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

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


## Abstract

Objective: To: (i) identify interventions aimed at increasing physical activity (PA) levels among South Asian (SA) adults, and (ii) identify the specific changes in the content and delivery mode of interventions designed to increase PA levels among SA people aged 18+.

**Design:** A systematic review of quantitative studies.

**Data synthesis:** Extracted data were synthesised using a narrative approach.

**Data sources:** Multiple electronic databases were searched - ASSIA, CINHAL, EMBASE, Medline, SPORTDiscus and PsychINFO. Included papers met the following criteria: 1) population: community dwelling SA adults, aged 18 years and older 2) outcome: reporting determinants of PA, exercise, or combination of the two measured objectively or using self-report. The search was restricted to English language articles published up to 31st January 2017.

**Results:** 15 trials/programmes (16 papers) met the review criteria. The findings show that involving the target community in developing culturally appropriate interventions appears to be important in their acceptability, delivery and take-up. Using community-based participation in intervention planning, evaluation and research appears to produce culturally and linguistically tailored interventions that address core values, attitudes, beliefs and norms and encourage participation in PA. Further, the use of community health workers and underpinning the interventions with a psychological theory show promise in increasing PA uptake.

**Conclusions:** This systematic review suggests that making cultural adaptations to PA interventions shows promise, but the evidence base presented currently is not strong. This does not mean that adopting such an approach is ineffective, but that the evidence base is currently lacking.



**Keywords:** South Asian; Prevention; Health promotion; Behaviour change; Physical Activity Interventions; Cultural adaptations.

## Background

Physical activity (PA) can reduce the risk of developing major chronic diseases by up to 50% and the risk of premature death by 20-30% [1,2]. However, 60% of the world's population do not achieve the minimum PA recommendations [1,2]. Minority groups are less physically active than the Western population as a whole [3] and suffer disproportionately higher rates of certain health conditions [4,5]. Specifically, South Asian (SA) people (those originating from the countries of India, Pakistan, Bangladesh and Sri Lanka) are less likely to exercise compared to their Caucasian peers, but experience greater levels of heart-disease and type 2-diabetes mellitus (DM) [5,6]. Additionally, SAs may have to exercise more than their white European counterparts to achieve the same levels of fitness to reduce their risk of DM [7].

Meeting the health needs of minority groups is a public health challenge, particularly **in** early intervention, prevention and reducing health inequalities [8-11]. Although some progress has been made in advancing our understanding of adapting behavioral interventions **for minority groups** [12], little evidence exists on effective interventions tailored to their needs [13,14]. M**inority groups** are generally treated as homogenous, leading to inappropriate generalisations and potentially unsuitable interventions [15].

Interventions that are effective in the general population are likely to prove effective among minority groups if appropriately tailored [13,15]. Cultural adaptations are modifications made to programmes so they reflect a cultural group's traditional world view and lifestyle and address within group differences [16]. For example, matching intervention messages to observable, surface characteristics of culture, i.e. language, dress [12] or by targeting deeper structures of culture, such as explanatory models about the causes of health and illness [17] and unique barriers/facilitators to changing behaviour [18].

If interventions are to be successful they must respond to cultural, religious and economic issues to address health needs [19]. Therefore, segmenting populations into subgroups by their cultural characteristics can augment receptivity to, acceptance of, and salience of health messages [18]. It is crucial that healthcare professionals understand the needs of diverse groups if they are to adapt evidence-based interventions [20] and tailor information and support so it is culturally acceptable and appropriate [9,13.21,22] to effectively promote behaviour change [10,21,23,24].

Recent systematic reviews have focussed on identifying what is known about PA levels and sedentary time among SA women [25]; levels of PA among SA adults residing in South Asia [26]; assessment of evidence for effectiveness of primary care based PA and dietary interventions in SA populations [27]; diet and PA interventions to prevent or treat obesity in SA children and adults [28]. No available reviews have focussed specifically on changes made to interventions to increase PA levels among SA adults.

### Aim

The aim of our systematic review was to: (i) identify interventions aimed at increasing PA levels among SA adults, and (ii) identify the specific changes in the content and delivery mode of interventions designed to increase PA levels among SA people aged 18+.

## Methods

*Design*

A structured systematic literature search was performed in January 2017 using established standards [29,30], with PRISMA guidelines used to inform conduct and reporting [31]. Search terms and strategy are presented in Box 1. The selection, inclusion and exclusion criteria are outlined in Box 2. Initial pilot searches found few studies that focused specifically on PA as the main outcome. Therefore, in addition to studies that specifically focussed on PA uptake and adherence as a primary outcome, we included studies that included PA uptake and adherence as a secondary outcome.

**Box 1: Search terms and search strategy**

*Search terms*

Search terms were developed under the headings 'South Asian' and 'Intervention' and 'uptake or maintenance'. 'Truncation (*) was employed where variations of a search term existed. Broad search terms were used to ensure that all studies meeting the inclusion criteria were captured. Keywords included combinations of "physical activity", "physical exercise", "exercise", "sport", "physical training" and "Indian" or "Pakistani" or "Bangladeshi" or "South Asian". A copy of the search terms used is available upon request from the first author.

*Search strategy*

Full holdings of the following six electronic databases were searched for references from first publication to 31st January 2017: ASSIA, Cumulative Index to Nursing and Allied Health Literature (CINAHL), EMBASE, Medline, PsycINFO and SPORTDiscus. A limit was not placed on the years searched for each database to enable the broadest capture of papers for comparison; however no records published prior to 1991 were returned from searches. Additional articles were identified by searching the references of included articles as well as systematic reviews, which were not included in our review.

**Box 2: Selection, inclusion and exclusion criteria**

Titles and abstracts located through the search process were screened by two reviewers (MH and ST) to identify relevant literature, which were then included for further assessment if they met the following criteria:

(1) participants were SA adults aged 18 years or older

(2) the study included assessment of an intervention or programme that included some attention to addressing PA

(3) randomised controlled trials, controlled before-and-after experimental, pre-test post-test, quasi-experimental.

(4) an outcome measure of PA was reported (objective or self-report measure)

(5) provided a measure of uptake and/or adherence as the proportion of participants who fully or partially completed the intervention

(6) published in English language, in a peer-reviewed journal.

Papers were excluded if they met any of the following criteria:

(1) studies without adult data

(2) studies focusing on other minority groups (not SA).

Systematic reviews were excluded to avoid overlap as we wanted to review primary data only; however references of retrieved systematic reviews were searched for any further references.

