2 days/week muscle-strengthening activity) NS: All intervention groups vs. Comparison.</p> <p>Walking time mins/week +ve: Flexibility and muscle-strengthening vs. Comparison, p<0.05. NS: Aerobic vs. Comparison; Aerobic, flexibility and muscle-strengthening vs. Comparison.</p> <p>36 months</p> <p>Walking time mins/week NS: All intervention groups vs. Comparison.</p>	<p>PA benefits (p<0.05). NS (combined intervention groups): Perceived benefits of PA, Intention to change PA.</p>	<p>months). +ve: Awareness of PA benefits, Perceived benefits of PA, Intention to change PA (p<0.01).</p>		
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Kinmonth, 2008 [19–22]	Three-arm, RCT.	<p>Intervention: N=120 (In-person), N=124 (Telephone). 12 months, advice leaflets on PA benefits, goal-setting, action-planning, self-monitoring, using rewards, goal-review, using prompts, building support from family and friends, relapse prevention (telephone or at home)/ TPB.</p> <p>Comparison: N=121 Advice leaflet.</p>	Baseline and 12 months.	<p>Intention to change PA: 2 items, scale 1-5.</p> <p>Perceived behavioural control: 2 items, scale 1-5.</p>	<p>6 months</p> <p>EPIC Norfolk PA Questionnaire: Total PA MET hours/week NS: all intervention groups vs. Comparison.</p> <p>12 months</p> <p>PA ratio (Energy expenditure on daytime PA, expressed as a ratio to measured resting energy expenditure) dayPAR NS: all intervention groups vs. Comparison.</p> <p>EPIC Norfolk PA Questionnaire: Total PA MET hours/week NS: all intervention groups vs. Comparison.</p>	<p>6 months</p> <p>+ve: Intention to change PA (all intervention groups vs. Comparison) (p<0.05).</p> <p>12 months</p> <p>NS: Intention to change PA (all intervention groups vs. Comparison). NB. Intervention effects on other mediators not reported.</p>	<p>PA: Total PA MET hours/week (6 months), all mediators (6 months). NS: Intention to change PA, Perceived behavioural control.</p> <p>PA: Total PA MET hours/week (12 months), all mediators (12 months). NS: Intention to change PA, Perceived behavioural control.</p> <p>PA: dayPAR ratio (12 months), all mediators (12</p>	N/A	N/A
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							months). NS: Intention to change PA, Perceived behavioural control.		
Lewis, 2013 [23]	Two-arm, RCT	Intervention: N=224 6 months, tailored feedback, manuals and tip sheets, self-monitoring/ TTM, SCT. Comparison: N=224 Information (non-PA).	Baseline, 3, 6 and 12 months.	Behavioural processes of change: 20 items, scale 1-5. Experiential/Cognitive Processes of Change: 20 items, scale 1-5. PA self-efficacy: 5 items, scale 1-5. Decisional balance (pros/cons): 16 items, scale 1-5.	6 and 12 months 7-Day PAR: Total PA mins/week +ve: 31.26, p<0.01.	3 and 6 months +ve: Behavioural processes of change, Experiential/ Cognitive processes of change, PA self-efficacy, Decisional balance (pros/cons) (p<0.01).	PA (baseline-6 months), all mediators (baseline-3 months). +ve: Behavioural processes of change (p<0.01). NS: all other mediators. PA (baseline-12 months), all mediators (baseline-6 months). +ve: Behavioural processes of change	PA (baseline-6 months), all mediators (baseline-3 months). +ve: Behavioural processes of change (p<0.05). NS: all other mediators. PA (baseline-12 months), all mediators (baseline-6 months). +ve: Behavioural processes of change (p<0.05).	Not published.

							(p<0.01). -ve: Experiential /Cognitive processes of change (p=0.04). NS: all other mediators.	-ve: Experiential/ Cognitive processes of change (p<0.05). NS: all other mediators.	
Lilienthal, 2014 [24]	Two-arm, RCT.	Intervention: N=43 Four weeks, 1-hour weekly sessions of telephone-based MI, tailored to fit their stage of change, individual barriers to PA, problem solving and encouragement, received a healthy active living guide/ TTM. Comparison: N=43 Received a healthy active living guide (information only).	Baseline, 4 weeks and 6 months.	PA self-efficacy: 6 items, scale 1-5. Stage of change for PA: 1 item, scale 1-5.	6 months CHAMPS: Moderate-intensity PA energy expenditure kcal/week NS.	4 weeks +ve: Stage of change for PA (p<0.05). NS: PA self-efficacy. 6 months +ve: PA self-efficacy (p<0.05), Stage of change for PA (p<0.05).	N/A	N/A	N/A
Mailey, 2014 [25]	Three-arm, RCT	Intervention: N=47 (Intervention), N=48 (Intervention Plus). 1 month, group sessions on behaviour modification strategies, discussion,	Baseline, 1 and 6 months.	PA self-efficacy: 8 items, scale 0-100. Barrier self-efficacy: 13 items, scale 0-100. Outcome expectancies	6 months Accelerometer MVPA mins/day (combined intervention	6 months Controlling for baseline and 1 month (combined intervention	PA: Accelerometer MVPA mins/day and total CPM (baseline-6	PA: GLTEQ (baseline-6 month), all mediators (baseline-6 month).	Not published.

