

A systematic review of interventions to increase physical activity among South Asian adults

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Table 1: Characteristics of included studies

Study	Design & aim	Intervention/ duration	Sample size	Sample characteristics	PA outcome measures	Results on PA	Quality rating
<i>Andersen et al. (2012) [36]</i> <i>Norway</i>	Randomised controlled trial looking at longer term effects (6 months) of an intervention aimed to increase PA among Pakistani immigrant men	Intervention group: 5 month programme, included structured group PA led by an exercise physiologist (2xs per week), 2 group lectures, an individual counselling session, written material and a phone call Control group: offered organised exercise, once a week for 4 months, one group lecture and written material at the end of the intervention	Intervention = 89 (9 lost at end of study assessment and another 2 at follow-up) Control = 61 (8 lost at end of study assessment and another 1 at follow-up)	Pakistani immigrant men, aged 25-60 years Not engaged in regular PA Excluded if they had diabetes, could not speak Norwegian or had an injury that would make PA difficult Recruited through mosques and Muslim festivals	Habitual PA was measured using an accelerometer = worn for 7 days during waking hours (expect for bathing and swimming) – it assessed counts per minute (CPM – ‘counts’ being the sum of acceleration over a given time period) Secondary outcomes = minutes spent in various levels of PA intensity	Total PA (CPM) increased more for the intervention group than controls between baseline and 6 month follow-up (p=0.001) Amount of moderate to vigorous PA increased more for the intervention group compared to controls from baseline to 6 month follow-up (p=0.003), whilst amount of sedentary time for those in the intervention group decreased more than controls over this time period (p=0.001)	++
<i>Andersen et al. (2013) [37]</i> <i>Norway</i>	Randomised controlled trial To explore the effectiveness of a 5 month intervention to increase PA	See above	See above	See above	End of intervention (5 months)	15% higher increase in total PA in intervention than in the control group (p=0.01); intervention group increased their moderate to vigorous PA more than controls (p=0.04)	+

						Both groups changed in amount of inactive time; no significant difference between them	
Bhopal et al. (2014) [38] UK	Family-cluster RCT To assess a weight control and PA intervention as part of a diabetes management strategy	Intervention group: 15 visits from dietitian over 3 years to advise participants and family volunteers (aged ≥ 18) on weight loss via diet and PA of at least 30 mins daily brisk walking Control group: 4 visits in the same period	Intervention = 78 families with 85 participants and 55 family volunteers Control = 78 families with 86 participants and 69 family volunteers	Men and women of Indian and Pakistani origin, 35 years or older Waist circumference 90 cm or greater in men or 80 cm or greater in women Impaired glucose tolerance or impaired fasting glucose	PA was a secondary outcome measure 30 minutes of PA assessed via short form International Physical Activity Questionnaire (IPAQ)	No significant difference in PA at recommended levels between groups at 3 years ($p = 0.7201$) Some increase in PA at recommended levels between baseline and year 1 in the intervention group and between year 2 and 3 in the control group	++
Islam et al. (2013) [39] USA	A pre-post, mixed methods, feasibility study To improve diabetes management - PA was part of a diabetes management strategy	6 monthly, CHW facilitated group sessions 3 one-to-one visits from a CHW at which the challenges of managing diabetes were discussed	47 individuals consented to participate Authors only provide data on those completing at least 4 of 6 educational sessions and 2 of the one-on-one visits	Bangladeshi men and women - first generation with type 2 diabetes Mean age of 26 'completers' = 53.4 (9.4) and 58% = female No terminal illness, not in previous cardiovascular study	PA was a secondary outcome measure Data collected via a survey administered in Bengali, which included questions on PA self-efficacy and frequency	At 12 months follow-up all 'completers' were confident they could engage in regular PA and 88.5% said they were active several days a week compared to 52% at baseline ($p=0.002$)	+