Where there were any disagreements regarding the inclusion of a paper, consensus was reached through discussion amongst the researchers.

*Inclusion criteria*

*Types of intervention*

Any intervention including PA or exercise at home or in the community **were included**. PA and exercise were defined as being general or structured movement of the body that would increase energy expenditure [32].

*Types of studies*

Preliminary pilot searches found few randomised controlled trials (RCTs) of PA interventions for SA people aged 18+ years. Therefore, we decided to include all relevant study designs (eg. RCT, non-RCT, controlled before-after studies, pre-test post-test) to draw from as wide an evidence base as possible.

*Quality assessment & data abstraction*

Quality of study design, including methods selection, identification of biases, appropriate use of statistical methods, and clarity of reporting was assessed using a validated checklist developed from the Scottish Intercollegiate Guidelines Network [33]. Study eligibility was confirmed by two researchers. Quality assessment and data extraction were performed by the first author (MH) and confirmed by one of four research team members.

Extracted data included socio-demographic characteristics; country of origin; sample size; intervention/control description; intervention outcomes – PA uptake/adherence, and intervention effects. Uptake and adherence were defined as those who initially participate in a PA intervention and those who continued participation in the intervention on follow-up, respectively. Long-term adherence was defined as 6-months or more [34]. Analyses of the retrieved papers were carried out between March-May 2017.

**Synthesis**

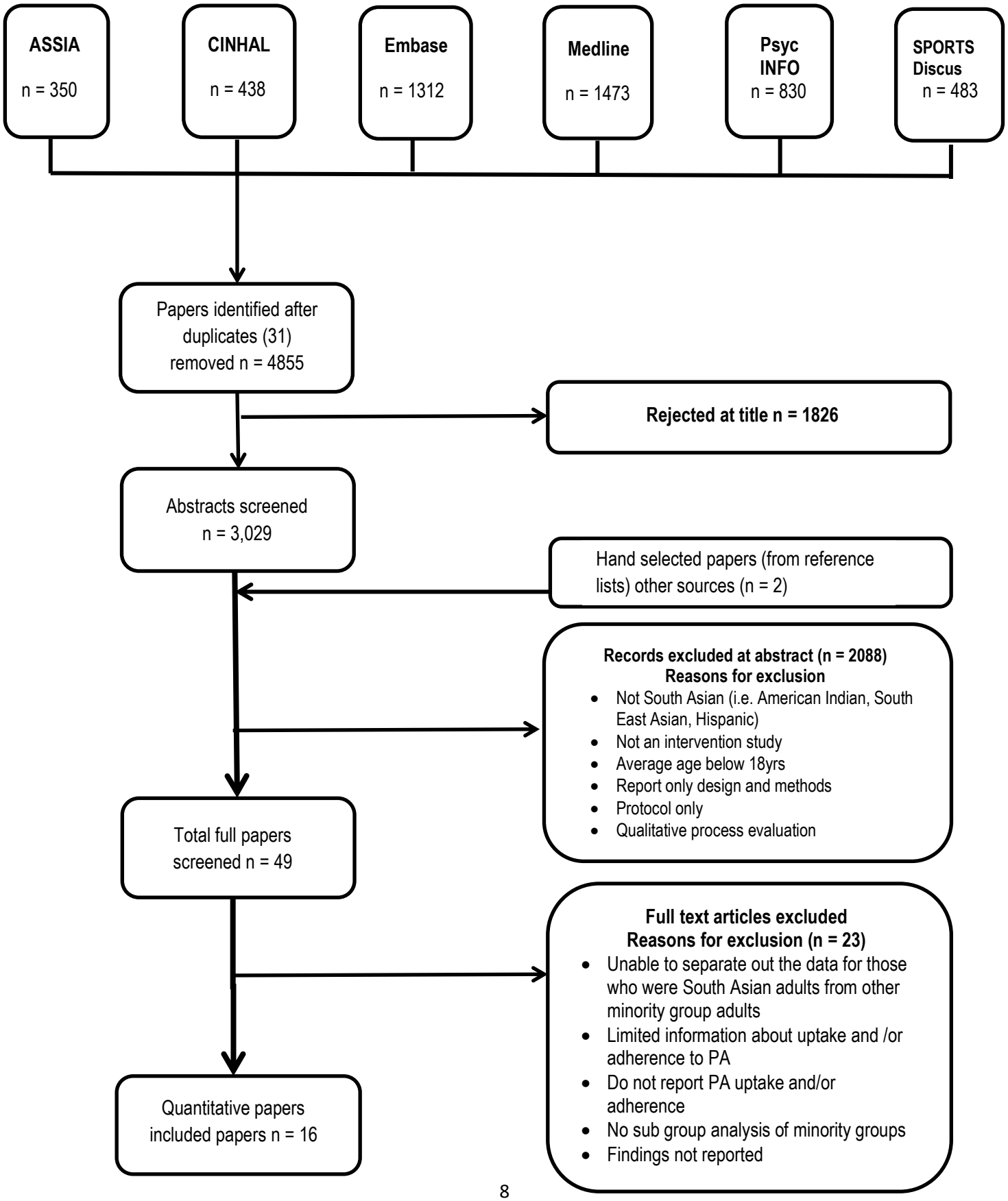
Findings from the included studies are described numerically and textually to provide a summary of evidence on interventions aiming to increase PA uptake and adherence among SAs aged $18^{+}$, to assess what cultural adaptations were made to take into account a person's ethnic background and their impact on PA uptake and adherence. Due to the small number of included studies and

heterogeneity in intervention type, assessment and outcome measures, meta-analysis was not possible, so a narrative synthesis was performed [35].

## Results

The study selection process is illustrated in Figure 1. Searches returned 4855 hits (excluding duplicates), of which16 papers, reporting on fifteen trials/programmes [36-51] met the inclusion criteria. Key characteristics and quality ratings are outlined in Table 1; cultural adaptations and design theory in Table 2.

**Figure 1: PRISMA flow diagram of study selection**



<Table 1>

<Table 2>

**Appraisal of studies**

All included studies/papers were of good or adequate quality (Table 1). The research design and reporting of the findings were not clear or well described in two thirds of the included studies/papers.

**PA interventions**

PA interventions targeting SA adults were related to:

(i) DM management/risk factor reduction as an end point in ten studies [38,39-41,43,45-49]. In these studies, PA was part of (a) *an educational programme* addressing DM self-management [39-41] or (b) *a text based messaging service* [46,47,48,49]; only one DM risk management study had PA as a primary outcome measure [43].