		<p>problem-solving, pedometer, electronic log, goal setting, information, exercise sheets, monthly telephone calls after 6 months (Intervention Plus)/ SCT.</p> <p>Comparison: N=46 Data collection only (waiting list).</p>		<p>(physical, social, self-evaluative): 15 items, scale 1-5.</p> <p>Goal setting: 10 items, scale 1-5.</p> <p>Planning (Action): 10 items, scale 1-5.</p> <p>Social support (family): 10 items, scale 1-5.</p> <p>Social support (friends): 10 items, scale 1-5.</p>	<p>groups) NS.</p> <p>Accelerometer total CPM (combined intervention groups) NS.</p> <p>GLTEQ: Total weekly leisure PA score (combined intervention groups) +ve: p<0.05.</p>	<p>groups).</p> <p>+ve: Outcome expectancies (p=0.05), Goal setting (P<0.01), Planning (Action) (p<0.01), Social support (family) (p<0.05).</p> <p>NS: PA self-efficacy, Barrier self-efficacy, Social support (friends).</p>	<p>month), all mediators (baseline-6 month).</p> <p>+ve: PA self-efficacy (p<0.01), Barrier self-efficacy (p<0.05), Goal setting (p<0.01), Planning (Action) (p<0.01).</p> <p>NS: all other mediators.</p> <p>PA: GLTEQ (baseline-6 month), all mediators (baseline-6 month).</p> <p>+ve: PA self-efficacy (p<0.01), Barrier self-efficacy (p<0.05), Goal setting (p<0.01),</p>	<p>+ve: PA self-efficacy (p<0.01), Planning (Action) (p<0.05).</p> <p>NS: Barrier self-efficacy, Goal setting.</p>	
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							Planning (Action) (p<0.01), Social support (family) (p<0.01). NS: all other mediators.		
Marcus, 1998 [26,27]	Two-arm, RCT	Intervention: N=78 6 months, individually-tailored reports and counselling messages, self-help manuals matched participant's stage of motivational readiness, feedback/ unclear theoretical underpinning. Comparison: N=72 PA self-help manuals from the AHA.	Baseline, 1, 3, 6 and 12 months (Mood assessed at 12 months only).	Motivational readiness for PA: 1 item, scale 1-5. Decisional balance (pros/cons): 16 items, scale 1-5. PA self-efficacy: 5 items, scale 1-5. Behavioural processes of change: 20 items, scale 1-5. Experiential/Cognitive processes of change: 20 items, scale 1-5. Perceived benefits of PA: 10 items, scale 1-5. Perceived barriers to PA: 6 items, scale 1-5.	6 months 7-Day PAR: Total PA mins/week +ve: p<0.01. 7-Day PAR: Engaging in 150 mins/week MVPA +ve: p<0.01. 12 months 7-Day PAR: Total PA mins/week NS. 7-Day PAR: Engaging in 150 mins/week MVPA +ve: p<0.05.	1 month NS: all mediators. 3 months +ve: Motivational readiness for PA (p<0.05), Behavioural processes of change (p<0.05). NS: all other mediators. 6 months +ve: Motivational readiness for PA (p<0.01).	PA: Total PA mins/week (12 months), all mediators (12 months). +ve: Motivational readiness for PA (p<0.01). NS: all other mediators. PA: Engaging in 150 mins/week MVPA (12 months), all mediators	N/A	N/A

				Mood: 20 items, scale 1-5.		NS: all other mediators. <u>12 months</u> +ve: Motivational readiness for PA (p<0.05), NS: all other mediators.	(12 months). +ve: PA self-efficacy (p<0.01), Mood (p<0.01), Perceived barriers to PA (p<0.05), Behavioural processes of change (p<0.01). NS: Perceived benefits of PA, Experiential /Cognitive processes of change.		
Marcus, Napolitano et al., 2007 [28–32]	Three-arm, RCT	Intervention: N=80 (Telephone), N=81 (Print). 12 months, individually tailored messages, stage-targeted booklets, goal-setting, PA logs/ TTM, SCT. Comparison: N=78 Non-PA information (waiting list).	Baseline, 6 and 12 months.	Behavioural processes of change: 20 items, scale 1-5. Experiential/Cognitive processes of change: 20 items, scale 1-5. PA self-efficacy: 5 items, scale 1-5. Decisional balance	<u>6 months</u> 7-Day PAR: Total PA mins/week +ve: p=0.03 (both intervention arms). <u>12 months</u>	<u>6 months</u> +ve (both intervention arms): PA self-efficacy (p<0.01), Decisional balance (pros/cons) (p≤0.04), Behavioural	PA (baseline-6 and 12 months), all mediators (baseline-6 and 12 months) +ve: Behavioural processes	PA (baseline-6 months), all mediators (baseline-6 months) Both intervention arms +ve: Behavioural	Methods not stated in protocol.

				<p>(pros/cons): 16 items, scale 1-5.</p> <p>Social support: 20 items, scale 1-5.</p> <p>EFI (Revitalisation): 3 items, scale 0-4.</p> <p>EFI (Positive Engagement): 3 items, scale 0-4.</p> <p>EFI (Tranquility): 3 items, scale 0-4.</p> <p>EFI (Physical exhaustion): 3 items, scale 0-4.</p> <p>Enjoyment: 18 items, scale 1-7.</p> <p>Outcome expectancies: 9 items, scale 1-5.</p>	<p>7-Day PAR: Total PA mins/week +ve: $p < 0.01$ (Print) NS: (Telephone).</p>	<p>processes of change ($p < 0.01$), Experiential/Cognitive processes of change ($p < 0.01$), Social support ($p < 0.01$), Revitalisation ($p \leq 0.01$).</p> <p>NS (both intervention arms): all other mediators.</p> <p>12 months</p> <p>Print arm +ve: all mediators ($p < 0.04$).</p> <p>Telephone arm +ve: PA self-efficacy ($P < 0.01$), Behavioural processes of change ($p < 0.01$),</p>	<p>of change ($p < 0.01$), Revitalisation ($p < 0.01$).</p> <p>NS: PA self-efficacy, Experiential/Cognitive processes of change, Decisional balance (pros/cons).</p> <p>NB. Group assignment is controlled for (Conceptual theory tests are not carried out separately for each intervention arm).</p>	<p>processes of change ($p = 0.01$), Revitalisation ($p < 0.01$).</p> <p>NS: PA self-efficacy, Experiential/Cognitive processes of change, Decisional balance (pros/cons).</p> <p>PA (baseline-12 months), all mediators (baseline-12 months)</p> <p>Both intervention arms +ve: Behavioural processes of change ($p = 0.01$), Revitalisation ($p < 0.01$).</p> <p>NS: PA self-efficacy,</p>	
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						Experiential/ Cognitive processes of change ($p<0.01$), Social support ($p=0.03$), Revitalisation ($p<0.01$), Tranquility ($p<0.01$), Physical exhaustion ($p=0.03$). NS: all other mediators.		Decisional balance (pros/cons), Experiential/ Cognitive processes of change.	
Marcus, 2013 [33– 35]	Two-arm RCT.	Intervention: N=132 6 months, goal-setting, self-monitoring by pedometers and logbooks, problem solving around barriers, enlisting social support, self- reward, feedback reports, information provision/ TTM, SCT. Comparison: N=134 Information (non-PA).	Baseline, 3, 6 and 12 months.	Stage of change for PA: 1 item, scale 1-4. PA self-efficacy: 5 items, scale 1-5. Behavioural processes of change: 20 items, scale 1-5. Experiential/Cognitive processes of change: 20 items, scale 1-5. Social support (family): 13 items, scale 1-8. Social support (friends):	6 months 7-Day PAR: MVPA mins/week +ve: $p<0.01$. Accelerometer: MVPA mins/week +ve: $p<0.01$. 12 months 7-Day PAR: MVPA mins/week +ve: $p<0.01$.	3 months +ve: PA self- efficacy ($p<0.01$), Behavioural processes of change ($p<0.01$), Experiential/ Cognitive processes of change ($p<0.01$). 6 months +ve: Social	7-Day PAR MVPA (baseline-6 months), social support mediators (baseline-6 months). +ve: Social support (family) ($p=0.03$). NS: Social support (friends), Social support (friends),	7-Day PAR MVPA (baseline-6 months), social support mediators (baseline-6 months). NS: Social support (family), Social support (friends), Social support	Methods not stated in protocol.