<p><i>Islam et al. (2014) [40]</i> USA</p>	<p>A quasi-experimental two-arm design - intervention and control groups allocated by neighbourhood</p> <p>To explore the impact, acceptability, and feasibility of a pilot CHW intervention designed to improve health behaviours and outcomes related to diabetes prevention</p>	<p>Intervention group: received six CHW facilitated interactive group sessions of approximately 2hrs including discussion on PA</p> <p>Held every 3 weeks in a community setting</p> <p>Follow-up phone calls from CHWs, to discuss challenges, strategies, and action plans for improving diet and PA and reducing stress</p> <p>Control group: instructed to engage in standard care, including seeking preventive and acute care</p>	<p>Intervention group = 76; Control group = 50</p> <p>Of the 126 participants, 108 completed baseline and 6-month follow-up surveys</p>	<p>Sikh Asian Indians living in New York - first generation (all born outside the USA)</p> <p>Intervention group mean age = 46.3 years, SD 11.6; Control group mean age = 47.8 years, SD 9.5</p> <p>Intervention group = 73 (96.1%) female; Control group = 29 (58%) female</p> <p>Intervention group = 71 (93.4%) married; Control group = 47 (97.9%) married</p>	<p>PA was a secondary outcome measure</p> <p>PA assessed via self-report</p>	<p>At 6 months, 88.7% of the intervention group reported engaging in any PA compared to 3.8% at baseline ($p < 0.01$)</p> <p>Control group: non-significant, smaller increase in PA</p> <p>Both intervention and control groups showed a significant increase in social interaction related to PA (e.g. whether participants were more likely to reach out to friends or family to engage in PA), but change was greater among the intervention than the control group (3.6 vs. 1.9) at 6-months ($p < 0.01$)</p>	<p>+</p>
<p><i>Jayasuriya et al. (2015) [41]</i> Sri Lanka</p>	<p>A randomised controlled trial</p> <p>To evaluate a theory driven Diabetes Self-Management</p>	<p>Intervention group: patient-centred assessment to elicit problems using motivational interviewing (MI);</p>	<p>Intervention group = 30; Control group = 30</p> <p>Of the 60 participants, 28 completed the</p>	<p>Sri Lankan participants with diabetes HbA1c $>7.5\%$ (58 mmol.mol) randomised to either intervention</p>	<p>PA was a secondary outcome measure</p> <p>PA was assessed using the IPAQ</p>	<p>78% overall attendance rate for the group classes</p> <p>After conducting individual make-up classes, 100% attendance was achieved</p>	<p>+</p>

	<p>(DSM) intervention delivered by trained nurses to improve glycaemic control - PA was part of this diabetes management strategy</p>	<p>problem solving, goal identification; commitment for change through MI and documented action plans; feedback and monitoring</p> <p>4 sessions of DSM intervention within 6 weeks of enrolment; then monthly for 5 further visits by the project nurses; total study period 6 months</p> <p>PA to increase exercise during household work (for women) and brisk walking (with a pedometer)</p> <p>Control group: visited diabetes clinic for routine care</p>	<p>intervention and 25 received usual care (90% and 83% retention rates respectively)</p>	<p>or usual care arm</p> <p>Intervention group = 83% female; Control group = 83% female</p> <p>Intervention group mean age = 51.5 years (SD 7.5); Control group mean age = 51.4 (SD 7.1)</p> <p>Mean duration since diabetes diagnosis = 22.2 months (SD 7.2)</p>	<p>Diabetes self-efficacy was measured using seven items of the Diabetes Self-Efficacy Scale (appropriate in a Sri Lankan context) (Cronbach Alpha 0.69)</p>	<p>Intervention group: increase in PA (measured as walking METs) was significant ($p = 0.035$) without controlling for other variables; but not significant in the multivariate ANCOVA model</p> <p>Intervention group: self-efficacy increased ($p = 0.001$), but not in the control group</p>	
<p>Kandula et al. (2015) [42]</p> <p>USA</p>	<p>Two arm randomised controlled trial</p> <p>To pilot-test and examine the feasibility and</p>	<p>Intervention group: 16-week lifestyle intervention that included group classes, experiential</p>	<p>Intervention group = 31; Control group = 32</p> <p>Randomized into one of the groups by a computer-</p>	<p>Asian Indian or Pakistani men and women, aged 30 - 59</p> <p>Had at least one ASCVD risk factor</p>	<p>PA was assessed using pedometers to self-monitor daily steps</p> <p>Exercise related</p>	<p>Intervention participants attended 5 out of 6 sessions on average</p> <p>100% retention rate in each arm at 3 and 6 months</p>	<p>++</p>