(ii) Healthy lifestyle: PA was part of a group based intervention using aerobic exercise, built on SA folk dance [42].

(iii) PA as a primary outcome measure: These interventions focussed on promoting PA uptake in two rural Indian villages [50]; increasing PA uptake and long-term adherence among Pakistani men (one study, two papers) [37,38]; increasing PA among SA immigrant women (from Indian, Sri Lankan, Bangladeshi, Nepal and Pakistani to Canada) through culturally tailored dance programmes [51] and a culturally tailored dance programme or standard gym-based exercise [44].

**Intervention content**

*Development of the intervention.* Four interventions (five papers) were developed with representatives from the target SA community using qualitative methods [36,37,39-42] or survey to assess health needs [42] (Table 2) to (i) explore PA expectations, preferences and potential barriers to undertaking

the intervention [36,37] and (ii) to develop culturally and/or linguistically tailored programmes [39,40,42]. One intervention used feedback from Indian consumers [46] to develop culturally tailored text messages designed to motivate healthy behaviours.

***Design theory of content.*** Six studies (seven papers) used psychological theories to inform/underpin their interventions [36-40,42,47) (Table 2): (i) Social Cognitive Theory [36,37,38,42], (ii) theory of planned behaviour [42]; (iii) Trans Theoretical Model (TTM) [38,47]; (iv) self-efficacy [39,40].

Six studies used a mixture of behavioural approaches [41,43,45-48] (Table 2): (i) goal setting and motivational interviewing [41]; (ii) social support and role modelling, self-monitoring, goal setting, feedback and reinforcement [43]; (iii) experiential methods [45]; (iv) personalised education and motivation [47]; (v) individually and/or culturally tailored mobile text messaging [46,47,48].

<Table 2>

***Cultural adaptations.*** 10 studies (11 papers) reported using some form of cultural adaptations [36-46,51] (Table 2): (i) community representatives used to ensure cultural appropriateness [36,37]; (ii) culturally adapted materials, messages and images to take into account of language, dress [38,39,40,42,50]; (iii) culturally and linguistically tailored group education sessions [39,40]; (iv) culture-specific dance [42,44,51] – a) aerobic exercise built on SA folk dance [42]; b) Bhangra dancing [44], led by a female SA personal trainer at a local fitness center in one arm of the trial; c) Bollywood dance [51]; (v) women-only exercises [39,43] and culturally appropriate exercise during household work [41]; (vi) culturally tailored intervention programmes, including mobile text messaging [38-40,42,45,46];

Three further studies did not report on any specific cultural adaptations to their intervention [47-49]; these studies were conducted in India or Pakistan.

**Intervention delivery**

Seven studies [38-40,42, 45,50-51] utilised participatory/social marketing approaches to promote/implement community-based PA intervention (see Table 2).

Five studies (six papers) used some form of target community involvement/resource to deliver the intervention [36,37,39,40,42,50] (Table 2). This included: a) community representatives and groups [50] to overcome barriers and facilitate program outcomes; b) festive gatherings (Melas)/community settings [39,40,42,43] to incorporate culturally-salient activities like yoga, aerobic exercise and for convenience; c) Community Health Workers (CHWs) from targeted areas [40,42]; d) SA advisory board [36,37,42] to plan and develop the intervention and review study materials and questionnaires to ensure they were culturally appropriate/meaningful; e) link workers and self-help groups to deliver the PA programme and provide a source of motivation to maintain PA amongst a rural Indian community [50].

Six studies reported using trained, bilingual staff or staff with same background i.e. gender, ethnicity for intervention delivery [39,40,43,44,45,51] and one study reported using group classes based on language preference [42] (Table 2).

**Outcomes**

***(i) Increase in PA.*** Six studies found significant increases in PA [36,37,39-40,45] using a range of assessment methods (Table 1). One study (two papers) used accelerometers [36,37]. Andersen et al [37] reported significant increases in PA levels (counts per minute (CPM)) in the intervention group compared to controls after the 5-month intervention ($p= 0.01$) and significant increases from baseline in the intervention group compared to controls ($p = 0.02$) 6 months post intervention [36]. Additionally, the amount of moderate to vigorous PA increased more for the intervention group compared to controls at 6 month follow-up ($p=0.003$), whilst amount of sedentary time decreased more in the intervention group compared to controls at 6 month follow up ($p=0.001$) [36]. **PA self-report measures** were used in other studies [39,40,41,45]. Islam et al. [39] (no control group) reported significant increases in PA from baseline to 12 months ($p < 0.001$) and Islam et al. [40] (control group included) reported significant increases in PA from baseline to 6 months ($p < 0.01$) compared to controls. Patel et al [45] found significant increases in PA 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 to which they were assigned.

***(ii) Increase in participation rates.*** Participation rates, as a success measure, were included in four studies [43,45,50,51]. In Subitha et al's [50] community-based PA intervention in a rural Indian Community, 54.6% (265/485 people) stated that they engaged in brisk walking >4 days a week; a further 32.2% (156/485 people) reported walking on 1-4 days per week during the 10-week intervention. Likewise, Vahabi and Damba [51] reported an average attendance of 85% (range 77%-96%) during a twice weekly, 6-week Bollywood dance intervention. Similarly, Kandula et al. [43] reported 100% retention rates at 3 and 6 months, with intervention participants attending 5 out of 6 sessions on average (range 1-6), for a culturally tailored exercise intervention for SA immigrant mothers with DM risk factors. Likewise, Lesser et al's [44] RCT of Bhangra dance or standard exercise program on visceral adipose tissue (VAT), reported average attendance of 78% +/- 33% and 67% +/- 25%, respectively (of 36 delivered exercise classes). Similarly, Patel et al's [45] pre-test post-test study reported average weekly attendance of 7.4 out of 12 and 80% retention rates post-test (12 weeks) for the intervention group; control group retention rate was 83%. However, using attendance as a proxy for actual PA does not confirm that those attending engaged in the activity.

***(iii) PA self-efficacy and outcome expectancy.*** PA self-efficacy and outcome expectancy, as a measure of success, were reported in three studies [36,39,51]. Islam et al [39] reported increases in PA self-efficacy post-intervention, with all participants moderately or very confident that they could engage in regular PA at 12 months follow-up and 89% of participants exercising at least several times a week compared to 52% at baseline (based on self-reported measures). Although self-efficacy did not differ between intervention and control groups in Andersen et al [36], they did note significantly higher outcome expectancy scores in the Pakistani men - intervention group (mean difference = 0.6; CI = 0.9 to 0.2; $P < 0.01$). Similarly, Vahabi and Damba [51] found that although there was a small increase in Outcome Expectations for Exercise score pre- and post-intervention, these changes were not significant.

