

# Effectiveness of prevention programmes for obesity and chronic diseases among immigrants to developed countries – a systematic review

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## Abstract

**Objective:** To determine whether interventions tailored specifically to particular immigrant groups from developing to developed countries decrease the risk of obesity and obesity-related diseases.

**Design:** Databases searched were MEDLINE (1966–September 2008), CINAHL (1982–September 2008) and PsychINFO (1960–September 2008), as well as Sociological Abstracts, PsychARTICLES, Science Direct, Web of Knowledge and Google Scholar. Studies were included if they were randomised control trials, ‘quasi-randomised’ trials or controlled before-and-after studies. Due to the heterogeneity of study characteristics only a narrative synthesis was undertaken, describing the target population, type and reported impact of the intervention and the effect size.

**Results:** Thirteen studies met the inclusion criteria. Ten out of thirteen (77%) studies focused on diabetes, seven (70%) of which showed significant improvement in addressing diabetes-related behaviours and glycaemic control. The effect on diabetes was greater in culturally tailored and facilitated interventions that encompassed multiple strategies. Six out of the thirteen studies (46%) incorporated anthropometric data, physical activity and healthy eating as ways to minimise weight gain and diabetes-related outcomes. Of the six interventions that included anthropometric data, only two (33%) reported improvement in BMI Z-scores, total skinfold thickness or proportion of body fat. Only one in three (33%) of the studies that included cardiovascular risk factors reported improvement in diastolic blood pressure after adjusting for baseline characteristics. All studies, except four, were of poor quality (small sample size, poor internal consistency of scale, not controlling for baseline characteristics).

**Conclusions:** Due to the small number of studies included in the present review, the findings that culturally tailored and facilitated interventions produce better outcomes than generalised interventions, and that intervention content is more important than the duration or venue, require further investigation.

**Keywords**  
Intervention  
Obesity  
Diabetes  
Immigrants  
Prevention

Migration from developing countries to affluent, Westernised countries is associated with an increased risk of chronic disease, especially obesity, diabetes and chronic heart diseases<sup>(1–3)</sup>. For example, the Ghanaian Health and Nutrition Analysis in Sydney found an increase in self-reported BMI (23·8 (SD 2·2) kg/m<sup>2</sup> for men and 23·4 (SD 4·5) kg/m<sup>2</sup> for women pre-migration *v.* 27·2 (SD 2·8) kg/m<sup>2</sup> and 27·4 (SD 4·7) kg/m<sup>2</sup>, respectively, post-migration) among Ghanaian migrants<sup>(4)</sup>. The study also found a high prevalence of both type 2 diabetes mellitus (T2DM) and impaired fasting glucose. The prevalence of T2DM was

20% in men and 11% in women, and impaired fasting glucose was 22% and 20%, respectively. Only 23% of study participants were aware of their T2DM status, indicating the lack of awareness and the increased risk of medical conditions related to uncontrolled diabetes. These findings were consistent with those reported in studies of the African Diaspora of West African origin<sup>(5,6)</sup> and Ethiopian migrants to Israel<sup>(7,8)</sup>.

The pattern observed among African migrants has also been reported for other migrant sub-populations. For example, the latest data reported by the Australian Institute

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of Health and Welfare<sup>(1)</sup> found that, overall, migrants born in Southern and Eastern Europe, North Africa and the Middle East experience rapid weight gain following migration and have a prevalence of overweight that is significantly higher than the Australian-born population. People whose main language spoken at home is a Middle Eastern, Northern African, Southern Asian, other South-West Asian or East Asian language were found to have higher rates of T2DM than Australian-born people<sup>(1)</sup>. In the USA, Hispanic (Mexican, Cuban and Puerto Rican) Americans have higher levels of overweight and obesity than do white Americans<sup>(9)</sup>. Similarly, in The Netherlands, the prevalence of overweight/obesity among Turkish and Moroccan immigrants is very high at 57–89%<sup>(10)</sup>. The risk of the escalation of obesity and T2DM has been found to follow a gradient as migrants become more affluent and urbanised, and as nutrition and lifestyle behaviours change<sup>(11)</sup>.

Despite the evidence for increased risk of obesity and chronic diseases post-migration, it is not clear whether public health interventions geared toward addressing obesity and obesity-related chronic diseases among migrants have been effective. The aims of the present study were: (i) to determine whether interventions tailored specifically to particular immigrant groups from developing to developed countries decrease the risk of obesity and obesity-related diseases; and (ii) to delineate and examine process indicators that describe why and how a particular intervention has worked.

## Methods

### Search strategy

MEDLINE (1966–September 2008), CINAHL (1982–September 2008) and PsychINFO (1960–September 2008) were searched. Other databases such as Sociological Abstracts, Science Direct, Web of Knowledge and Google Scholar were also searched. The search strategies utilised are given in Table 1. However, no additional relevant or different studies were found through these additional databases. In addition, a lateral approach involving a review of reference lists in relevant papers/reviews was undertaken. Two more studies were identified but only one met our inclusion criteria.

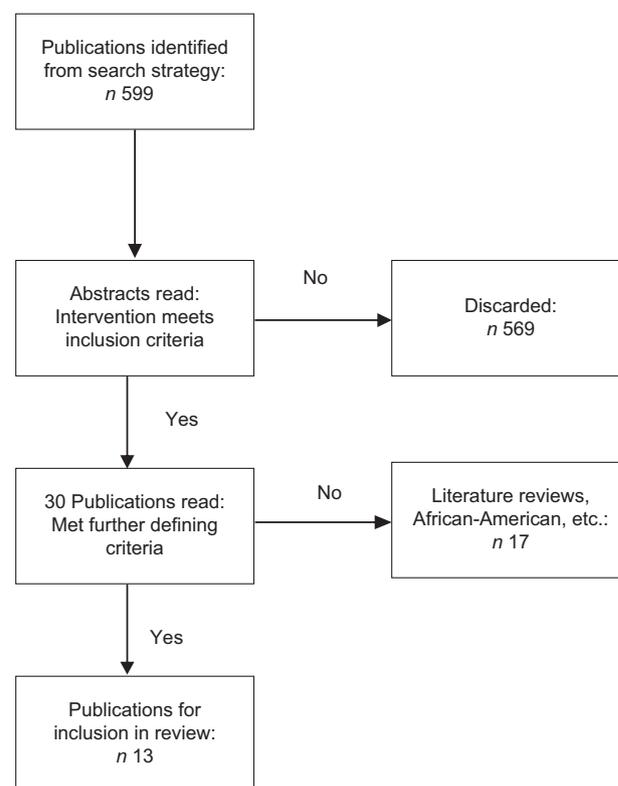
### Selection of interventions and data extraction