	<p>initial efficacy of the SAHELI intervention to improve moderate/vigorous PA and saturated fat intake</p> <p>PA was part of a healthy lifestyle intervention to reduce atherosclerotic cardiovascular disease (ASCVD) risk</p>	<p>activities, behaviour change telephone counselling and heart health <i>melas</i> (festive gatherings)</p> <p>Group classes held weekly for 6 weeks, lasting 60 - 90 mins</p> <p>Control group: mailed test results with brief explanation, pre-existing print education materials about ASCVD, diet, exercise and weight loss</p>	<p>generated list</p> <p>Participants stratified by gender in equal numbers</p>	<p>Exclusion criteria: living in the same household, but relatives from different households were not excluded</p>	<p>confidence measured using Self Efficacy Scale</p>	<p>No significant differences between treatment arms for change in moderate-vigorous PA</p> <p>Intervention group exercise confidence mean (95% CI) increased from 0.4 (-1.67, 2.52) at 3 months to 1.1 (-1.14, 3.38) at 6 months</p> <p>Control group exercise confidence mean (95% CI) increased from -2.2 (-4.25, -0.17) at 3 months to -1.4 (-3.62, 0.83) at 6 months</p>	
<p>Kandula et al. (2016) [43]</p> <p>USA</p>	<p>Non-randomized design, pre-post test study</p> <p>To evaluate a culturally tailored exercise intervention</p> <p>PA was part of a diabetes risk factor reduction strategy</p>	<p>16 weeks of culturally tailored exercise classes, self-monitoring with activity trackers, goal setting and classes on healthy eating</p> <p>Participants required to attend a minimum of 2 exercise classes every week</p>	<p>N= 30 SA mothers with children aged 6-14 years</p>	<p>SA women at risk of developing diabetes</p> <p>Hindi or English speaking</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> • Self-reported diabetes mellitus and/or on diabetes medication • BMI \geq 35 Kgm^{-2} 	<p>PA was the primary outcome measure and assessed using ActiGraph accelerometer and self-report</p> <p>Daily step counts collected via Fitbit Zip™ activity tracker</p> <p>Exercise related confidence</p>	<p>Adherence measured as class attendance was 75%; 57% of the women attended at least 80% of the classes</p> <p>Study retention = 100%</p> <p>No significant changes in accelerometer-measured PA (p = 0.33)</p> <p>Self-reported exercise increased significantly post intervention (95% CI,</p>	<p>++</p>