				<p>13 items, scale 1-8.</p> <p>Social support (rewards and punishment): 13 items, scale 1-8.</p>	<p>Accelerometer: MVPA mins/week</p> <p>+ve: p<0.01.</p>	<p>support (family) (p<0.01), Social support (friends) (p=0.003), Social support (rewards and punishment) (p<0.01).</p> <p>12 months</p> <p>+ve: Social support (family) (p=0.02), Social support (friends) (p=0.01), Social support (rewards and punishment) (p<0.01).</p> <p>NB. Stage of change for PA results not reported.</p>	<p>Social support (rewards and punishment).</p> <p>Accelerometer MVPA (baseline-6 months), social support mediators (baseline-6 months).</p> <p>+ve: Social support (family) (p<0.05).</p> <p>NS: Social support (friends), Social support (rewards and punishment).</p> <p>7-Day PAR MVPA (baseline-12 months), social support</p>	<p>(rewards and punishment).</p> <p>Accelerometer MVPA (baseline-6 months), social support mediators (baseline-6 months).</p> <p>+ve: Social support (family) (p<0.05).</p> <p>NS: Social support (friends), Social support (rewards and punishment).</p> <p>7-Day PAR MVPA (baseline-12 months), social support</p>
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							<p>social support mediators (baseline-12 months).</p> <p>+ve: Social support (friends) (p=0.02).</p> <p>NS: Social support (family), Social support (rewards and punishment).</p> <p>Accelerometer MVPA (baseline-12 months), social support mediators (baseline-12 months).</p> <p>NS: Social support (family), Social support</p>	<p>mediators (baseline-12 months).</p> <p>+ve: Social support (friends) (p<0.05).</p> <p>NS: Social support (family), Social support (rewards and punishment).</p> <p>Accelerometer MVPA (baseline-12 months), social support mediators (baseline-12 months).</p> <p>NS: Social support (family), Social support (friends), Social</p>	
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							(friends), Social support (rewards and punishment).	support (rewards and punishment) .	
Marcus, 2016 [35,36]	Two-arm, RCT.	<p>Intervention: N=104 6 months, website, self-monitoring, goal-setting, message board, online access to researcher, maps of PA opportunities, videos, tailored feedback, information, email prompts/ TTM, SCT.</p> <p>Control: N=101 Website with information about non-PA health behaviours.</p>	Baseline, 6 and 12 months.	<p>PA self-efficacy: 5 items, scale 1-5.</p> <p>Behavioural processes of change: 20 items, scale 1-5.</p> <p>Cognitive processes of change: 20 items, scale 1-5.</p> <p>Social support (friends): 13 items, scale 1-8.</p> <p>Social support (family): 13 items, scale 1-8.</p> <p>Social support (rewards and punishment): 13 items, scale 1-8.</p> <p>Enjoyment: 18 items, scale 1-7.</p> <p>Depression: 10 items, scale 0-4.</p> <p>Perceived stress: 14 items, scale 0-4.</p>	<p>6 months</p> <p>7-Day PAR: MVPA mins/week. +ve: p<0.001.</p> <p>12 months</p> <p>7-Day PAR: MVPA mins/week. +ve: p=0.007.</p>	<p>6 months</p> <p>+ve: PA self-efficacy (p<0.001), Cognitive processes of change (p<0.001), Behavioural processes of change (p<0.001). NS: All other mediators.</p>	N/A	N/A	N/A

<p>Martinson, 2008 [37–40]</p>	<p>Two-arm, RCT</p>	<p>Intervention: N=523 24 months, interactive telephone and postal PA support, motivational campaigns, lending library of PA resources/SCT, Relapse Prevention Theory.</p> <p>Comparison: N=526 Information about the 10,000 steps PA program, newsletters.</p>	<p>Baseline, 6, 12 and 24 months.</p>	<p>PA self-efficacy: 12 items, scale 0%-100%.</p> <p>Perceived barriers to PA: 21 items, scale 1-5.</p> <p>Enjoyment: 4 items, scale 1-5.</p> <p>PA integrated in the self-concept: 5 items, scale 1-5.</p> <p>Social support (family): unclear items, scale 1-5.</p> <p>Social support (friends): unclear items, scale 1-5.</p>	<p>6 months</p> <p>CHAMPS: Energy expenditure in MVPA kcal/week +ve: p=0.03.</p> <p>12 months</p> <p>CHAMPS: Energy expenditure in MVPA kcal/week +ve: p=0.04.</p> <p>24 months</p> <p>CHAMPS: Energy expenditure in MVPA kcal/week +ve: p=0.01.</p>	<p>6 months</p> <p>+ve: PA self-efficacy (p<0.01), PA integrated in the self-concept (p<0.01), Social support (family) (p<0.01), Social support (friends) (p<0.05).</p> <p>NS: all other mediators.</p> <p>12 months</p> <p>+ve: PA integrated in the self-concept (p<0.01), Social support (family) (p<0.01), Social support (family) (p<0.01).</p> <p>NS: all other mediators.</p> <p>24 months</p>	<p>PA (composite of 6, 12 and 24 month measures), all mediators (composite of 6, 12 and 24 month measures).</p> <p>+ve: PA self-efficacy (p<0.05), Perceived barriers to PA (p<0.05), PA integrated in the self-concept/Enjoyment (p<0.01), Social support (family) (p<0.05), Social support (friends) (p<0.05).</p>	<p>PA (composite of 6, 12 and 24 month measures), all mediators (composite of 6, 12 and 24 month measures).</p> <p>+ve: PA self-efficacy and PA integrated in the self-concept/Enjoyment (p=0.05).</p> <p>NS: all other mediators.</p>	<p>Methods not stated in protocol.</p>
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						<p>+ve: PA self-efficacy (p<0.01), PA integrated in the self-concept (p<0.01), Enjoyment (p<0.01), Social support (family) (p<0.01), Social support (friends) (p<0.01).</p> <p>NS: all other mediators.</p>			
Naylor, 1999 [41]	Four-arm, controlled trial	<p>Intervention: N=178 (Stage-based materials and counselling), N=39 (Stage-based materials only), N=36 (Non-stage based advice). 30 minutes, stage-oriented exercise materials with counselling (arm 1), stage-oriented exercise materials without counselling (arm 2), and non-staged materials with</p>	Baseline, 2 and 6 months.	<p>Stage of change for PA: 1 item, scale 1-5.</p> <p>PA self-efficacy scale: 5 items, scale 1-7.</p>	<p>6 months</p> <p>AAQ: Weekly Total PA energy score</p> <p>NS.</p>	<p>2 and 6 months</p> <p>NS (combined intervention groups): Stage of change for PA, PA self-efficacy.</p>	PA (repeated measures), Stage of change for PA (advancing a stage baseline-6 months).	N/A	N/A