All potentially relevant studies were screened by two reviewers (A.M.N.R. and K.B.) for eligibility using the following criteria: (i) the intervention targeted immigrants from developing to developed countries; (ii) the intervention's objective was the prevention of obesity, T2DM and/or CHD; (iii) the intervention design was a randomised controlled trial, a 'quasi-randomised' trial or a controlled before-and-after study; (iv) at least 40% of the study sample were non-African American migrants where a multi-ethnic sample was used; (v) an intervention group

**Table 1** Search strategies for all of the search engines utilised

1. '(accultura\*/assimilation)' and 'intervention' and '(obesity/overweight/weight gain/body fat/diabetes/Type 2 diabetes/cardiovascular disease/heart disease)'
2. 'ethnic group\*' and 'intervention' and '(obesity/overweight/weight gain/body fat/diabetes/Type 2 diabetes/cardiovascular disease/heart disease)'
3. '(migra\*/migration/migrants)' and 'intervention' and '(obesity/overweight/weight gain/body fat/diabetes/Type 2 diabetes/cardiovascular disease/heart disease)'

/ = or.



**Fig. 1** Flow chart of study selection

had at least forty subjects; and (vi) the study was published in a peer-reviewed journal. Papers selected for inclusion (see Fig. 1 for flow chart) were then independently reviewed by two reviewers (A.M.N.R. and K.B.). The review extracted information describing the intervention and outcomes.

Poor-quality studies, for the purposes of the present review, were defined as those that had any of the following design flaws: inadequate sample size; poor definition of control groups; no clear measurement or control for confounders; no clear or specific definition of outcome measures; or analyses unadjusted for confounders<sup>(12)</sup>. Studies without these flaws were categorised as being of good quality and suitable for inclusion.

### Exclusion criteria

Studies were excluded if they included non-immigrants, focused mainly on African-Americans, were medical and/or

drug interventions, did not define the migrant group, did not define the intervention, did not clearly outline the methodological approaches, and did not include obesity or BMI, T2DM or heart disease as an outcome measure.

### **Types of outcome measures**

Outcome measures included change in BMI; weight, waist and hip measurements; lean tissues mass; body fat; nutritional targets for patients with diabetes; self-reported nutrition adherence for diabetes self-management; diabetes knowledge; self efficacy and management; dietary fat consumption; glycaemic control; and cardiovascular risk factors.

### **Data synthesis**

Due to the heterogeneity of study characteristics and impact indicators, undertaking a meta-analysis was not appropriate. The analysis focused on the narrative, describing the target population, the setting, type and reported impact of intervention, and where possible the effect size. The interventions were assessed for cultural competence and cultural leverage. Culturally competent interventions were those that used community participants' expertise and social structures to culturally tailor strategies and activities in order to address culture-related barriers; and used cultural practices, products, philosophies or environments in order to make the intervention culturally acceptable and as the means to facilitate behaviour change among participants.

### **Results**

The initial electronic database searches identified 599 studies, of which only thirteen met the inclusion criteria (Fig. 1). Of the thirteen studies, ten (77%) focused primarily on T2DM and three (23%) focused on cardiovascular risk factors such as blood pressure and serum lipids. Six out of the thirteen studies (46%) included anthropometric measures such as BMI and waist:hip ratio. The included studies and their limitations are summarised in Table 2. A summary of intervention outcomes by setting and by number of intervention components is presented in Table 3.

### **Interventions reporting significant effects**

Gucciardi *et al.*<sup>(13)</sup> conducted a 3-month randomised controlled trial to evaluate the impact of culturally competent diabetes education intervention on nutrition adherence and glycaemic control among sixty-one Portuguese Canadian adults with T2DM. The intervention had two components: (i) individual counselling only; and (ii) individual counselling ( $n = 25$ ) in conjunction with group education ( $n = 36$ ). After adjusting for baseline measures, the study found that regardless of the education format, participants in both treatment conditions improved significantly from pre to post intervention.

However, the improvement was greater in the multiple intervention (mean difference between multiple *v.* single intervention) in scores for attitude (0.20 (SD 0.11),  $P = 0.09$ ), subjective norm (0.25 (SD 0.13),  $P = 0.06$ ), perceived behavioural control (0.16 (SD 0.11),  $P = 0.03$ ), intention to adhere to nutrition recommendations (0.20 (SD 0.11),  $P = 0.03$ ) and self-reported nutrition adherence (0.42 (SD 0.14),  $P = 0.001$ ), except for glycated haemoglobin (HbA<sub>1c</sub>; 0.08 (SD 0.34),  $P = 0.75$ ). The study limitations are summarised in Table 2.

In New Zealand, Simmons *et al.*<sup>(14)</sup> conducted a 2-year non-randomised, controlled, church-based intervention programme to reduce diabetes risk factors among Western Samoans. Two Seventh Day Adventist churches were selected for the study through their pastors. In one church, a 2-year nutrition and physical activity education programme was implemented as part of church attendance. After 2 years of intervention the study found that, compared with the control group, those in the intervention group had: (i) reduced waist circumference (change over time, diff =  $-4$  (SD 10) cm *v.*  $+2$  (SD 7) cm,  $P < 0.001$ ); (ii) reduced waist and hip circumference (diff =  $-4$  (SD 10) cm *v.*  $+2$  (SD 7) cm and  $-5$  (SD 9) cm *v.*  $+1$  (SD 5) cm respectively,  $P < 0.001$ ); (iii) increased open (diff =  $+46$  (SD 26) % *v.*  $+4$  (SD 17) %,  $P < 0.001$ ) and closed (diff =  $+12$  (SD 24) % *v.*  $+3$  (SD 22) %,  $P < 0.05$ ) knowledge scores; (iv) increased physical activity ( $+0.5$  (SD 2.5) *v.*  $-0.5$  (SD 2.4) d/week,  $P < 0.05$ ; exercising 3 d/week:  $+22\%$  *v.*  $-8\%$ ,  $P < 0.05$ ; stopping exercising:  $10\%$  *v.*  $24\%$ ,  $P < 0.05$ ; initiating exercise:  $31\%$  *v.*  $15\%$ ,  $P < 0.05$ ; no change in exercise pattern:  $59\%$  *v.*  $61\%$ ,  $P < 0.001$ ); and (v) reduced dietary fat intakes (seven-item fat score:  $-14$  (SD 28) *v.*  $-3$  (SD 24),  $P < 0.001$ ; do not cut fat off meat:  $-47\%$  *v.*  $-7\%$ ,  $P < 0.001$ ; do not cut skin off chicken:  $-9\%$  *v.*  $-4\%$ ,  $P < 0.05$ ). However, the two groups did not differ in terms of BMI or waist:hip ratio. Despite these positive outcomes, the study suffered some serious limitations (Table 2). In addition, the two churches (intervention and control) were only 3 km away from each other and there was a spill-over effect in that the control group initiated its own exercise programme during the intervention.