***(iv) PA as a secondary outcome measure.*** PA was a secondary outcome measure in 11 studies [38-41-43,45-49] (see Table 1). Significant increases in PA were found in two studies [45,48]. Patel et al. [45] observed a significant increase in PA at follow-up analysis between baseline and post-test at 12 weeks ($p < 0.0005$) and baseline and follow-up at 24 weeks ($p = 0.001$). Shahid et al. [48] found a

significant increase in physically active patients at 4 months in the intervention group (16.4% to 44.5%; $p < 0.001$), compared to the control group (14.1% to 16.4%; $p=0.472$).

## Discussion

The aim of this review was to locate studies of interventions aimed at SA adults to increase PA and to identify to identify specific changes to their content and delivery mode for this population. An important finding was that culturally-adapted PA interventions tended to be more accepted by the target community. However, although some studies demonstrated improved PA uptake and/or adherence, this was not consistently evidenced across all included studies. Nevertheless, it supports, to some extent evidence from previous studies involving other ethnic/cultural groups [52] and systematic reviews [13,53], which suggest that cultural adaptations of interventions make them more accepted and effective.

Our reivew found several cultural adaptations/strategies that seem to improve PA uptake and/or adherence: (i) using participatory approaches to identify relevant cultural attitudes and norms to inform PA interventions; (ii) adapting content of intervention materials, images and messages to take into account language, dress and the target populations explanatory models to undertaking self-care behaviour (iii) using CHWs or ethnic/culture specific local facilitators/trained bilingual staff to overcome the barriers to intervention uptake; (iv) using community/neighbourhood facilities/places of worship; (v) including culture-specific dance.

Involving the target community in developing culturally appropriate interventions appears to be important in their acceptability, delivery and take-up. In particular, community-based participation in intervention planning, evaluation and research may help to produce culturally and linguistically tailored interventions that address core values, attitudes, beliefs and norms and encourage participation by ensuring recruitment and retention appropriately address community needs and barriers [9,40,50,54]. Likewise, undertaking prior qualitative work with the target community allows for identification of relevant cultural attitudes and norms to inform PA interventions [36,37]. Hence, studies included in this review highlight added benefits to using community-based approaches: (i) recruitment of participants and (ii) facilitating access to PA interventions. This is supported by the literature [55,56].

The site of intervention delivery, specifically the use of community/neighbourhood facilities and melas/religious festivals, appears to be important in terms of acceptability, take-up and adherence. Likewise, using culture-specific dance [60] may increase impact and sustainability of PA [57].

Although not specific to SA adults, a review by Davidson et al. [54] concurs overall with the above cultural adaptations, such as use of places of worship where minority groups congregate and use of culture specific dance. In our review, studies showed how Indian communities, not only embraced the dances, but also sustained this form of PA. Contrary, Davidson et al. [54] report how perceived relevance to adaptations for behaviour change to improve health is dependent on specific cultural priorities (p. 828). For example, adapted interventions for weight loss, such as portion control may not be acceptable in some cultures as being fat is seen as 'beautiful' [54].

Davidson et al. [54] also note that cultural adaptation improved usage of interventions for diet and PA to promote health among minority groups. The importance of context, that can either enhance or reduce the effectiveness of adaptations, was also highlighted. Davidson et al. [54] developed a typology of adaptation approaches through conducting seven systematic reviews and evaluating 107 studies. They argued that healthcare professionals need to include a particular minority group's cultural context into the adaptations for an intervention to work and be accepted [65]. This point may be the reason why some studies in our review did not show acceptance by minority populations even though cultural adaptation was undertaken. The findings of our review, therefore support Davidson et al's [54] notion that minority groups are not homogenous, rather they are heterogenic with their own cultural context. Hence adaptations need to be culturally-context specific.

It should be noted that our review included studies conducted inside and outside of SA countries, to capture as much data as possible due to the paucity of evidence in this field. Taking this approach provides a broad sense of what has been researched to support and promote PA among SA adults. Furthermore, it reflects the range of strategies, in terms of content and delivery mode, adopted to address PA among this population, regardless of where they are living. It is acknowledged that such wide-ranging inclusion criteria could be perceived as a limitation. However, it does add to the argument that the current evidence base is lacking around the topic of cultural adaptation, given that there were no clear distinctions in effectiveness in terms of studies that did and did not include such modifications. It should also be noted that studies conducted in SA countries tended to focus on diabetes, rather than

considering PA as a general health behaviour, and on increasing PA levels among rural communities, highlighting a gap in knowledge that researchers can examine going forward.

## Conclusion

Making cultural adaptations to PA interventions is a complex area. From the way the studies were designed, it was difficult to isolate the effects of cultural adaption. Nevertheless, making cultural adaptations shows promise and should be followed up with research using more robust designs following the MRC framework for developing complex interventions [61]. The evidence presented currently is not strong enough. However, it does not suggest that making adaptations is ineffective.

### Author statements

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#### *Competing interests*

None declared.

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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 |
|---|---|---|---|---|---|---|---|
| ***Andersen et al. (2012) [36]***<br><br>***Norway*** | 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<br><br>**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)<br><br>Control = 61 (8 lost at end of study assessment and another 1 at follow-up) | Pakistani immigrant men, aged 25-60 years<br><br>Not engaged in regular PA<br><br>Excluded if they had diabetes, could not speak Norwegian or had an injury that would make PA difficult<br><br>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)<br><br>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)<br><br>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) | ++ |

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| ***Andersen et al. (2013) [37]***<br><br>***Norway*** | Randomised controlled trial<br><br>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)<br><br>Both groups changed in amount of inactive time; no significant difference between them | + |
| ***Bhopal et al. (2014) [38]***<br><br>***UK*** | Family-cluster RCT<br><br>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 | Intervention = 78 families with 85 participants and 55 family volunteers<br><br>Control = 78 families with 86 participants and 69 family volunteers | Men and women of Indian and Pakistani origin, 35 years or older<br><br>Waist circumference 90 cm or greater in men or 80 cm or greater in women | PA was a secondary outcome measure<br><br>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)<br><br>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 | ++ |