		counselling for exercise (arm 3)/ TTM. Comparison: N=41 No intervention.							
Norris, 2000 [42]	Two-arm, RCT	Intervention: N=362 4 weeks (PACE) and 5 months (enhanced PACE), Counselling, educational materials. Booster telephone calls and postcard mailings (enhanced PACE)/ TTM Comparison: N=460 No intervention.	Baseline and 6 months.	PA self-efficacy: unclear items, scale 0-100. Social support: 1 item, scale yes/no. Perceived barriers to PA: 7 items, scale 1-5. Perceived benefits of PA: unclear items, scale 0-100.	6 months PASE: Total PA mins/week NS.	6 months NS: all mediators.	N/A	N/A	N/A
Okazaki, 2014 [43]	Two-arm, RCT.	Intervention: N=49 4 months, computer-based program, goal-setting, instructions on strength and stretch training, feedback and comparisons, information provision, weblog for interacting with other participants and researchers, email tip sheets related to personal goals and barriers / SCT, Health Belief Model. Comparison: N=28 Non-PA health course.	Baseline, 4 and 12 months.	Stage of change for PA: one item, scale 1-5.	12 months IPAQ: Energy expenditure in MVPA kcal/day NS.	4 months +ve: Stage of change for PA (p<0.03). 12 months +ve: Stage of change for PA (p<0.03).	N/A	N/A	N/A

Opdenacker, 2008 [44,45]	Two-arm, cluster RCT	<p>Intervention: N=81 6 months, one information meeting, self-help booklet, and monthly reminder letters/ TTM, SCT</p> <p>Comparison: N=88 No intervention.</p>	Baseline and 6 months.	<p>Perceived benefits of PA: 20 items, scale 1-5.</p> <p>Perceived barriers to PA: 20 items, scale 1-5.</p> <p>PA self-efficacy: 16 items, scale 1-5.</p> <p>Behavioural processes of change: 3 items, scale 1-5.</p> <p>Experiential/Cognitive processes of change: 3 items, scale 1-5.</p> <p>Social support: 10 items, scale 1-5.</p>	<p>6 months</p> <p>Accelerometer total activity counts/5 days +ve: $p < 0.05$.</p>	<p>6 months</p> <p>+ve: Behavioural processes of change ($p < 0.05$).</p> <p>NS: all other mediators.</p>	PA (baseline-6 months), all mediators (baseline-6 months). NS: all mediators.	PA (baseline-6 months), all mediators (baseline-6 months). NS: all mediators.	Not published.
Pekmezi, 2009 [46]	Two-arm, RCT.	<p>Intervention: N=45 6 months, goal-setting, self-monitoring, problem-solving barriers, social support, self-rewarding for meeting PA goals, monthly mailings and tailored feedback/ TTM, SCT.</p> <p>Control: N=48 Health information (non-PA).</p>	Baseline and 6 months.	<p>Behavioural processes of change: 20 items, scale 1-5.</p> <p>Cognitive processes of change: 20 items, scale 1-5.</p> <p>PA self-efficacy: 5 items, scale 1-5.</p> <p>Depression: 10 items, scale 0-4.</p> <p>Perceived environment (home): 15 items, scale yes/no.</p>	<p>6 months</p> <p>7-Day PAR: MVPA mins/week. NS.</p>	<p>6 months</p> <p>+ve: Behavioural processes of change ($p = 0.005$), Cognitive processes of change ($p = 0.003$), Perceived environment (home) ($p = 0.04$).</p> <p>NS: all other</p>	N/A	N/A	N/A

				<p>Perceived environment (facilities): 18 items, scale yes/no.</p> <p>Social support (family): 13 items, scale 1-8.</p> <p>Social support (friends): 13 items, scale 1-8.</p> <p>Social support (rewards and punishment): 13 items, scale 1-8.</p>		mediators.			
Plotnikoff, 2007 [47,48]	Three-arm, RCT	<p>Intervention: N=176 (Standard), N= 165 (Stage-matched). 12 months, Stage-matched printed booklets or standard PA booklets/ SCT, TTM, TPB, Protection Motivation Theory.</p> <p>Comparison: N=166 No intervention.</p>	Baseline, 6 and 12 months.	<p>PA self-efficacy: 9 items, scale 1-5.</p> <p>Decisional balance pros: 5 items, scale 1-5.</p> <p>Decisional balance cons: 6 items, scale 1-5.</p> <p>Behavioural processes of change: 9 items, scale 1-5.</p> <p>Experiential/Cognitive processes of change: 10 items, scale 1-5.</p> <p>Severity: 3 items, scale 1-5.</p> <p>Vulnerability: 3 items, scale 1-5.</p>	6 and 12 months GLTEQ: MET mins/week (combined intervention groups) NS.	<p>6 months</p> <p>+ve (combined intervention groups): Experiential/ Cognitive processes of change.</p> <p>NS (combined intervention groups): all other mediators.</p> <p>12 months</p> <p>+ve (combined intervention</p>	PA (baseline-6 months), Experiential /Cognitive processes of change (baseline-6 months). NS. PA (baseline-12 months), Experiential /Cognitive processes of change, Decisional balance pros	PA (baseline-12 months), Decisional balance pros (baseline-12 months). NS.	Not published.

				<p>Fear: 3 items, scale 1-5.</p> <p>Response efficacy: 3 items, scale 1-5.</p> <p>Attitude to PA: 6 items, scale 1-5/1-7.</p> <p>Injunctive norms: 4 items, scale 1-5/1-7.</p> <p>Descriptive norms: 4 items, scale 1-5/1-7.</p> <p>Social support: 3 items, scale 1-5/1-4.</p> <p>Perceived behavioural control: 4 items, scale 1-5.</p>		<p>groups): Decisional balance pros.</p> <p>NS (combined intervention groups): all other mediators.</p>	<p>(baseline-12 months).</p> <p>+ve: Decisional balance pros (p<0.05).</p> <p>NS: Experiential /Cognitive processes of change.</p>		
<p>Slootmaker , 2009 [49]</p>	<p>Two-arm, RCT</p>	<p>Intervention: N=51 3 months, PA monitor, brief web-based tailored PA advice, goal setting/ unclear theoretical underpinnings.</p> <p>Comparison: N=51 One brochure and general advice on PA recommendations.</p>	<p>Baseline, 3 and 8 months.</p>	<p>Intention to change PA: 1 item, scale 1-5.</p> <p>Attitude to PA: 2 items, scale 1-5.</p> <p>Social influences: 5 items, scale 1-5.</p> <p>PA self-efficacy: 2 items, scale 1-5.</p> <p>Perceived barriers to PA: 3 items, scale 1-5.</p>	<p>8 months</p> <p>AQUAA: MVPA mins/week NS.</p>	<p>3 and 8 months</p> <p>NS: all mediators.</p>	<p>N/A</p>	<p>N/A</p>	<p>N/A</p>