Simmons *et al.*<sup>(15)</sup> subsequently undertook a non-randomised controlled church-based study to compare the impact on weight and exercise of a 2-year diabetes risk reduction programme in four churches in New Zealand. There were two Tongan Latter Day Saints churches with two different bishops; and two Samoan Seventh Day Adventist churches with the same pastor. The intervention and control churches in each congregation were matched as closely as possible for denomination, socio-economic status and organisation. Both churches used leaflets in the first language of their congregation and a specially designed video in English (translated piecemeal by a bilingual church member). The intervention included a 2-year nutrition and physical activity education programme, with sessions customised for

**Table 2** Study characteristics of articles included in the present systematic review

Reference	Design, population and setting	Sample size	Intervention	Outcome measure(s)	Study quality and limitations
Gicciardi <i>et al.</i> (2007) <sup>(13)</sup>	RCT Portuguese-speaking adults with T2DM Diabetes Education Centre; Toronto, Canada	61	<i>Group 1: Intervention</i> 3-month intervention that incorporated diabetes education counselling in conjunction with group education.  The individual counselling: administered by diabetes educators (nurses) in collaboration with dietitians and incorporated initial assessment, mutually agreed-upon diabetes management plans that included management goals, nutritional care, nutrition therapy and the management of existing complications and co-morbidities, and referrals as needed. The frequency and intensity of each follow-up were dependent on the patient's progress and achievements  The group education intervention: facilitated by a multidisciplinary health-care team and incorporated 15 h of mixed education methods (didactic methods, mutual goal setting, situation problem solving, cognitive reframing, role-playing methods) over three consecutive weekdays. A key component of the intervention was nutrition therapy focusing on healthy eating (limited but consistent intake of carbohydrate, adequate daily intake of fruit and vegetables, reduced intake of saturated fats, reduced fat in cooking)  <i>Group 2: Control</i> Diabetes education counselling only	Attitudes; subjective norms; PBC; intentions; nutrition adherence; HbA <sub>1c</sub>	Quality = poor. Small sample size; poor internal consistency of scores for the scale used; significant differences between participants who dropped out and those who completed the study
Simmons <i>et al.</i> (1998) <sup>(14)</sup>	Non-randomised controlled study West Samoans aged >14 years Two complete church congregations; South Auckland, New Zealand	222	<i>Group 1: Intervention</i> The intervention included an introductory talk and four diabetes awareness sessions as part of the church services. These were complemented by leaflets in Samoan and English; a video customised for Pacific Islanders people; flip charts with specifically designed posters in Samoan; advice about weight; two blocks of four food cooking demonstrations and healthy eating sessions; exercise sessions focusing on sitting exercises, low-impact aerobics and walking. Finally, sport activities were organised once weekly for the first year and twice weekly thereafter; and a diabetes support group was established  <i>Group 2: Control</i> No education programme	Weight; BMI; WC; HC; WHR; diabetes knowledge; exercise; fat consumption	Quality = poor. Did not adjust for baseline characteristics when assessing the effect of the intervention even though the two groups differed at baseline; small sample size

**Table 2** Continued

Reference	Design, population and setting	Sample size	Intervention	Outcome measure(s)	Study quality and limitations
Simmons <i>et al.</i> (2004) <sup>(15)</sup>	Non-randomised controlled study Four complete church congregations (2 × Samoan adults, 2 × Tongan adults); Auckland, New Zealand	78 Samoan 188 Tongan	<i>Group 1: Intervention</i> Diabetes education focused on the nature of diabetes and its symptoms, the long-term consequences of uncontrolled diabetes and nutrition (including cooking demonstrations). Exercise sessions were commenced which included sitting exercises, low-impact aerobics, traditional dance movements, walking and organised sports. Cooking sessions were tailored to the particular dietary preferences of each Islands group <i>Group 2: Control</i> No education programme	Diabetes knowledge; weight; WC; readiness to change weight	Quality = poor. Did not adjust for baseline characteristics when assessing the effect of the intervention; small sample size
Brown <i>et al.</i> (2007) <sup>(16)</sup>	RCT Mexicans aged 35–70 years with T2DM Texas, USA	216	<i>Group 1: Intervention</i> Group diabetes education session and support group – 26 sessions and 52 h, i.e. 24 h of education and 28 h of support groups (extended programme). Group sessions were delivered by Spanish bilingual nurses, dietitians and community workers covering: (i) weekly instructional sessions on nutrition, home glucose monitoring, exercise and self-care; (ii) support group to promote behaviour change through problem solving, goal setting and food preparation <i>Group 2: Control</i> Compressed programme: eleven sessions (eight weekly sessions and three strategically placed support sessions), 22 h, i.e. 16 h of education and 6 h of support group	Barriers; benefits; control; job impact; support; HbA <sub>1c</sub>	Quality = good. Adequate sample size, robust power analysis and adjusted for baseline characteristics
Griffiths <i>et al.</i> (2005) <sup>(17)</sup>	RCT Bangladeshi migrants with chronic diseases; 70% diabetes General practices or community centres; East London, UK	462	<i>Group 1: Intervention</i> The intervention comprised six weekly 3 h sessions and took place in general practices or community health. The six sessions covered topics that included symptom management, communication with health professionals, managing medication, exercise and decision-making <i>Group 2: Control</i> No education programme	Self-efficacy; self-management behaviour; communication, depression scores; health-care use	Quality = good. Adequate sample size and robust power analysis
Baradaran <i>et al.</i> (2006) <sup>(22)</sup>	RCT South Asians – Pakistani (n 85) & Indian (n 33); white (n 27) comparison group, all adults Day care centres and general practices; Glasgow, Scotland	145	<i>Group 1: Intervention</i> Group education – lectures and group discussions consisting of three sessions, one dietitian-led session of about 1 h duration and one podiatrist-led session of about 1.5 h duration The format of the educational programme was based on group education, the size of each group being between six and twelve The educational intervention was carried out in day care centres and in general practice surgeries <i>Group 2: Two control groups</i> Ethnic (randomly assigned) and white (non-randomly assigned) control group: no intervention	Knowledge; attitude towards seriousness; attitude towards complications and practice	Quality = poor. The analysis relied on paired <i>t</i> tests to examine outcomes by comparing baseline and follow-up assessment without adjusting for baseline characteristics