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| | | **Control group:** 4 visits in the same period | | Impaired glucose tolerance or impaired fasting glucose | | | |
| ***Islam et al. (2013) [39]*** <br><br> ***USA*** | A pre-post, mixed methods, feasibility study <br><br> To improve diabetes management - PA was part of a diabetes management strategy | 6 monthly, CHW facilitated group sessions <br><br> 3 one-to-one visits from a CHW at which the challenges of managing diabetes were discussed | 47 individuals consented to participate <br><br> 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 <br><br> Mean age of 26 'completers' = 53.4 (9.4) and <br> 58% = female <br><br> No terminal illness, not in previous cardiovascular study | PA was a secondary outcome measure <br><br> 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) | + |
| ***Islam et al. (2014) [40]*** | A quasi-experimental two-arm design - intervention and | **Intervention group:** received six CHW facilitated | Intervention group = 76; Control group = 50 | Sikh Asian Indians living in New York - first generation (all | PA was a secondary outcome measure | At 6 months, 88.7% of the intervention group reported engaging in any PA compared to 3.8% at | + |

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| ***USA*** | control groups allocated by neighbourhood<br><br>To explore the impact, acceptability, and feasibility of a pilot CHW intervention designed to improve health behaviours and outcomes related to diabetes prevention | interactive group sessions of approximately<br><br>2hrs including discussion on PA<br><br>Held every 3 weeks in a community setting<br><br>Follow-up phone calls from CHWs, to discuss<br><br>challenges, strategies, and action plans for improving diet and PA and reducing stress<br><br>**Control group:** instructed to engage in standard care,<br><br>including seeking preventive and | Of the 126 participants, 108 completed baseline and 6-month follow-up surveys | born outside the USA)<br><br>Intervention group mean age = 46.3 years, SD 11.6;<br><br>Control group mean age = 47.8 years, SD 9.5<br><br>Intervention group = 73 (96.1%) female; Control group = 29 (58%) female<br><br>Intervention group = 71 (93.4%) married; Control group = 47 (97.9%) married | PA assessed via self-report | baseline ($p < 0.01$)<br><br>Control group: non-significant,<br><br>smaller increase in PA<br><br>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 ($p < 0.01$) |

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| | | acute care | | | | | |
| ***Jayasuriya et al. (2015) [41]***<br><br>***Sri Lanka*** | A randomised controlled trial<br><br>To evaluate a theory driven Diabetes Self-Management (DSM) intervention delivered by trained nurses to improve<br><br>glycaemic control - PA was part of this diabetes management strategy | **Intervention group:** patient-centred assessment to elicit problems using motivational interviewing (MI); problem solving, goal identification; commitment for change through MI and documented action plans; feedback and monitoring<br><br>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 | Intervention group = 30; Control group = 30<br><br>Of the 60 participants, 28 completed the intervention and 25 received usual care (90% and 83% retention rates respectively) | Sri Lankan participants with diabetes HbA1c >7.5% (58 mmol.mol) randomised to either intervention or usual care arm<br><br>Intervention group = 83% female;<br><br>Control group = 83% female<br><br>Intervention group mean age = 51.5 years (SD 7.5); Control group mean age =51.4 (SD 7.1)<br><br>Mean duration since diabetes diagnosis = 22.2 | PA was a secondary outcome measure<br><br>PA was<br><br>assessed using the IPAQ<br><br>Diabetes self-efficacy was measured using seven items of the Diabetes Self-Efficacy Scale (appropriate in a Sri Lankan context) (Cronbach Alpha 0.69) | 78% overall attendance rate for the group classes<br><br>After conducting individual make-up classes, 100% attendance was achieved<br><br>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<br><br>Intervention group: self-efficacy increased<br><br>(p = 0.001), but not in the control group | + |

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| | | | | months (SD 7.2) | | | |
| | | PA to increase exercise during household work (for women) and brisk walking (with a pedometer)<br><br>**Control group:** visited diabetes clinic for routine care | | | | | |
| ***Kandula et al. (2015) [42]***<br><br>***USA*** | Two arm randomised controlled trial<br><br>To pilot-test and examine the feasibility and initial efficacy of the SAHELI intervention to improve moderate/vigorous PA and saturated fat | **Intervention group**: 16-week lifestyle intervention that<br><br>included group classes, experiential activities, behaviour<br><br>change telephone counselling and heart health *melas* (festive | Intervention group = 31; Control group = 32<br><br>Randomized into one of the groups by a computer-generated list<br><br>Participants stratified by gender in equal | Asian Indian or Pakistani men and women, aged 30 - 59<br><br>Had at least one ASCVD risk factor<br><br>Exclusion criteria:<br><br>living in the<br><br>same household, | PA was<br><br>assessed using<br><br>pedometers to self-monitor daily steps<br><br>Exercise related confidence measured using Self Efficacy Scale | Intervention participants attended 5 out of 6 sessions on average<br><br>100% retention rate in each arm at 3 and 6 months<br><br>No significant differences between treatment arms for change in moderate-vigorous PA | ++ |

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| | intake<br><br>PA was part of a healthy lifestyle intervention to reduce atherosclerotic cardiovascular disease (ASCVD) risk | gatherings)<br><br>Group classes held weekly for 6 weeks, lasting 60 - 90 mins<br><br>**Control group:** mailed test results with brief explanation, pre-existing print education materials about ASCVD, diet, exercise and weight loss | numbers | but relatives<br><br>from different households were not excluded | | 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<br><br>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 | |
| ***Kandula et al. (2016) [43]***<br><br>***USA*** | Non-randomized design, pre-post test study<br><br>To evaluate a culturally tailored exercise intervention | 16 weeks of culturally tailored exercise classes, self-monitoring with activity trackers, goal setting and classes on healthy eating | N= 30 SA mothers with children aged 6-14 years | SA women at risk of developing diabetes<br><br>Hindi or English speaking | PA was the primary outcome measure and assessed using ActiGraph accelerometer and self-report | Adherence measured as class attendance was 75%; 57% of the women attended at least 80% of the classes<br><br>Study retention = 100% | ++ |

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| | | Exclusion criteria: | Daily step counts collected via Fitbit Zip™ activity tracker | No significant changes in accelerometer-measured PA (p = 0.33) |
| PA was part of a diabetes risk factor reduction strategy | Participants required to attend a minimum of 2 exercise classes every week | • Self-reported diabetes mellitus and/or on diabetes medication | Exercise related confidence assessed using the Self Efficacy for Exercise Scale | Self-reported exercise increased significantly post intervention (95% CI, 23-42; p < 0.01) |
| | Certified exercise instructors conducted classes at Metropolitan Asian Family Services and Ultimate Martial Arts - led participants in | • BMI ≥ 35 $Kgm^{-2}$ | Readiness to exercise assessed using readiness-to-exercise scale | 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 |
| | 45 mins of moderate-intensity exercise drawing on Zumba® and aerobics | • BP over 160/100 mm Hg | | Readiness to exercise – percentage of women in the action/maintenance stages increased to 45%, from 17%, post intervention, but was not statistically significance |
| | Participants were instructed on how to gradually increase the | • Currently pregnant | | |