				Awareness of PA level: 1 item, scale yes/no.					
Solomon, 2014 [50]	Stepped wedge cluster RCT (5 time periods).	Intervention: N=4,693 12 weeks, PA opportunities, media, community volunteers, purchasing equipment/ Principles of community development. Comparison: N=5,719 No intervention.	Baseline and quarterly until intervention end (24 months).	Descriptive norms: 2 items, scale -2-2. PA habit: 3 items, scale -2-2. Social support (community): 3 items, scale -2-2. Commitment: 3 items, scale 0-10. Intention to change PA: 1 item, scale 1-4. Perceived environment: 24 items, scale yes/no.	24 months IPAQ: MET mins/week NS.	24 months +ve: PA habit NS: all other mediators.	N/A	N/A	N/A
Sriramatr, 2014 [51]	Four-arm, RCT	Intervention: N=55 (I-P), N=55 (I-NP). 3 months, Intervention with pre-test (I-P) or the intervention with no pre-test (I-NP), web-based, self-monitoring (pedometer), goal setting, emails/ SCT Comparison: N=55 (C-P), N=55 (C-NP). Control with pre-test (C-P) or control with no	Baseline, 3 and 6 months.	PA self-Efficacy for Exercise: 9 items, scale 0-100%. Outcome expectancies: 9 items, scale 1-5. Self-regulatory skill use for PA: 20 items, scale 1-5.	6 months Pedometer steps/day +ve: p<0.01.	3 and 6 months +ve: all mediators.	N/A	N/A	N/A

		pre-test (C-NP). Computer instruction and pedometers.							
van Stralen, 2009 [52–55]	Three-arm, cluster RCT	<p>Intervention: N=652 (Basic), N=733 (Environmental). 4 months, tailored letters, tailored information about PA opportunities, web-based forum and e-buddy system (Environmental)/ I-Change Model, TTM, HAPA, Precaution Adoption Process Model, Self-regulation theory, SDT.</p> <p>Comparison: N=586 One tailored letter, after completion of the research period (waiting list).</p>	Baseline, 3, 6 and 12 months.	<p>Awareness of PA level: 1 item, unclear scale (3 and 6 months).</p> <p>Decisional balance pros: 9 items, unclear scale (3 months).</p> <p>Decisional balance cons: 7 items, unclear scale (3 months).</p> <p>Social support: 1 item, unclear scale (3 months).</p> <p>Social modelling: 1 item, unclear scale (3 months).</p> <p>Sports partner: 1 item, unclear scale (3 months).</p> <p>Intrinsic motivation for PA: 6 items, unclear scale (3 months).</p> <p>PA self-efficacy: 10 items, unclear scale (3 months).</p> <p>Perceived environment:</p>	<p>6 months</p> <p>SQUASH: Total PA days/week +ve: p<0.01 (Basic) +ve: p<0.01 (Environmental).</p> <p>12 months</p> <p>SQUASH: Total PA days/week +ve: p<0.01 (Basic) +ve: p<0.01 (Environmental).</p> <p>SQUASH: Total PA mins/week +ve: p<0.05 (Environmental). NS: Basic.</p>	<p>3 months</p> <p>Basic +ve: Social modelling (p<0.05), PA self-efficacy (p<0.05). NS: all other mediators.</p> <p>Environmental +ve: Social modelling (p<0.05). NS: all other mediators.</p> <p>6 months</p> <p>Basic +ve: Awareness of PA level (p<0.01), Intention to change PA (p<0.01).</p>	<p>PA: days/week (baseline-12 months), all mediators (baseline-3 months). +ve: Awareness of PA level (p<0.01), Sports partner (p<0.01), PA self-efficacy (p<0.01). NS: all other mediators.</p> <p>PA: mins/week (baseline-12 months), all mediators (baseline-3 months). NS: all other mediators.</p> <p>PA: mins/week (baseline-12 months), all mediators (baseline-3 months). NS: all other mediators.</p> <p>PA: days/week (baseline-12 months), all mediators (baseline-3 months). NS: all other mediators.</p>	<p>PA: days/week (baseline-12 months), all mediators (baseline-3 months). NS: all other mediators.</p> <p>PA: mins/week (baseline-12 months), all mediators (baseline-3 months). NS: all other mediators.</p> <p>PA: days/week (baseline-12 months), all mediators (baseline-3 months). NS: all other mediators.</p>	Methods not stated in protocol.

				<p>8 items, unclear scale (6 months).</p> <p>Intention to change PA: 3 items, unclear scale (6 months).</p> <p>Commitment: 3 items, unclear scale (6 months).</p> <p>Planning (Strategic): 10 items, unclear scale (6 months).</p> <p>Planning (Action): 6 items, unclear scale (6 months).</p> <p>Coping planning: 5 items, unclear scale (6 months).</p>		<p>NS: all other mediators.</p> <p>Environmental</p> <p>+ve: Awareness of PA level (p<0.01), Perceived environment (p<0.01), Intention to change PA (p<0.01), Commitment (p<0.05).</p> <p>NS: all other mediators.</p>	<p>NS: all other mediators.</p> <p>PA: days/week (baseline-12 months), all mediators (baseline-6 months).</p> <p>+ve: Awareness of PA level (p<0.01), Planning (Strategic) (p<0.01), Intention to change PA (p<0.01).</p> <p>NS: all other mediators.</p> <p>PA: mins/week (baseline-12 months), all mediators (baseline-6 months).</p> <p>Both intervention groups.</p> <p>+ve: Awareness of PA level (p<0.05), Intention to change PA (p<0.01).</p> <p>NS: all other mediators.</p> <p>PA: mins/week (baseline-12 months), all mediators (baseline-6 months).</p> <p>Both intervention groups.</p> <p>NS: all mediators.</p> <p>+ve: Planning</p>	<p>mediators (baseline-6 months).</p> <p>Both intervention groups.</p> <p>+ve: Awareness of PA level (p<0.05), Intention to change PA (p<0.01).</p> <p>NS: all other mediators.</p> <p>PA: mins/week (baseline-12 months), all mediators (baseline-6 months).</p> <p>Both intervention groups.</p> <p>NS: all mediators.</p>	
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							(Strategic) (p<0.05). NS: all the mediators.		
Wadsworth, 2010 [56]	Two-arm, RCT.	<p>Intervention: N=45 24 weeks, six weekly emails and web-pages, four monthly booster emails, access to an e-counsellor, written information, goal-setting, time management, self-monitoring, social support, reinforcements, relapse prevention, expectancies of exercise, overcoming barriers, anticipation of relapse, natural history of exercise, and building of exercise self-efficacy, exercise recommendations, safety advice, campus PA opportunities, comparison with others/ SCT.</p> <p>Comparison: N=46 Written information containing exercise recommendations, safety advice, campus PA opportunities, and</p>	Baseline, 6 weeks and 6 months.	<p>Self-regulatory skill use for PA: 43 items, scale 1-5.</p> <p>PA self-efficacy: 15 items, 0%-100%.</p> <p>Outcome expectancies: 19 items, scale 1-5.</p>	<p>6 months</p> <p>IPAQ: Moderate-PA days/week NS.</p>	<p>6 weeks</p> <p>+ve: Self-regulatory skill use for PA (p=0.01).</p> <p>NS: all other mediators.</p> <p>6 months</p> <p>NS: all mediators.</p>	<p>NB. Mediators measured at 6 months were not subjected to further testing as no significant group-effect was found, mediators measured at 6 weeks were only examined in relation to PA at 6 weeks.</p>	<p>NB. Mediators measured at 6 months were not subjected to further testing as no significant group-effect was found, mediators measured at 6 weeks were only examined in relation to PA at 6 weeks.</p>	Not published.