Table 2 Continued

Reference	Design, population and setting	Sample size	Intervention	Outcome measure(s)	Study quality and limitations
Uitewaal <i>et al.</i> (2005) <sup>(23)</sup>	Prospective controlled study Turkish T2DM adults aged <75 years General practices; Rotterdam, Netherlands	104	<i>Group 1: Intervention</i> Education sessions – the individual sessions consisted of four sessions with the educator and patient together and three ‘triangle’ sessions with the GP, educator and patient present, to discuss the 3-monthly assessment of the glycaemic control and cardiovascular risk factors Patients were encouraged to have one of the individual sessions with the dietitian and one with the partner present, although this was not obligatory <i>Group 2: Control</i> No education programme	Glycaemic control; cardiovascular risk factors	Quality = good. Adjusted for baseline characteristics and acceptable sample size
Davis <i>et al.</i> (2007) <sup>(24)</sup>	Comparative study Adolescent (12–17 years) female Latinas Homes and classrooms; Los Angeles, USA	30	Comparative study of two interventions: a 90 min individualised home-based format v. a group classroom-based format. The study did not use a control group	Weight; BMI; total lean tissue mass; total cholesterol; dietary intake	Quality = poor. Small sample size and short follow-up period
Lujan <i>et al.</i> (2007) <sup>(21)</sup>	RCT Mexican-American adults with T2DM Catholic faith-based clinic; Texas–Mexico border, USA	149	<i>Group 1: Intervention</i> Eight weekly, 2 h, culturally appropriate participative group classes (English and Spanish) + biweekly telephone follow-up + biweekly distribution of inspirational faith-based health behaviour change postcards for 16 weeks <i>Group 2: Control</i> Received usual care: one-on-one patient education (verbal information + one or two pamphlets on diabetes self-management skills)	HbA <sub>1c</sub> ; diabetes knowledge; diabetes health beliefs	Quality = poor. Poor adjustment of baseline characteristics when assessing the effect of the intervention. In addition, participants who missed more than two of the eight classes or did not complete at least three data collection interviews ( <i>n</i> 18) were discarded, but it was not clear how significantly different they were from those who completed the study
Spruijt-Metz <i>et al.</i> (2008) <sup>(25)</sup>	Pair-matched cluster randomised Middle-school girls of Latina background; mean age 12·5 years School members of California Board of Education and the Catholic Archdiocese, USA	459	<i>Group 1: Intervention</i> Four schools for the intervention: received media-based physical activity intervention in class sessions for five (longer sessions) to seven (shorter sessions) consecutive school days and three for the control Students received material on physical activity and sedentary behaviours + learning activities (print or verbal, e.g. physical activity fact sheets distributed and discussed) to increase physical activity and reduce sedentary behaviours Intervention schools also developed animated Public Service Announcements (created by a team of seven to ten children in each intervention school) <i>Group 2: Control</i> Three schools for the control group: no intervention	BMI; total energy expenditure; % body fat	Quality = poor. Geographically convenient sample of modest size; intervention poorly described, e.g. the follow-up period not clear and poorly described; inadequate analysis, did not tease out which study component(s) made a difference or impacted on BMI and body fat; low participation rate, only 136/246 (55%) girls in the intervention schools participated; units of outcome measures poorly described

Table 2 Continued

Reference	Design, population and setting	Sample size	Intervention	Outcome measure(s)	Study quality and limitations
Brown <i>et al.</i> (1996) <sup>(20)</sup>	Non-equivalent control group Greek-Australian women (aged 35–65 years), members of Greek Orthodox church Greek Orthodox church; New South Wales, Australia	48	<i>Group 1: Intervention</i> The first 12 weeks included attending a weekly group meeting at the church and an exercise programme which was provided in a written booklet encompassing a 12-week programme of low-to-moderate intensity aerobic exercise Exercise frequency and duration increased from three sessions, each of 9 min of walking, in the first week, to four sessions of 45 min each in the final week. The booklet was written in English At the weekly group meeting, the migrant health worker supplemented the booklet with verbal translations and participants were encouraged to make their own notes in their preferred language. The weekly group meeting also included a 2 h discussion where participants reported on their exercise activities during the previous week and identified barriers to exercise Strategies for dealing with these barriers were discussed. The discussion covered dietary materials where women were encouraged to identify sources of saturated fat in their own diets, to modify traditional high-fat Greek and Australian recipes, and to bring in samples of modified foods for the group to taste <i>Group 2: Control</i> No intervention	BMI; total skinfold thickness; WHR; SBP; DBP; serum lipids; food habits score	Quality = poor. Very small sample size; convenience control group (recruited by word of mouth); baseline characteristics not adjusted for at follow-up, especially as the two groups differed significantly at baseline in terms of physical activity, fitness and resting BP
Bell <i>et al.</i> (2001) <sup>(18)</sup>	Quasi-experimental design (pair matched) Samoan church members aged >20 years Church-based; New Zealand	471	<i>Group 1: Intervention church</i> Promotion of low-fat <i>ad libitum</i> diets: thirty-one sessions of 1 h duration addressing the nutrition education components (healthy eating), nine of which were held in the church in the context of a healthy feast (serving culturally appropriate fruits, with emphasis on fruit and vegetables). Targeted families, caterers and the church as a whole. Sessions delivered by Pacific Island Heartbeat Physical activity: weekly aerobic sessions built into regular programme of church activities + walking groups + newsletters and diabetes support group to support the nutrition and exercise sessions. Trained instructors conducted the aerobic sessions: 170 sessions over the study period, with twenty-three people attending each session Training church leaders to become leaders of nutrition education and aerobic sessions <i>Group 2: Control church</i> No intervention	BMI; BP; nutrition knowledge; leisure-time activity	Quality = good. Adequate sample size and baseline characteristics adjusted for at follow-up. Did not tease out the direct effect of intervention components. The control and interventions churches were in the same geographic location, hence risk of contamination between control and intervention churches. There was a considerable number lost to follow-up and this was pronounced in the control group

Table 2 Continued

Reference	Design, population and setting	Sample size	Intervention	Outcome measure(s)	Study quality and limitations
Hawthorne (2001) <sup>(19)</sup>	RCT Pakistani migrant women (adults), with T2DM Primary community health-care setting; Manchester, UK	105	<b>Group 1: Intervention arm</b> Pictorial flashcards in a one-to-one interview + health education covering the following domains: appropriate diabetes diet, value of glucose monitoring, diabetes complication and services available in primary care setting. Health education sessions were delivered by trained bilingual workers in Urdu and Punjabi <b>Group 2: Control</b> No intervention	HbA <sub>1c</sub> ; diabetes knowledge	Quality = poor. Intervention poorly described in terms of frequency and intensity of intervention components. The analyses could not depict the direct effect of the intervention components. Baseline characteristics not controlled for when assessing the programme effect

RCT, randomised controlled trial; T2DM, type 2 diabetes mellitus; GP, general practitioner; PBC, perceived behavioural control; HbA<sub>1c</sub>, glycated haemoglobin; WC, waist circumference; HC, hip circumference; WHR, waist:hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; BP, blood pressure.