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| | | amount and intensity of PA to achieve the 150 min of moderate-intensity PA per week | | | | (p = 0.11) | |
| ***Lesser et al (2016) [44]***<br><br>***Canada*** | Single-blinded RCT<br><br>To investigate the effectiveness<br><br>of a standard exercise (SE) program and<br><br>Bhangra dance (BD) on visceral adipose tissue (VAT) deposition and cardiometabolic risk factors | 12-week exercise programme of:<br><br>(i) culturally based (Bhangra dance), or<br><br>(ii) standard (gym-based), or<br><br>(iii) control (non-exercise) | Sample size based on a power<br><br>of 0.80; calculated 20 participants for each group<br><br>To account for a possible 25% dropout rate, 25 participants per group were enrolled<br><br>Participants randomized to culturally based (BD) n=26, SE n=23, or control n=26 | Physically inactive, postmenopausal SA women with Type II diabetes | Type of exercise was a secondary outcome measure<br><br>PA determined<br><br>by the modified Minnesota Leisure Time Physical Activity<br><br>Questionnaire and reported as average weekly kilocalories expended<br><br>Adherence to the exercise intervention based on attendance at | 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 | ++ |

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| | | | | | the 36 prescribed exercise classes | | |
| ***Patel et al. (2017) [45]***<br><br>***USA*** | Experimental, pre-post-test control group repeated measures design<br><br>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:<br><br>(i) **Intervention group:** 12-week group-based lifestyle program<br><br>(ii) **Control group:** received standard print material on diabetes prevention | N = 70<br><br>individuals were randomized<br><br>into intervention<br><br>group (n=36) or control group (n=34) | Convenience sample of<br><br>Gujarati Asian Indians from a mandir (Hindu temple)<br><br>Inclusion criteria:<br><br>(i) Aged >18 years<br><br>(ii) Diabetes risk score ≥ 50 (Mohan et al 2005)<br><br>(iii) HbA1c value<br><br>< 6.4%<br><br>Exclusion criteria:<br><br>(i) Had diabetes, or unstable | PA was a secondary outcome measure<br><br>Self-reported PA using Health Promoting Lifestyle Profile II (HPLP II)<br><br>Pedometer daily step counts recorded<br><br>on weekly logs for both intervention and control groups | Intervention participants' average weekly attendance was 7.4/12<br><br>Retention rate at post-test (12 weeks) =<br><br>intervention group 80% and control 83%<br><br>Significant increase in PA in follow-up analysis between baseline and post-test at 12<br><br>weeks ($p$ < 0.0005) and baseline and follow-up test at 24 weeks ($p$ = 0.001) regardless of group<br><br>Significant main effect of time regardless of group | + |

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| | | | | chronic disease<br><br>(ii) Unable to participate in<br><br>regular PA<br><br>(iii) Pregnant or planning to be pregnant in next 6 months<br><br>(iv) Currently involved in a supervised program for weight loss | | Participants mean score on the PA subscale of the HPLP II improved between 0, 3 and 6 months, regardless of group assignment | |
| ***Pfammatter et al. (2016) [46]***<br><br>***India*** | Prospective, parallel cohort design<br><br>To examine whether mDiabetes improved fruit, vegetable, and fat intakes and exercise; hence PA was part of a | **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 | 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 | Most of the sample were male (88.52%)<br><br>Lived in an urban location (68.78%)<br><br>Resided in the North of India (67.06%) | Self-report PA: "Do you exercise currently?" with response options "yes" or "no" asked in an interview | Intervention group reported a small increase in exercise relative to controls, but this was not significant | + |

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| | diabetes risk factor reduction strategy | **Control group:** participants received no contact | 982 in intervention group and 943 in control group took phone survey | | | | |
| ***Ramachandran et al. (2013) [47]***<br><br>***India*** | A prospective, parallel-group, randomised controlled trial<br><br>To assess a tailored mobile phone messaging service to encourage<br><br>lifestyle change<br><br>compared with standard lifestyle advice<br><br>PA was part of a diabetes risk factor reduction strategy | **Intervention group:** frequent mobile phone messages<br><br>**Control group:** standard lifestyle modification advice at baseline | N=537, randomly assigned (1:1) to intervention (n=271) or standard care (control group) (n=266) | Working Indian men, aged 35–55 years, with impaired glucose tolerance | PA was a secondary outcome measure<br><br>PA recommendation<br><br>• Brisk walk for at least 30 mins per day<br><br>• Walk 3–4 kms in 30 mins at least 5 days a week<br><br>• Cycle 6–7 kms in 30 mins<br><br>• If occupation involved strenuous work, no specific advice | Adherence to PA recommendations at 24 months did<br><br>not differ between the two groups – Intervention group: 36 (27–54), Control group: 36 (31–56) | + |

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| | | | | | PA adherence<br><br>• Poor: less than 150 mins per week (non-adherent)<br><br>• Fair: 150–250 mins per week (adherent)<br><br>• Good: more than 250 mins per week or if occupation<br><br>involved strenuous work (adherent)<br><br>PA assessed by<br><br>questionnaire | | |
| ***Shahid et al. (2015) [48]*** | Randomized controlled trial | **Intervention group:**<br><br>received regular feedback based | N = 440 patients<br><br>• Intervention | Patients between 18 - 70 years | Self-report PA | Intervention group: demonstrated significant ($p < 0.001$) increase in PA from 16.4% to 44.5% at 4 | + |

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| ***Pakistan*** | To determine the effect of mobile phone intervention on HbA1c in type-2 Diabetes Mellitus in a rural areas of Pakistan<br><br>PA was part of a diabetes management strategy | on their blood glucose over the last 15 day readings via phone over a 4 month period<br><br>**Both group:** leaflets on diet, healthy lifestyles, symptoms of hypoglycemia and<br>hyperglycemia, complications of diabetes<br><br>Educated about going to doctor if blood glucose remained very high or very low<br><br>**Control group:** advised on medication,<br>diet, lifestyle, and | group n=220<br><br>• Control<br>group n=220 | Residing in rural areas of Pakistan<br><br>HbA1c ≥ 8.0%<br><br>Had a personal, functional mobile phone | | months<br><br>Control group:<br>insignificant improvement (p=0.472) was observed in<br>PA in control group from 14.1% to 16.4% at 4 months |