		information on how they compare to others. Advised to begin a moderate-intensity PA program.							
Whitehead , 2007 [57]	Two-arm, RCT.	Intervention: N=107 Single mailing, stage-targeted PA materials, individually tailored letter/ TTM. Control: N=100 Single mailing (non-PA).	Baseline, 1 and 6 months.	Stage of change for PA: 5 items.	6 months 7-Day PAR: caloric expenditure kcal/week. +ve: p<0.05.	1 month +ve: Stage of change for PA (p<0.0001). 6 months NS: Stage of change for PA.	N/A	N/A	N/A
Wilcox, 2007 [58,59]	Two-arm, cluster RCT	Intervention: N=311 24 months, promotion by pastors, church bulletin boards, bulletin inserts, health fairs, announcements, exercise CDs, skills-based program, website, media/ Social ecology, TTM. Comparison: N=260 12 months of the intervention (delayed control).	Baseline, 12 and 24 months.	Social support (instrumental/institutional): 5 items, scale yes/no. PA self-efficacy: 5 items, scale 1-7. Enjoyment: 5 items, scale 1-5.	12 and 24 months BRFSS: % participants meeting recommendations for 150 mins/week MVPA NS.	12 months NS: all mediators.	PA (baseline-12 months), all mediators (baseline-12 months). NS: all mediators.	PA (baseline-12 months), all mediators (baseline-12 months). NS: all mediators.	Methods not stated in protocol.
Williams, 2011 [60]	Two-arm, RCT.	Intervention: N=124 9 months, pedometers, video, additional in-	Baseline, 6 and 12 months.	Stage of change for PA: 1 item, scale 1-5.	6 and 12 months	6 months +ve: Decisional	N/A	N/A	N/A

		<p>person session/ TTM, SCT (10 constructs).</p> <p>Comparison: N=124 Individually tailored print-based program (5 constructs).</p>	<p>Behavioural processes of change: 20 items, scale 1-5.</p> <p>Experiential/Cognitive processes of change: 20 items, scale 1-5.</p> <p>PA self-efficacy: 5 items, scale 1-5.</p> <p>Decisional balance (pros/cons): 40 items, scale 1-5.</p> <p>Goal setting: 10 items, scale 1-5.</p> <p>Planning (Action): 10 items, scale 1-5.</p> <p>Social support (friends/family): 20 items, scale 1-5.</p> <p>Outcome expectancies: 9 items, scale 1-5.</p> <p>Enjoyment: 18 items, scale 1-7.</p>	<p>7-Day PAR: % participants meeting recommendations for 150 mins/week MVPA NS.</p>	<p>balance (pros/cons) (p=0.03), Social support (friends) (p=0.02).</p> <p>NS: all other mediators.</p> <p>12 months</p> <p>+ve: Social support (friends) (p=0.01).</p> <p>NS: all other mediators.</p>			
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Wilson, 2015 [61,62]	Three-arm, non-equivalent control group design.	<p>Intervention: N=133 (Full), N=164 (Walking only). 24 months, walking program with social marketing strategies to improve perceptions of safety and access to places for PA, incentives, walking trails, walks led by trained walking leaders and patrolled by off-duty police officers/ Ecological and social marketing perspectives.</p> <p>Control: N=137 General Health Bi-annual health-related events (non-PA).</p>	Baseline, 12, 18 and 24 months.	<p>Physical activity integrated in the self-concept: 10 items, scale 1-6.</p> <p>Self-determined motivation: 8 items, scale 1-5.</p> <p>PA self-efficacy: 16 items, scale 0%-100%.</p> <p>Perceived environment: 26 items, scale 1-5.</p> <p>Social support (community): 9 items, unclear items.</p>	<p>12 months</p> <p>Accelerometer: MVPA mins/week. NS (both intervention arms).</p>	N/A	<p>24 months</p> <p>+ve: Social support (community) (p=0.01).</p> <p>NS: all other mediators.</p> <p>NB. Results are from multilevel growth models including between-person interactions for time X mean value of the mediator.</p>	N/A	N/A
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AAQ: Activity Assessment Questionnaire; ACSM: American College Sports Medicine; AHA: American Heart Association; AQuAA: Activity Questionnaire for Adolescents and Adults; BRFS: Behavioural Risk Factor Surveillance System; CBHEPA: Community-based health-enhancing physical activity; CDC: Centres for Disease Control; CHAMPS: Community Healthy Activities Model Program for Seniors; CPM: Counts per minute; CST: Chester Step Test; EFI: Exercise-induced Feeling Inventory; GLTEQ: Gordin Leisure-Time Exercise Questionnaire; GPAQ: General Physical Activity Questionnaire; HAPA: Health Action Process Approach; IPAQ: International Physical Activity Questionnaire; kcal: kilocalories; kg: kilogram; LTEQ: Leisure-time Exercise Questionnaire; MET: Metabolic equivalent task; MI: Motivational interview; mins: minutes; MVPA: moderate-vigorous intensity physical activity; N/A: Not applicable/not conducted; NS: Non-significant; PA: Physical activity; PAR: Physical Activity Recall; PACE: Physician-Based Assessment and Counselling for Exercise; PASE: Physical activity Scale for the Elderly; RCT: Randomised controlled trial; RT: Randomised Trial; SCT: Social Cognitive Theory; SDT: Self Determination Theory; SEBC: Stage of Exercise Behaviour Scale; SQUASH: Short Questionnaire to Assess Health Enhancing PA; SRT: Self-regulation theory; TPB: Theory of Planned Behaviour; TTM: Transtheoretical Model; vs: versus.