Samoan and Tongan people, respectively. The study found that diabetes knowledge increased significantly in both intervention churches when compared with the control church, but more so among Samoans (2-year change in open knowledge score: +46 (SD 26) % *v.* +4 (SD 17) % for Samoans; +19 (SD 24) % *v.* +8 (SD 25) % for Tongans;  $P < 0.001$ ). While there was an improvement in weight, waist circumference and physical activity in the Samoan intervention, no significant change was seen in either control church or the Tongan intervention church. In this study, baseline characteristics were not adjusted for when establishing the effect of the intervention. As in Simmons *et al.*'s previous study<sup>(14)</sup>, this study also suffered from a small sample size and spill-over effects.

Brown *et al.*<sup>(16)</sup> compared the effect of two culturally competent diabetes self-management interventions on the health beliefs of Mexicans in America. Analyses of covariance in which the baseline values and the 3-month values were used as covariates were conducted to examine the 3- and 12-month outcomes, respectively. After 12 months of intervention, health belief scores improved from baseline for both the compressed intervention (control of effect of diabetes: +0.3,  $P < 0.01$ ) and the longer and extended intervention (control of effect of diabetes: -0.4,  $P < 0.01$ ; barriers to taking medication: +0.2,  $P < 0.05$ ; benefit of therapy: +0.2,  $P < 0.05$ ). There was an improvement in HbA<sub>1c</sub> for the extended programme (-1.0,  $P < 0.05$ ). Individuals with higher intervention attendance reported greater control over diabetes, and high control scores were associated with low HbA<sub>1c</sub>, explaining 13.1% of the variance in HbA<sub>1c</sub> ( $P < 0.001$ ). The sample size was acceptable and the study used robust power analysis, adjusting for baseline differences.

Griffiths *et al.*<sup>(17)</sup> conducted a 4-month randomised controlled trial to examine the effectiveness of a culturally adapted, lay-led, self-management programme for Bangladeshi adults with diabetes and other chronic diseases (CVD, asthma and arthritis) in the UK. The intervention comprised six weekly education sessions, each of 3 h duration. The intention-to-treat analysis showed that the programme improved self-efficacy (effect size, *i.e.* adjusted difference in means: 0.67; 95% CI 0.08, 1.25;  $P = 0.025$ ) and self-management behaviour (effect size: 0.53; 95% CI 0.01, 1.06;  $P = 0.047$ ). Attending three or more sessions had greater impact than attending fewer sessions, with greater improvements in self-efficacy (effect size: 1.47; 95% CI 0.50, 1.82;  $P < 0.001$ ), self-management behaviour (effect size: 1.16; 95% CI 0.50, 1.82;  $P = 0.047$ ) and depression scores (effect size: -0.34; 95% CI -1.22, -0.07;  $P = 0.028$ ). The sample size was acceptable and the study used robust power analysis, adjusting for baseline differences.

Bell *et al.*<sup>(18)</sup> undertook a study to promote weight loss in Samoan church communities through an exercise programme and nutrition education. Using a quasi-experimental design, the study involved three non-randomised Samoan church communities (two intervention churches,

**Table 3** Summary of intervention outcomes by setting and number of intervention components

Outcome measures	Setting	No. of intervention components	Findings	Reference
Reported changes: between-group differences				
BMI, total skinfold thickness, % body fat	Church-based	2+	+	14, 15, 18, 20, 21
Blood pressure, physical activity, aerobic fitness	Church-based	2+	+	14, 15, 18, 20, 21
Nutrition and diabetes knowledge, HbA <sub>1c</sub>	Church-based	2+	+	14, 15, 18, 20, 21
Nutrition and diabetes knowledge, HbA <sub>1c</sub>	Primary health/ community care	2+	+	13, 16, 19
Improved self-efficacy, self-management behaviour	Primary health/ community care	1 only	+	17
No reported changes: no differences between groups				
No differences in all included study outcome measures	Primary health/ community care	1 only	0	22, 23
	School-based	2+	0	24, 25

HbA<sub>1c</sub>, glycated haemoglobin; 0 = intervention did not make a difference to outcome measures; + = intervention had an impact on outcome measures.

*n* 365; one control church, *n* 106) in Auckland, New Zealand. The intervention churches received aerobics sessions and nutrition education over a year. No changes were observed over time in the intervention churches in terms of knowledge about how to reduce the fat content of meals (e.g. diluting coconut milk, removing fat from meat or skin from chicken or eating vegetables frequently). However, the proportion of participants undertaking vigorous physical activity increased by 10% in the intervention churches but declined by 5% in the control church ( $P=0.007$ ). BMI decreased by 0.2 kg/m<sup>2</sup> (from 34.8 to 34.6 kg/m<sup>2</sup>) in the intervention churches compared with an increase of 0.4 kg/m<sup>2</sup> (from 34.3 to 34.7 kg/m<sup>2</sup>) in the control group ( $P=0.046$ ). No group difference was found over time for waist circumference and blood pressure after adjusting for baseline characteristics.

The study by Hawthorne<sup>(19)</sup> assessed the effect of culturally appropriate health education on glycaemic control and diabetes knowledge among Pakistani migrant women (*n* 105) in Manchester, UK, using a randomised controlled trial. The intervention arm received one-to-one education on diabetes care for 6 months. Diabetes knowledge increased significantly in both the control and intervention groups. The proportion of women in the intervention with knowledge related to diabetes complications increased from 23% to 86% for eye problems, from 28% to 82% for heart-related issues and from 7% to 74% for feet-related issues, while food knowledge score increased from 71% to 85% (all  $P<0.05$ ). Changes were also evident in the control group in terms of knowledge about diabetes complications (eye problems, +4%; feet-related complications, +17%) and food knowledge score (+4%). Changes in the intervention group were significantly higher than those in the control group ( $P<0.05$ ). In the intervention group, the mean HbA<sub>1c</sub> varied from 8.9 (SE 0.3) % to 8.3 (SE 0.3) % and such change was more pronounced in literate than illiterate women. In contrast, HbA<sub>1c</sub> remained constant in the control group (from 8.8 (SE 0.3) % to 8.7 (SE 0.3) %),  $P>0.05$ .