		<p>Certified exercise instructors conducted classes at Metropolitan Asian Family Services and Ultimate Martial Arts - led participants in 45 mins of moderate-intensity exercise drawing on Zumba® and aerobics</p> <p>Participants were instructed on how to gradually increase the amount and intensity of PA to achieve the 150 min of moderate-intensity PA per week</p>		<ul style="list-style-type: none"> • BP over 160/100 mm Hg • Currently pregnant 	<p>assessed using the Self Efficacy for Exercise Scale</p> <p>Readiness to exercise assessed using readiness-to-exercise scale</p>	<p>23-42; p < 0.01)</p> <p>Fitbit Zip™ activity trackers – average number of steps at the end of the first week of the intervention (3161 steps per day) doubled to 6700 per day by the last week of the intervention</p> <p>Readiness to exercise – percentage of women in the action/maintenance stages increased to 45%, from 17%, post intervention, but was not statistically significance (p = 0.11)</p>	
<p>Lesser et al (2016) [44]</p> <p>Canada</p>	<p>Single-blinded RCT</p> <p>To investigate the effectiveness of a standard exercise (SE) program and Bhangra dance (BD) on visceral</p>	<p>12-week exercise programme of:</p> <p>(i) culturally based (Bhangra dance), or</p> <p>(ii) standard (gym-based), or</p> <p>(iii) control (non-exercise)</p>	<p>Sample size based on a power of 0.80; calculated 20 participants for each group</p> <p>To account for a possible 25% dropout rate, 25 participants per</p>	<p>Physically inactive, postmenopausal SA women with Type II diabetes</p>	<p>Type of exercise was a secondary outcome measure</p> <p>PA determined by the modified Minnesota Leisure Time Physical Activity Questionnaire and</p>	<p>Average attendance in the BD and SE program was 78% +/- 33% and 67% +/- 25%, respectively, of the 36 delivered exercise classes, with attendance ranging from 1 to 36 classes in each group</p>	<p>++</p>

	adipose tissue (VAT) deposition and cardiometabolic risk factors		group were enrolled Participants randomized to culturally based (BD) n=26, SE n=23, or control n=26		reported as average weekly kilocalories expended Adherence to the exercise intervention based on attendance at the 36 prescribed exercise classes		
Patel et al. (2017) [45] USA	Experimental, pre-post-test control group repeated measures design To evaluate the effectiveness of a community-based culturally appropriate lifestyle intervention program (that included PA) to reduce the risk for type 2 diabetes (T2DM)	Random allocation (stratified by marital status) to: (i) Intervention group: 12-week group-based lifestyle program (ii) Control group: received standard print material on diabetes prevention	N = 70 individuals were randomized into intervention group (n=36) or control group (n=34)	Convenience sample of Gujarati Asian Indians from a mandir (Hindu temple) Inclusion criteria: (i) Aged >18 years (ii) Diabetes risk score \geq 50 (Mohan et al 2005) (iii) HbA1c value < 6.4% Exclusion criteria: (i) Had diabetes, or unstable chronic disease (ii) Unable to participate in regular PA (iii) Pregnant or planning to be pregnant in next 6 months	PA was a secondary outcome measure Self-reported PA using Health Promoting Lifestyle Profile II (HPLP II) Pedometer daily step counts recorded on weekly logs for both intervention and control groups	Intervention participants' average weekly attendance was 7.4/12 Retention rate at post-test (12 weeks) = intervention group 80% and control 83% Significant increase in PA in follow-up analysis between baseline and post-test at 12 weeks ($p < 0.0005$) and baseline and follow-up test at 24 weeks ($p = 0.001$) regardless of group Significant main effect of time regardless of group Participants mean score on the PA subscale of the HPLP II improved between 0, 3 and 6 months, regardless of group assignment	+