1. Andersen E, Burton NW, Anderssen SA: Physical activity levels six months after a randomised controlled physical activity intervention for Pakistani immigrant men living in Norway. *Int J Behav Nutr Phys Act.* 2012; 9:47.
2. Arroggi A, Schotte A, Bogaerts A, Boen F, Seghers J: Short- and long-term effectiveness of a three-month individualized need-supportive physical activity counseling intervention at the workplace. *BMC Public Health.* 2017; 17:52.
3. Bennett JA, Young HM, Nail LM, Winters-Stone K, Hanson G: A telephone-only motivational intervention to increase physical activity in rural adults - A randomized controlled trial. *Nurs Res.* 2008; 57:24–32.
4. Buman MP, Giacobbi PRJ, Dzierzewski JM, et al.: Peer volunteers improve long-term maintenance of physical activity with older adults: a randomized controlled trial. *J Phys Act Heal.* 2011; 8 Suppl 2:S257-266.
5. Calfas KJ, Sallis JF, Nichols JF, et al.: Project GRAD: two-year outcomes of a randomized controlled physical activity intervention among young adults. *Graduate Ready for Activity Daily. Am J Prev Med.* 2000; 18:28–37.
6. Sallis JF, Calfas KJ, Alcaraz JE, Gehrman C, Johnson MF: Potential mediators of change in a physical activity promotion course for university students: Project GRAD. *Ann Behav Med.* 1999; 21:149–158.
7. Carroll JK, Lewis BA, Marcus BH, Lehman EB, Shaffer ML, Sciamanna CN: Computerized tailored physical activity reports. A randomized controlled trial. *Am J Prev Med.* 2010; 39:148–156.
8. Dallow CB, Anderson J: Using self-efficacy and a transtheoretical model to develop a physical activity intervention for obese women. *Am J Heal Promot.* 2003; 17:373–381.
9. Estabrooks PA, Smith-Ray RL, Almeida FA, et al.: Move More: translating an efficacious group dynamics physical activity intervention into effective clinical practice. *Int J Sport Exerc Psychol.* 2011; 9:4–18.
10. Friederichs SAH, Oenema A, Bolman C, Lechner L: Motivational interviewing and self-determination theory in a web-based computer tailored physical activity intervention: a randomized controlled trial. *Psychol Health.* 2016; 31:907–930.
11. Friederichs SAH, Bolman C, Oenema A, Verboon P, Lechner L: Exploring the working mechanisms of a web-based physical activity intervention, based on self-determination theory and motivational interviewing. *Internet Interv.* 2016; 3:8–17.
12. Graham-Clarke P, Oldenburg B: The effectiveness of a general-practice-based physical activity intervention on patient physical activity status. *Behav Chang.* 1994; 11:132–144.
13. Hallam JS, Petosa R: The long-term impact of a four-session work-site intervention on selected Social Cognitive Theory variables linked to adult exercise adherence. *Heal Educ Behav.* 2004; 31:88–100.
14. Harris T, Kerry SM, Limb ES, et al.: Effect of a primary care walking intervention with and without nurse support on physical activity levels in 45- to 75-year-olds: the Pedometer And Consultation Evaluation (PACE-UP) cluster randomised clinical trial. *PLOS Med.* 2017; 14:e1002210.

15. Hunter RF, Tully MA, Davis M, Stevenson M, Kee F: Physical activity loyalty cards for behavior change: a quasi-experimental study. *Am J Prev Med.* 2013; 45:56–63.
16. Isaacs AJ, Critchley JA, Tai SS, et al.: Exercise Evaluation Randomised Trial (EXERT): a randomised trial comparing GP referral for leisure centre-based exercise, community-based walking and advice only. *Health Technol Assess (Rockv).* 2007; 11:.
17. Kamada M, Kitayuguchi J, Inoue S, et al.: A community-wide campaign to promote physical activity in middle-aged and elderly people: a cluster randomized controlled trial. *Int J Behav Nutr Phys Act.* 2013; 10:44.
18. Kamada M, Kitayuguchi J, Abe T, et al.: Community-wide promotion of physical activity in middle-aged and older Japanese: a 3-year evaluation of a cluster randomized trial. *Int J Behav Nutr Phys Act.* 2015; 12:82.
19. Kinmonth A-L, Wareham NJ, Hardeman W, et al.: Efficacy of a theory-based behavioural intervention to increase physical activity in an at-risk group in primary care (ProActive UK): a randomised trial. *Lancet.* 2008; 371:41–48.
20. Hardeman W, Kinmonth AL, Michie S, Sutton S: Theory of planned behaviour cognitions do not predict self-reported or objective physical activity levels or change in the ProActive trial. *Br J Health Psychol.* 2011; 16:135–150.
21. Hardeman W, Michie S, Kinmonth AL, Sutton S: Do increases in physical activity encourage positive beliefs about further change in the ProActive cohort?. *Psychol Health.* 2011; 26:899–914.
22. Michie S, Hardeman W, Fanshawe T, Prevoost AT, Taylor L, Kinmonth AL: Investigating theoretical explanations for behaviour change: the case study of ProActive. *Psychol Health.* 2008; 23:25–39.
23. Lewis BA, Williams DM, Martinson BC, Dunsiger S, Marcus BH: Healthy for Life: A randomized trial examining physical activity outcomes and psychosocial mediators. *Ann Behav Med.* 2013; 45:203–212.
24. Lilienthal KR, Pignol AE, Holm JE, Vogeltanz-Holm N: Telephone-based motivational interviewing to promote physical activity and stage of change progression in older adults. *J Aging Phys Act.* 2014; 22:527–535.
25. Mailey EL, McAuley E: Impact of a brief intervention on physical activity and social cognitive determinants among working mothers: a randomized trial. *J Behav Med.* 2014; 37:343–355.
26. Marcus BH, Bock BC, Pinto BM, Forsyth LH, Roberts MB, Traficante RM: Efficacy of an individualized, motivationally-tailored physical activity intervention. *Ann Behav Med.* 1998; 20:174–180.
27. Bock BC, Marcus BH, Pinto BM, Forsyth LH: Maintenance of physical activity following an individualized motivationally tailored intervention. *Ann Behav Med.* 2001; 23:79–87.
28. Marcus BH, Napolitano MA, King AC, et al.: Telephone versus print delivery of an individualized motivationally tailored physical activity intervention: Project STRIDE. *Heal Psychol.* 2007; 26:401–409.
29. Marcus BH, Napolitano MA, King AC, et al.: Examination of print and telephone