Brown *et al.*<sup>(20)</sup> used a non-equivalent control group to examine the impact of a minimal intervention heart health

programme in a sample of Greek migrant women (*n* 48) attending a Greek Orthodox church in Australia. The intervention consisted of exercise and dietary modification. For the intervention group, there was a significant reduction in BMI (from 29.4 to 27.6 kg/m<sup>2</sup>;  $P<0.001$ ), total skinfold thickness (from 115.4 to 109.9 mm;  $P<0.001$ ), proportion of body fat derived from skinfold measurements (from 41.8% to 40.1%;  $P<0.001$ ), diastolic blood pressure (from 87.1 to 79.3 mmHg;  $P<0.001$ ) and aerobic fitness as measured by the exercise heart rate (from 114.2 to 100.2 beats/min;  $P<0.001$ ). There was no effect on food habits scores, serum lipids, systolic blood pressure and waist:hip ratio. There was no change in any of the outcome measures over the follow-up time for the comparison group.

Lujan *et al.*'s<sup>(21)</sup> randomised controlled trial aimed to determine the effectiveness of an intervention led by *promotoras* (community lay workers) on the glycaemic control, diabetes knowledge and diabetes health beliefs of Mexican-Americans (*n* 149) with T2DM living in a major city on the Texas–Mexico border. The intervention was delivered through Catholic faith-based clinics and behaviour change postcards. Mean HbA<sub>1c</sub> decreased in the intervention group and increased in the control group at 3 months post baseline, but the differences were significant and more pronounced at the 6-month assessment (decreased by 46%, from 8.21 (SD 2.2) % to 7.76 (SD 1.87) %, in the intervention group *v.* increased by 30%, from 7.71 (SD 1.49) % to 8.01 (SD 1.8) %, in the control group;  $P<0.001$ ). The diabetes knowledge mean score change did not differ at the 3-month assessment between the intervention and control groups, but was significantly higher in the intervention group (from 69.1 (SD 13.6) to 77.2 (SD 14.4)) than in the control group (from 66.9 (SD 15.2) to 65.1 (SD 21.0)) at the 6-month assessment ( $P<0.001$ ). The diabetes health belief score decreased in both groups from baseline; the difference was not significant at the 3-month assessment but significantly different at the 6-month assessment (from 56.4 (SD 12.2) to 54.6 (SD 8.4) in the intervention group *v.* from 57.0 (SD 10.6) to 50.8 (SD 13.6) in the control group;  $P<0.01$ ).

### **Features of interventions that work**

In summary, seven successful interventions out of ten (70%) showed significant improvement in addressing diabetes and diabetes-related behaviours (glycaemic control). Six out of the thirteen studies (46%) incorporated anthropometric data, physical activity and healthy eating as ways to minimise weight gain and diabetes-related outcomes. Of the six interventions that included anthropometric data, only two (33%) reported improvement in BMI Z-scores, total skinfold thickness or proportion of body fat. Only one in three (33%) of the studies that included cardiovascular risk factors reported improvement in diastolic blood pressure after adjusting for baseline characteristics.

Interventions that showed improvement had something in common: the application of a cultural competence framework and cultural leverage. That is, they used community participants' expertise and social structures both to define strategies for addressing culture-related factors and to shape the intervention. For example, in the study by Gucciardi *et al.*<sup>(13)</sup>, the control and intervention emphasised cultural and linguistic competence. Regardless of education format, there was an improvement in outcome measures because patients were more comfortable with the classes being taught in their language and incorporating cultural norms. Similarly, Brown *et al.*<sup>(16)</sup> used group sessions offered in Spanish and facilitated by Mexican-American nurses, dietitians and community workers as well as Spanish-language educational materials. In the same line of reasoning, Griffiths *et al.*<sup>(17)</sup> successfully utilised Bangladeshi tutors of the same sex as the programme group in a lay-led self-management programme. The culturally adapted programme improved participant self-efficacy to control chronic disease and increased the use of self-management skills. Lujan *et al.*<sup>(21)</sup> also used trained, bilingual lay workers to implement a culturally competent diabetes education programme which resulted in decreased HbA<sub>1c</sub> and increased diabetes knowledge.

In contrast, Simmons *et al.*<sup>(14)</sup> focused on community social structures where the community church was utilised as the intervention setting because the church is recognised as the social centre for the Western Samoan and Tongan cultures. The intervention was culturally tailored and held as part of church services, utilising translated and culturally relevant and tested educational tools. The follow-up study<sup>(15)</sup> found that participation in the intervention by the Tongan participants was less than that of the Samoan participants, suggesting that the role of community social structures as mediating influences in population-based interventions is important for success. Use of the culturally tailored and appropriate nutrition and exercise intervention resulted in decreased BMI and increased intensity of leisure-time activity, but had little impact on nutrition-related behaviours<sup>(18)</sup>. Programmes that apply practical tools and seek to overcome socio-cultural (using existing community social groups

and networks and run in familiar settings) and linguistic barriers maximise participation and adherence to activities, and result in greater health outcomes<sup>(20)</sup>.

### **Interventions not reporting significant effects**

Four studies that reported no significant effect on obesity-related health issues were reviewed. Baradaran *et al.*<sup>(22)</sup> conducted a study with South Asians in Scotland to determine the effectiveness of a diabetes education programme. Participants, who were mainly Pakistani (72%) and Indian (23%) with diabetes and over the age of 30 years, were randomly allocated to two groups: one ethnic intervention group (*n* 59) and one ethnic control group (*n* 59). A third group of white people (*n* 27) served as a control group. Since patients had different religions and came from different cultures, three programmes were implemented for women only, two programmes for men only, and one programme for mixed gender. A total of eighteen educational sessions on diabetes management were offered in each programme as part of the intervention. On completion of the intervention all mean scores for both the intervention group and the control group were significantly higher. The study found that the intervention group showed significant improvements in scores for knowledge (+12.5%), attitudes towards seriousness of diabetes control (+13.5%), complications (+8.1%), and health and diabetes practice (+20.0%). However, there were also changes in the ethnic and white control groups but the differences in improvement between these two control groups were not significant. The study had a small sample size and the analysis did not adjust for baseline characteristics.