				(iv) Currently involved in a supervised program for weight loss			
Pfammatter et al. (2016) [46] <i>India</i>	<p>Prospective, parallel cohort design</p> <p>To examine whether mDiabetes improved fruit, vegetable, and fat intakes and exercise; hence PA was part of a diabetes risk factor reduction strategy</p>	<p>Intervention group: received 56 text messages on diabetes and to motivate change, in a choice of 12 languages over 6 months; one per day for first 6 days, then 2 per week</p> <p>Control group: participants received no contact</p>	<p>Intervention participants randomly selected from one million Nokia subscribers who elected to opt in to mDiabetes; Control group participants randomly selected from non-Nokia mobile phone subscribers</p> <p>982 in intervention group and 943 in control group took phone survey</p>	<p>Most of the sample were male (88.52%)</p> <p>Lived in an urban location (68.78%)</p> <p>Resided in the North of India (67.06%)</p>	<p>Self-report PA: “Do you exercise currently?” with response options “yes” or “no” asked in an interview</p>	<p>Intervention group reported a small increase in exercise relative to controls, but this was not significant</p>	+
Ramachandran et al. (2013) [47] <i>India</i>	<p>A prospective, parallel-group, randomised controlled trial</p> <p>To assess a tailored mobile phone messaging service to encourage lifestyle change compared with standard lifestyle advice</p>	<p>Intervention group: frequent mobile phone messages</p> <p>Control group: standard lifestyle modification advice at baseline</p>	<p>N=537, randomly assigned (1:1) to intervention (n=271) or standard care (control group) (n=266)</p>	<p>Working Indian men, aged 35–55 years, with impaired glucose tolerance</p>	<p>PA was a secondary outcome measure</p> <p>PA recommendation</p> <ul style="list-style-type: none"> • Brisk walk for at least 30 mins per day • Walk 3–4 kms in 30 mins at least 5 days a week • Cycle 6–7 kms in 30 mins 	<p>Adherence to PA recommendations at 24 months did not differ between the two groups – Intervention group: 36 (27–54), Control group: 36 (31–56)</p>	+

	PA was part of a diabetes risk factor reduction strategy				<ul style="list-style-type: none"> • If occupation involved strenuous work, no specific advice <p>PA adherence</p> <ul style="list-style-type: none"> • Poor: less than 150 mins per week (non-adherent) • Fair: 150–250 mins per week (adherent) • Good: more than 250 mins per week or if occupation involved strenuous work (adherent) <p>PA assessed by questionnaire</p>		
Shahid et al. (2015) [48] Pakistan	<p>Randomized controlled trial</p> <p>To determine the effect of mobile phone intervention on HbA1c in type-2 Diabetes Mellitus in a rural areas of Pakistan</p> <p>PA was part of a diabetes management</p>	<p>Intervention group: received regular feedback based on their blood glucose over the last 15 day readings via phone over a 4 month period</p> <p>Both group: leaflets on diet, healthy lifestyles, symptoms of</p>	<p>N = 440 patients</p> <ul style="list-style-type: none"> • Intervention group n=220 • Control group n=220 	<p>Patients between 18 - 70 years</p> <p>Residing in rural areas of Pakistan</p> <p>HbA1c ≥ 8.0%</p> <p>Had a personal, functional mobile phone</p>	<p>Self-report PA</p>	<p>Intervention group: demonstrated significant (p < 0.001) increase in PA from 16.4% to 44.5% at 4 months</p> <p>Control group: insignificant improvement (p=0.472) was observed in PA in control group from 14.1% to 16.4% at 4 months</p>	+

	strategy	<p>hypoglycemia and hyperglycemia, complications of diabetes</p> <p>Educated about going to doctor if blood glucose remained very high or very low</p> <p>Control group: advised on medication, diet, lifestyle, and blood glucose levels</p> <p>Asked about Self Monitoring Blood Glucose (SMBG) at baseline and at regular follow up</p> <p>Advised to come for usual follow up visit at 4 months</p>					
Shetty et al. (2011) [49]	Pilot randomised trial	Intervention group: received SMS written in English once in 3 days as a reminder to follow dietary modification, PA and drug regimen	N = 215	Men and women with type 2 diabetes, receiving oral hypoglycaemic agent (OHA) and/or insulin for at least 5 years	PA was a secondary outcome measure	Intervention group (SMS group): adherence to PA advice improved from 47% to 56% - change was not statistically significant	+
India	To investigate the acceptability and feasibility of using short message services (SMS) via cell phones to ensure adherence to	Control group:	<ul style="list-style-type: none"> Intervention group n=110 Control group n=105 <p>Randomised using a computer-generated random number</p>	Aged 30 to 65 years	PA assessed based on scores given for occupational & leisure time activities	Control group: adherence to PA advice was noted as 47% and 52% during the baseline and 1st year visits respectively	