- channels for physical activity promotion: rationale, design, and baseline data from Project STRIDE. *Contemp Clin Trials*. 2007; 28:90–104.
30. Napolitano MA, Borradaile KE, Lewis BA, et al.: Accelerometer use in a physical activity intervention trial. *Contemp Clin Trials*. 2010; 31:514–523.
 31. Papandonatos GD, Williams DM, Jennings EG, et al.: Mediators of physical activity behavior change: findings from a 12-month randomized controlled trial. *Heal Psychol*. 2012; 31:512–520.
 32. Williams DM, Papandonatos GD, Napolitano MA, Lewis BA, Whiteley JA, Marcus BH: Perceived enjoyment moderates the efficacy of an individually tailored physical activity intervention. *J Sport Exerc Psychol*. 2006; 28:300–309.
 33. Marcus BH, Dunsiger SI, Pekmezi DW, et al.: The Seamos Saludables study: a randomized controlled physical activity trial of Latinas. *Am J Prev Med*. 2013; 45:598–605.
 34. Marcus BH, Dunsiger SI, Pekmezi D, et al.: Twelve-month physical activity outcomes in Latinas in the Seamos Saludables trial. *Am J Prev Med*. 2015; 48:179–182.
 35. Hartman SJ, Dunsiger SI, Bock BC, et al.: Physical activity maintenance among Spanish-speaking Latinas in a randomized controlled trial of an internet-based intervention. *J Behav Med*. 2017; 40:392–402.
 36. Marcus BH, Hartman SJ, Larsen BA, et al.: Pasos Hacia La Salud: a randomized controlled trial of an internet-delivered physical activity intervention for Latinas. *Int J Behav Nutr Phys Act*. 2016; 13:62.
 37. Martinson BC, Sherwood NE, Crain AL, et al.: Maintaining physical activity among older adults: six-month outcomes of the Keep Active Minnesota randomized controlled trial. *Prev Med (Baltim)*. 2008; 46:111–119.
 38. Crain AL, Martinson BC, Sherwood NE, O'Connor PJ: The long and winding road to physical activity maintenance. *Am J Health Behav*. 2010; 34:764–775.
 39. Martinson BC, Sherwood NE, Crain AL, et al.: Maintaining physical activity among older adults: 24-month outcomes of the Keep Active Minnesota randomized controlled trial. *Prev Med (Baltim)*. 2010; 51:37–44.
 40. Sherwood NE, Martinson BC, Crain AL, Hayes MG, Pronk NP, O'Connor PJ: A new approach to physical activity maintenance: rationale, design, and baseline data from the Keep Active Minnesota Trial. *BMC Geriatr*. 2008; 8:17.
 41. Naylor PJ, Simmonds G, Riddoch C, Velleman G, Turton P: Comparison of stage-matched and unmatched interventions to promote exercise behaviour in the primary care setting. *Health Educ Res*. 1999; 14:653–666.
 42. Norris SL, Grothaus LC, Buchner DM, Pratt M: Effectiveness of physician-based assessment and counseling for exercise in a staff model HMO. *Prev Med (Baltim)*. 2000; 30:513–523.
 43. Okazaki K, Okano S, Haga S, Seki A, Suzuki H, Takahashi K: One-year outcome of an interactive internet-based physical activity intervention among university students. *Int J Med Inform*. 2014; 83:354–360.
 44. Opdenacker J, Boen F, Vanden Auweele Y, De Bourdeaudhuij I: Effectiveness of a

- lifestyle physical activity intervention in a women's organization. *J Women's Heal.* 2008; 17:413–421.
45. Opdenacker J, De Bourdeaudhuij I, Auweele Y Vanden, Boen F: Psychosocial mediators of a lifestyle physical activity intervention in women. *Psychol Sport Exerc.* 2009; 10:595–601.
 46. Pekmezi DW, Neighbors CJ, Lee CS, et al.: A culturally adapted physical activity intervention for Latinas. *Am J Prev Med.* 2009; 37:495–500.
 47. Plotnikoff R, Brunet S: The efficacy of stage-matched and standard public health materials for promoting physical activity in the workplace: the Physical Activity Workplace Study (PAWS). *Am J Health Behav.* 2007; 21:501–509.
 48. Plotnikoff RC, Pickering MA, Rhodes RE, et al.: A test of cognitive mediation in a 12-month physical activity workplace intervention: does it explain behaviour change in women? *Int J Behav Nutr Phys Act.* 2010; 7:32.
 49. Sloopmaker SM, Chinapaw MJM, Schuit AJ, Seidell JC, Van Mechelen W: Feasibility and effectiveness of online physical activity advice based on a personal activity monitor: randomized controlled trial. *J Med Internet Res.* 2009; 11:e27.
 50. Solomon E, Rees T, Ukoumunne OC, Metcalf B, Hillsdon M: The Devon Active Villages Evaluation (DAVE) trial of a community-level physical activity intervention in rural south-west England: a stepped wedge cluster randomised controlled trial. *Int J Behav Nutr Phys Act.* 2014; 11:94.
 51. Sriramatr S, Berry TR, Spence JC: An internet-based intervention for promoting and maintaining physical activity: a randomized controlled trial. *Am J Health Behav.* 2014; 38:430–439.
 52. van Stralen MM, de Vries H, Mudde AN, Bolman C, Lechner L: Efficacy of two tailored interventions promoting physical activity in older adults. *Am J Prev Med.* 2009; 37:405–417.
 53. van Stralen MM, de Vries H, Mudde AN, Bolman C, Lechner L: The working mechanisms of an environmentally tailored physical activity intervention for older adults: a randomized controlled trial. *Int J Behav Nutr Phys Act.* 2009; 6:83.
 54. van Stralen MM, de Vries H, Bolman C, Mudde AN, Lechner L: Exploring the efficacy and moderators of two computer-tailored physical activity interventions for older adults: a randomized controlled trial. *Ann Behav Med.* 2010; 39:139–150.
 55. van Stralen MM, de Vries H, Mudde AN, Bolman C, Lechner L: The long-term efficacy of two computer-tailored physical activity interventions for older adults: main effects and mediators. *Heal Psychol.* 2011; 30:442–452.
 56. Wadsworth DD, Hallam JS: Effect of a web site intervention on physical activity of college females. *Am J Health Behav.* 2010; 34:60–69.
 57. Whitehead D, Bodenlos JS, Cowles ML, Jones GN, Brantley PJ: A stage-targeted physical activity intervention among a predominantly African-American low-income primary care population. *Am J Heal Promot.* 2007; 21:160–163.
 58. Wilcox S, Laken M, Bopp M, et al.: Increasing physical activity among church members: community-based participatory research. *Am J Prev Med.* 2007; 32:131–

138.

59. Baruth M, Wilcox S, Blair S, Hooker S, Hussey J, Saunders R: Psychosocial mediators of a faith-based physical activity intervention: implications and lessons learned from null findings. *Health Educ Res.* 2010; 25:645–655.
60. Williams DM, Papandonatos GD, Jennings EG, et al.: Does tailoring on additional theoretical constructs enhance the efficacy of a print-based physical activity promotion intervention? *Health Psychol.* 2011; 30:432–441.
61. Wilson DK, Van Horn ML, Siceloff ER, et al.: The results of the “Positive Action for Today’s Health” (PATH) trial for increasing walking and physical activity in underserved African-American communities. *Ann Behav Med.* 2015; 49:398–410.
62. Sweeney AM, Wilson DK, Lee Van Horn M: Longitudinal relationships between self-concept for physical activity and neighborhood social life as predictors of physical activity among older African American adults. *Int J Behav Nutr Phys Act.* 2017; 14:67.