In The Netherlands, Uitewaai *et al.*<sup>(23)</sup> conducted a prospective controlled study to examine the effect of a diabetes education programme on glycaemic control and cardiovascular risk factors in Turkish T2DM patients. Participants were offered seven individual educational sessions and three group sessions or routine care, and glycaemic control and cardiovascular risk factors were used as outcome measures. After 1 year of the intervention there were no significant differences in glycaemic control (HbA<sub>1c</sub> and fasting plasma glucose) between the intervention and control groups. A significant decrease in HbA<sub>1c</sub> was observed in women with HbA<sub>1c</sub> > 7% at baseline but not in the other subgroups studied. Serum lipid concentrations, blood pressure and BMI remained unchanged in the intervention group. Although the study adjusted for baseline characteristics, the sample size was too small and inadequate to detect any differences between the two groups.

Davis *et al.*<sup>(24)</sup> conducted a study of twenty-three female 12- to 17-year-old Latinos in the USA. Two versions of a 12-week carbohydrate nutrition intervention were compared in relation to dietary, physiological and metabolic effects. One version of the intervention was disseminated via an individualised home-based format

(*n* 11) while the other was delivered in a group classroom-based format (*n* 12). Repeated-measures analyses of covariance were used after controlling for covariates and baseline characteristics. Mixed modelling showed no significant differences in changes in dietary intake between intervention groups, but both groups significantly reduced their intake of added sugar, sugary beverages and refined carbohydrates by 33%, 66% and 35%, respectively, while dietary fibre consumption increased significantly by 44% ( $P < 0.01$ ) throughout the 12 weeks. There was a significant time effect for BMI Z-scores within each intervention group ( $P < 0.05$ ), exhibiting significant improvements (Z-score decreased by 0.1 in each of the interventions). There was no significant time by intervention group interaction for any of the physiological or metabolic variables, indicating that change over time was not significantly different between intervention groups. The lack of difference between the two groups may have been due to the small sample size.

Spruitj-Metz *et al.*<sup>(25)</sup> undertook a school-based intervention to increase physical activity and decrease sedentary behaviours using a pair-matched cluster randomised design in predominantly Latino middle-school girls (*n* 459; mean age 12.5 years). The intervention involved media-based physical activity in class for five (longer sessions) to seven (shorter sessions) consecutive school days. Students received materials on physical activity (print or verbal, e.g. physical activity fact sheets distributed and discussed) and sedentary behaviour learning activities. Students in the intervention also developed animated Public Service Announcements (created by a team of seven to ten children in each intervention school). The control group received no intervention. Outcome measures included BMI, total energy expenditure and percentage body fat. Hierarchical regression model using changes in outcome measures over the follow-up period suggested that the intervention had a significant effect on reducing time spent on sedentary behaviours ( $-0.27$  (SE 0.14),  $P < 0.05$ ). The intervention did not have any effect on BMI percentiles or Z-scores ( $P = 0.27-0.49$ ), percentage body fat ( $P = 0.86$ ) or total energy expenditure ( $P > 0.05$ ).

## Discussion

We searched for evidence that interventions tailored specifically to particular immigrant groups from developing to developed countries decrease the risk of obesity and obesity-related diseases. We found thirteen studies that met our inclusion criteria. The analyses of these studies suggested that a number of factors may contribute to successful outcomes. Interventions that were tailored to the cultural needs of the target population in terms of cultural norms, attitude and beliefs<sup>(13)</sup>, and that were implemented within the community setting and utilised translated and culturally relevant educational tools, and

community-based trained diabetes and physical activity educators<sup>(14-16,23)</sup>, showed greater improvements in diabetes-related behaviours and glycaemic control, and in making changes in dietary and exercise patterns. The interventions' effect on anthropometric outcomes such as BMI or waist:hip ratio was negligible or non-existent, and this may have been due to the relatively short follow-up periods. Notwithstanding this, the impact on diabetes was greater in interventions that encompassed multiple strategies, and studies that did not find any impact on diabetes had sample sizes too small to be able to detect any difference between the intervention and the control groups.

The findings suggest that community social structures are important mediating influences in migrant population-based interventions for diabetes and diabetes-related problems. The emphasis on culturally relevant group interventions and community structures in addressing diabetes is consistent with the literature<sup>(26,27)</sup>, and the positive impact could be due the fact that participants were more comfortable with the classes being taught in their language and incorporating cultural norms. However, given that three out of the seven studies showing an impact used small sample sizes and failed to adjust for baseline differences, the observed evidence can be described as limited. Although most of the studies with small sample sizes and failure to control for baseline characteristics found an intervention effect on diabetes regardless of the education format, in a relatively unbiased group intervention offered in Spanish and facilitated by Mexican-American nurses, dietitians and community workers, Brown *et al.*<sup>(16)</sup> reported a different pattern. These authors incorporated increased nutritional content and Spanish-language educational materials, as well a larger number of hours in instructional and group sessions. They found that, when the interventions were implemented over an extended period of time and with increased content, the dose effect of the intervention seemed to underlie the programme success.

That the present review is based only on a small number of studies that met the inclusion criteria underlines the paucity of data in this very important research area, and hence the need for more investigations. Future research must involve large numbers of participants from immigrant backgrounds and should ensure that adequate control groups are included, and that spill-over effects are minimised. Interventions that include anthropometric outcomes also need to be of longer duration and intensity to be able to observe a trend in outcomes. However, the reviewed papers provide a base on which to build studies that will identify low-cost, effective health promotion programmes that can be included in large community-based interventions. What has been adequately described in these studies is the format and the intensity of the intervention delivery, the uptake of the intervention and the training of the individuals involved with intervention

delivery. What is missing and requires further evaluation includes the most appropriate method for recruiting migrant populations, the duration of the intervention, and follow-up approaches.

### Study limitations

The present review has some limitations worth outlining. Although our main interest for inclusion was randomised control trials, 'quasi-randomised' trials or controlled before-and-after studies, the included studies varied considerably in terms of design, follow-up period, outcome measures, target population and setting, making synthesis of results and comparison of outcomes across studies difficult. Hence, it was impossible to measure whether observed changes in diabetes behaviours, glycaemic control, and dietary and exercise patterns were of clinical, not just statistical, significance.

The current systematic review did not include articles published in a language other than English because the research team did not have adequate linguistic skills and competence in other languages. It is possible that there may be other studies published in other languages that could shed further light on the issue investigated herein. Further information might also be elicited through expert opinion. It is also important to note that studies without positive outcomes tend to be harder to get published, so the literature available may not represent all of the knowledge generated by research.