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| | | blood glucose levels<br><br>Asked about Self Monitoring Blood Glucose (SMBG) at baseline and at regular follow up<br><br>Advised to come for usual follow up visit at 4 months | | | | | |
| ***Shetty et al. (2011) [49]***<br><br>***India*** | Pilot randomised trial<br><br>To investigate the acceptability and feasibility of using short message services (SMS) via cell phones<br><br>to ensure adherence to management prescriptions by | **Intervention group:** received SMS written in English once<br><br>in 3 days as a reminder to follow dietary modification, PA and drug regimen<br><br>**Control group:** received standard care (including | N = 215<br><br>• Intervention group n=110<br><br>• Control<br><br>group n=105<br><br>Randomised using a computer-generated random | Men and women with type 2 diabetes, receiving oral<br><br>hypoglycaemic agent (OHA) and/or insulin for at least 5 years<br><br>Aged 30 to 65 years | PA was a secondary outcome measure<br><br>PA assessed based on scores given for occupational & leisure time activities | Intervention group (SMS group): adherence to PA advice improved from 47% to 56% - change was not statistically significant<br><br>Control group: adherence to PA advice was noted as 47% and 52% during the baseline and 1st year visits respectively | + |

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| | diabetic patients<br><br>PA was part of a diabetes management strategy | appropriate prescriptions of drugs and advice on diet and PA)<br><br>**Both groups:** advised to report for clinic reviews at quarterly intervals | number | Read English<br><br>A minimum of high school education<br><br>HbA1c value<br><br>ranging between 7.0% to 10.0% | | | |
| ***Subitha et al. (2013) [50]***<br><br>***India*** | Community-based participatory research<br><br>To study the development and implementation of interventions promoting PA in a rural Indian community though social marketing | Health education by one-to-one counselling, written materials and community events to raise awareness of moderate intensity PA<br><br>Brisk walking for 30 mins 4 days a week = how moderate intensity | 485 residents of 2 villages in Tamil Nadu who wished to participate<br><br>Village leaders, self-help groups and youth clubs were involved in promoting PA | Men=232, women=253; aged 25-49 years<br><br>Socioeconomic class:<br>• Upper=132<br>• Middle=150<br>• Lower=203 | Baseline PA was measured using the<br><br>IPAQ that was adapted to local variations in PA and local culture<br><br>A log of PA sessions for the 10-week intervention was maintained in the | Those aged 20-29 years and 30-39 years = 10 and 3 times more likely to participate in the<br><br>intervention, respectively, than 40-49 year olds<br><br>Significant association was found between gender and participation behaviour ($p<0.001$); men dropped out in higher numbers - 20% compared | + |

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| | | PA was defined<br><br>30 walking groups were formed under 4 coordinators, in a home-based setting with professional supervision and guidance | | Education:<br>• None=78<br>• Primary school=75<br>• Middle school=120<br>• High school=162<br>• Graduate or above=50<br><br>Skill level:<br>• Labourer=146<br>• Semi-skilled=90<br>• Professional=29<br>• Non-worker=220 | form of a group attendance record | 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)<br><br>Age, educational status and occupation were significant determinants of maintenance of PA (>4 sessions per week) | |
| ***Vahabi & Damba (2015) [51]***<br><br>***Canada*** | Mixed methods approach<br><br>To explore the feasibility and health impacts of a culture and | 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<br><br>Overall mean pre-intervention Self-Efficacy | + |

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| gender specific PA intervention | | Mean age=42 (range 22-58)<br><br>Average time in Canada=10.7 years (SD +/- 8.2)<br><br>All participants spoke and wrote in English<br><br>56% had a family history of type 2 diabetes and a third had a family history of heart disease<br><br>52% were married and had one, two, or three children<br><br>85% had a | Adherence to PA assessed by participation rate | Expectancy of Exercise Score (SEE) was 7.4<br><br>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)<br><br>Overall mean post-intervention SEE score was lower than pre-intervention, 6.8 compared to 7.4 pre intervention<br><br>Overall mean pre-intervention Outcome Expectations for Exercise<br><br>(OEE ) score = 4.4, which increased slightly at post-intervention to 4.6<br><br>Comparison of pre-intervention and post- |

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| | university degree or higher<br><br>Most worked full time outside the home | intervention OEE showed an increase in OEE, but changes were not significant |

**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].

**Table 2: Cultural adaptations and design theory of the included studies**

| Paper | Cultural adaptations | Design theory |
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| **Andersen et al. (2012) [36]** | Used representatives from the Pakistani community to plan and develop the intervention | Participatory/collaborative approach<br><br>Based on social cognitive theory and targeting self-efficacy, social environment and outcome expectancies<br><br>Constructs specifically to promote PA self-efficacy, social support for PA and outcome expectancies, were measured by psychosocial scales |
| **Andersen et al. (2013) [37]** | As above | Participatory/collaborative approach<br><br>Based on social cognitive theory and targeting environment, behavioural capability, self-control, self-efficacy, expectations and expectancies |
| **Bhopal et al. (2014) [38]** | Reported using culturally adapted and translated resources, including the Counterweight Programme, but did not outline how and/or what cultural adaptations were made. This was identified in another publication [62]. Adaptions related to PA were the translation of materials into Gurmukhi and Urdu<br><br>Utilised family involvement and support of the family cook as mandatory to enrolment into the trial (families, not individuals were randomised) | Trans Theoretical Model (TTM) |
| **Islam et al. (2013) [39]** | Culturally and linguistically tailored group education sessions/programme<br><br>Used trained Community Health Workers (CHWs), who were community leaders in the targeted study area, to deliver the intervention<br><br>All group education sessions were held in clinical and community settings<br><br>All group education sessions were separated by | Based on the principles of community-based participatory research to improve diabetes management, where increasing PA was one component<br><br>Community stakeholders involved throughout the development, design and implementation of the intervention |