	management prescriptions by diabetic patients PA was part of a diabetes management strategy	received standard care (including appropriate prescriptions of drugs and advice on diet and PA) Both groups: advised to report for clinic reviews at quarterly intervals		Read English A minimum of high school education HbA1c value ranging between 7.0% to 10.0%			
Subitha et al. (2013) [50] India	Community-based participatory research To study the development and implementation of interventions promoting PA in a rural Indian community through social marketing	Health education by one-to-one counselling, written materials and community events to raise awareness of moderate intensity PA Brisk walking for 30 mins 4 days a week = how moderate intensity PA was defined 30 walking groups were formed under 4 coordinators, in a home-based setting with professional supervision and guidance	485 residents of 2 villages in Tamil Nadu who wished to participate Village leaders, self-help groups and youth clubs were involved in promoting PA	Men=232, women=253; aged 25-49 years Socioeconomic class: • Upper=132 • Middle=150 • Lower=203 Education: • None=78 • Primary school=75 • Middle school=120 • High school=162 • Graduate or above=50 Skill level: • Labourer=146 • Semi-skilled=90 • Professional=29 • Non-worker=220	Baseline PA was measured using the IPAQ that was adapted to local variations in PA and local culture A log of PA sessions for the 10-week intervention was maintained in the form of a group attendance record	Those aged 20-29 years and 30-39 years = 10 and 3 times more likely to participate in the intervention, respectively, than 40-49 year olds Significant association was found between gender and participation behaviour (p<0.001); men dropped out in higher numbers - 20% compared with 7% of women, and maintenance of brisk walking for >4 days a week was better in women (63%) than in men (42%; p<0.001) Age, educational status and occupation were significant determinants of maintenance of PA (>4 sessions per week)	+

Vahabi & Damba (2015) [51]	Mixed methods approach	6-weeks, 2 days per week, Bollywood Dance exercise program led by a female SA instructor	A convenience sample of 27 SA women (Indians, Sri Lankans, Bangladeshi, Nepalese & Pakistani) from Greater Toronto	Those scoring < 14 on the Godin Leisure-Time Exercise Questionnaire = eligible to participate	Baseline PA levels were assessed using Godin Leisure-Time Exercise Questionnaire, but not reported	At 6 weeks, participation was 85%, with 82% of participants attending 10 or more of the classes	+
Canada	To explore the feasibility and health impacts of a culture and gender specific PA intervention			Mean age=42 (range 22-58)	Adherence to PA assessed by participation rate	Overall mean pre-intervention Self-Efficacy Expectancy of Exercise Score (SEE) was 7.4	
				Average time in Canada=10.7 years (SD +/- 8.2)		15% had a baseline SEE score of 2 to 4 (not confident), 41% had a score of 5 to 7 (confident), and 44% had a score of 8 to 10 (very confident)	
				All participants spoke and wrote in English		Overall mean post-intervention SEE score was lower than pre-intervention, 6.8 compared to 7.4 pre intervention	
				56% had a family history of type 2 diabetes and a third had a family history of heart disease		Overall mean pre-intervention Outcome Expectations for Exercise (OEE) score = 4.4, which increased slightly at post-intervention to 4.6	
				52% were married and had one, two, or three children			
				85% had a university degree or higher		Comparison of pre-intervention and post-intervention OEE showed an increase in OEE, but changes were not significant	
				Most worked full time outside the home			

Quality score: ++ Applies if all or most of the criteria from the checklist are fulfilled; where criteria are not fulfilled, the conclusions of the study are thought very unlikely to alter **or +** Applies if some of the criteria from the checklist are fulfilled; where criteria are not fulfilled or are not adequately described, the conclusions of the study are thought unlikely to alter. **Based on Scottish Intercollegiate Guidelines Network guide [33].**