### Conclusion

Although the literature on interventions tailored specifically to immigrant groups targeted at obesity and related health concerns is limited, there are clear messages from the articles reviewed. Culturally tailored and language-specific educational programmes are more likely to engage participants and result in more efficacious outcomes if designed well. The findings that culturally tailored and facilitated interventions aimed at diabetes among immigrants provide increased outcome measures in the target culture compared with generalised interventions, and that intervention content is more important than the duration or venue of the intervention, require further investigation. Any obesity and chronic disease-related intervention to be aimed at a particular immigrant group needs to be culturally competent and research should be done into the cultural expectations, beliefs, behaviours and practices of the target group, which should be taken into account when designing the intervention programme.

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### References

1. Australian Institute of Health and Welfare (2003) *A Picture of Diabetes in Overseas-born Australians*. Bulletin no. 9. Canberra: AIHW.
2. Renzaho A, Gibbons K, Swinburn B, Jolley D & Burns C (2006) Obesity and under nutrition in sub-Saharan African immigrant and refugee children in Victoria, Australia. *Asia Pac J Clin Nutr* **15**, 482–490.
3. Landman J & Cruickshank J (2001) A review of ethnicity, health and nutrition-related diseases in relation to migration in the United Kingdom. *Public Health Nutr* **4**, 647–657.
4. Saleh A, Amanatidis S & Samman S (2002) The effect of migration on dietary intake, type 2 diabetes and obesity: the Ghanaian Health and Nutrition Analysis in Sydney, Australia (GHANAISA). *Ecol Food Nutr* **41**, 255–270.
5. Cooper RS, Rotimi C, Ataman S *et al.* (1997) The prevalence of hypertension in seven population of West African origin. *Am J Public Health* **87**, 160–168.
6. Cooper RS, Rotimi CN, Kaufman JS, Owoaje EE, Fraser H, Forrester T, Wilks R, Riste LK & Cruickshank JK (1997) Prevalence of NIDDM among populations of the African Diaspora. *Diabetes Care* **20**, 343–348.
7. Cohen M, Stern E, Rusecki Y & Zeidler A (1988) High prevalence of diabetes in young adult Ethiopian immigrants to Israel. *Diabetes* **37**, 824–828.
8. Bursztyjn M & Raz I (1993) Blood pressure, glucose, insulin and lipids of young Ethiopian recent immigrants to Israel and in those resident for 2 years. *J Hypertens* **11**, 455–459.
9. Pawson I, Martorell R & Mendoza F (1991) Prevalence of overweight and obesity in US Hispanic populations. *Am J Clin Nutr* **53**, 6 Suppl., 1522S–1528S.
10. Dijkshoorn H, Nierkens V & Nicolaou M (2008) Risk groups for overweight and obesity among Turkish and Moroccan migrants in The Netherlands. *Public Health* **122**, 625–630.
11. Misra A & Ganda O (2007) Migration and its impact on adiposity and type 2 diabetes. *Nutrition* **23**, 696–708.
12. Egger M, Smith GD & Altman DG (2001) *Systematic Reviews in Health Care. Meta-analysis in Context*. London: BMJ Books.
13. Gucciardi E, DeMelo M, Lee R & Grace S (2007) Assessment of two culturally competent diabetes education methods: individual versus individual plus group education in Canadian Portuguese adults with type 2 diabetes. *Ethn Health* **12**, 163–187.
14. Simmons D, Fleming C, Voyle J, Fou F, Feo S & Gatland B (1998) A pilot urban church-based programme to reduce risk factors for diabetes among Western Samoans in New Zealand. *Diabet Med* **15**, 136–142.
15. Simmons D, Voyle J, Fou F, Feo S & Leakehe L (2004) Tale of two churches: differential impact of a church-based diabetes control program among Pacific Islands people in New Zealand. *Diabet Med* **21**, 122–128.
16. Brown S, Blozis S, Kouzekanani K, Garcia A, Winchell M & Hanis C (2007) Health beliefs of Mexican Americans with type 2 diabetes. *Diabetes Educ* **33**, 300–308.
17. Griffiths C, Motlib J, Azad A *et al.* (2005) Randomised controlled trial of a lay-led self-management programme for Bangladeshi patients with chronic disease. *Br J Gen Pract* **55**, 831–837.
18. Bell AC, Swinburn BA, Amosa H & Scragg RK (2001) A nutrition and exercise intervention program for controlling

- weight in Samoan communities in New Zealand. *Int J Obes Relat Metab Disord* **25**, 920–927.
19. Hawthorne K (2001) Effect of culturally appropriate health education on glycaemic control and knowledge of diabetes in British Pakistani women with type 2 diabetes mellitus. *Health Educ Res* **16**, 373–381.
  20. Brown W, Lee C & Oyomopito R (1996) Effectiveness of a bilingual heart health program for Greek-Australian women. *Health Promot Int* **11**, 117–125.
  21. Lujan J, Ostwald SK & Ortiz M (2007) Promotora diabetes intervention for Mexican Americans. *Diabetes Educ* **33**, 660–669.
  22. Baradaran H, Knill-Jones R, Wallia S & Rodgers A (2006) A controlled trial of the effectiveness of a diabetes education programme in a multi-ethnic community in Glasgow. *BMC Public Health* **6**, 134.
  23. Uitewaal P, Voorham A, Bruijnzeels M, Berghout A, Bernsen RM, Trienekens PH, Hoes AW & Thomas S (2005) No clear effect of diabetes education on glycaemic control for Turkish type 2 diabetes patients: a controlled experiment in general practice. *Netw J Med* **63**, 428–434.
  24. Davis J, Ventura E, Alexander K, Salguero LE, Weigensberg MJ, Crespo NC, Spruijt-Metz D & Goran MI (2007) Feasibility of a home-based versus classroom-based nutrition intervention to reduce obesity and type 2 diabetes in Latino youth. *Int J Pediatr Obes* **2**, 22–30.
  25. Spruijt-Metz D, Nguyen-Michel ST, Goran MI, Chou CP & Huang TT (2008) Reducing sedentary behavior in minority girls via a theory-based, tailored classroom media intervention. *Int J Pediatr Obes* **3**, 240–248.
  26. Utz SW, Williams IC, Jones R, Hinton I, Alexander G, Yan G, Moore C, Blankenship J, Steeves R & Oliver MN (2008) Culturally tailored intervention for rural African Americans with type 2 diabetes. *Diabetes Educ* **34**, 854–865.
  27. Norris SL, Nichols PJ, Caspersen CJ *et al.* (2002) Increasing diabetes self-management education in community settings: a systematic review. *Am J Prev Med* **22**, 39–66.