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| | gender and conducted in Bengali<br><br>Intervention delivered by two trained, bilingual Bangladeshi CHWs who were community leaders – one male and one female<br><br>One-to-one visits were conducted in locations convenient to participants – home, community locations, restaurants and clinics | |
| **Islam et al. (2014) [40]** | Culturally and linguistically tailored group education sessions/programme<br><br>All curriculum materials were developed in English, translated into Punjabi, and reviewed for accuracy by bilingual study staff<br><br>Intervention led by three trained, bilingual Sikh Asian Indian CHWs and a bilingual, South Asian Indian CHW supervisor at the Community-based Organisation, who were active community leaders in the targeted study area, to deliver the intervention<br><br>Group activities, physical exercise, culturally-appropriate images and language, and adult learning techniques were incorporated into all educational sessions<br><br>**Educational sessions were held in a convenient community setting**<br><br>Educational sessions were held during the weekend and early afternoon to accommodate participant schedules, particularly women who had childcare obligations | Based on the principles of community-based participatory research to develop action-orientated solutions to improve diabetes management, where increasing PA was one component<br><br>Community stakeholders tailored existing curricula and developed evaluation tools for use in the Sikh community; emphasis placed on cultural relevancy of concepts and examples and linguistic concordance of the intervention<br><br>Community stakeholders involved in the study design facilitating adaptation of the Diabetes Prevention Programme |
| **Jayasuriya et al (2015) [41]** | The PA intervention targeted increasing culturally appropriate exercise during household work (for women) | Self-management intervention based on components of behavioural theory – specifically goal setting (active collaborative approach) and motivational interviewing (goal orientated, client-centred counselling approach) |

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| | | Motivational Interviewing |
| **Kandula et al. (2015) [42]** | Study partners and SA community advisory board reviewed study materials and questionnaires to ensure cultural equivalence<br><br>Used a culturally tailored group lifestyle intervention programme<br><br>Used SA's explanatory models into prevention messages<br><br>Matching intervention materials and messages to take into account of language, dress<br><br>Community based facility utilised for the intervention<br><br>Group classes were based on language preference<br><br>Group based activity for social support<br><br>Use of *Melas* (festive gatherings) to incorporate culturally-salient activities to reinforce healthy behaviours, increase group cohesion and support – activity included yoga, aerobic exercise built on SA folk dance | Community-based participatory research (CBPR) framework<br><br>Survey to assess health needs<br><br>Intervention based on the constructs from the theory of planned behaviour and social cognitive theory<br>Integrated evidence-based behaviour change strategies with SA's sociocultural context and beliefs<br><br>Intervention developed using evidence based behavioural strategies and included:<br>• Social support and role modelling - group exercise classes<br>• experiential activities<br>• behaviour change counselling<br>• goal setting techniques<br>• information on how to self-monitor daily steps and how top gradually increase activity<br>• telephone support/counselling used a motivational interviewing framework |
| **Kandula et al. (2016) [43]** | Culturally specific strategies included:<br>• Women-only exercise classes<br>• Exercise classes for children<br>• Use of community partnerships<br>• Classes held at a convenient location in the community<br>• Sensitivity to cultural values - i.e. modesty and gender roles<br>• Classes advertised as fitness and exercise | Integrated evidence-based behavioural strategies and community-based participatory research principles, using community partners, to develop the exercise intervention<br><br>Exercise intervention also developed using evidence based behavioural strategies and included:<br>• Social support and role modelling - group exercise classes<br>• Self-monitoring – with Fitbit™ wireless activity tracker<br>• Goal setting for physical activity outside the class |

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| | and not as dance classes<br>• Music during classes had no inappropriate content<br>• Use of bilingual, culturally concordant study staff | • Feedback and reinforcement – provided by study staff using reports generated from Fitbit™ data<br><br>Used a discontinuous protocol (Gillett et al 1996) - where participants could rest as needed during class and rejoin the class once ready |
| **Lesser et al (2016) [44]** | Female SA personal trainer at a local fitness centre used for the Standard Exercise group<br><br>Bhangra dance was used as one of the intervention arms led by a female SA personal trainer at a local fitness centre | |
| **Patel et al. (2017) [45]** | Culturally tailored an evidence based modified US Diabetes Prevention Program (DPP), the National Diabetes Education Program's (NDEP) Power to Prevent (P2P)<br><br>No details provided as to how the programme and materials were culturally tailored for Asian Indians to address language and culture<br><br>Intervention led and facilitated by a bilingual healthcare professional (session leader Gujarati American)<br><br>Session leader orally translated information to personalise the intervention with examples of Gujarati colloquialisms, customs and traditions<br><br>Specific barriers to adopting healthy behaviours were addressed by the Gujarati American facilitator through inspirational cultural messaging and visuals | Community-based approach<br><br>Facilitator led 20 minutes of group PA time during 8 of the 12 sessions as a form of reinforcement<br><br>Experiential methods e.g. exercise demonstration, were used to engage participants<br><br>Text messaging and email communication to attend sessions as reminders<br><br>Pedometers provided to increase motivation and reinforcement |
| **Pfammatter et al. (2016) [46]** | Text messages form the mDiabetes program were culturally tailored to be more acceptable and actionable by the population through feedback from Indian consumers | Text messages for the mDiabetes program were developed by Emory University and reviewed by a Behaviour Change Task Force – no further detail provided on behaviour change strategies |

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| | Texta were available in one of 12 languages based on participant preference. | |
| **Ramachandran et al (2013) [47]** | No specific cultural adaptations to the intervention were reported | Personalised education and motivation about healthy lifestyle principles, and written information about physical activity<br><br>Individually tailored mobile phone messaging content based on the TTM – messages contained fewer than 160 characters; 60–80 messages were created for each TTM stage and sent cyclically, so participants would not be likely to receive the same message in a 6-month period (on the basis of them receiving two to four messages per week) |
| **Shahid et al (2015) [48]** | No specific cultural adaptations to the intervention were reported | |
| **Shetty et al (2011) [49]** | No specific cultural adaptations to the intervention were reported | |
| **Subitha et al. (2013) [50]** | Pamphlets and banners were prepared in the local Language to create health awareness<br><br>However, used link workers (people who provide person centred support and act as a bridge to services in the wider community) and self-help groups (SHGs) to deliver the PA programme, as well as a source of motivation to maintain PA<br><br>Actively resourced people in rural villages, such as village leaders, youth clubs, SHGs, teachers and health workers of the primary health centre to motivate the study population | Community-based participatory approach underpinned by social marketing principles – specific behaviour change goal, consumer research, audience segmentation, marketing mic/channels of communication, service and incentive to the participants and reducing sedentary behaviour |
| **Vahabi & Damba (2015) [51]** | A culture and gender specific physical activity - *Bollywood Dance* exercise program, developed and led by a female SA instructor | Community-based approach at delivery level |