

May 29. 2018: WP4: Deliverable 9

D4.3 Final report intervention elements

OPTIMIZING STRATEGIES FOR PREVENTION OF TYPE 2 DIABETES AMONG SOUTH ASIANS LIVING IN EUROPE

Background

Health-related interventions should be increasingly diversity-sensitive, but the need for adapting specific interventions to immigrants remains also unmet (1). Specifically, adapted health interventions targeting diseases for which there is high prevalence among a given immigrant group and when the behaviour to be changed is closely linked to their socio-cultural values, are often needed.

More than five million people of South Asian origin are living in Europe today. Although the South Asian population is diverse and includes people from India, Pakistan, Afghanistan, Bangladesh, Nepal, Bhutan, Maldives and Sri Lanka, a common feature for people with South Asian origin is their high risk of developing Type 2 Diabetes (T2D) at a younger age and at a lower body weight than White European-origin populations. This risk seems to further increase when South Asians migrate to European countries (2), partly because of changes in lifestyle behaviors and nutritional transitions, resulting in physical inactivity and a shift away from traditional dietary habits to more diabetogenic diets (3). Therefore, the prevention of T2D in this population is a priority in terms of the potential avoidable health burden and the health expenditures. However, engaging South Asian participants in lifestyle interventions promoting healthy behaviour has proved challenging in several European studies, and the effects of such interventions in Europe seem to be more modest than for the European-origin population (4). For these reasons, finding the best way to adapt interventions to prevent and treat diabetes among immigrants of South Asian origin to the individual socio-cultural background is necessary to reduce health inequalities and provide effective health care (5).

In order to learn from the experience gained during previously conducted studies aiming to decrease the risk of T2D among South Asians, several work packages (WP) within the EuroDHYAN project were designed to gain an in-depth insight into existing health promotion strategies aimed at promoting healthy diet and physical activity in this particular populations. In an attempt to ascertain which elements contribute to the acceptability, reach, and effectiveness for interventions designed to prevent T2D within South Asian origin people living in Europe, we first described the state-of-art of such health promotion strategies and identified the descriptive gaps in the literature in WP 4.1. Following , a meta-analyses of relevant studies was conducted in WP 4.2. Building upon knowledge gained in WP 4.1, key researchers from different studies were identified and interviewed to obtain more detailed information about their experience regarding effective intervention elements that should be kept, as well as elements that needed to be changed.

Specifically, we sought answers to the following research questions:

1. Which intervention elements that were applied in the behavioural interventions aimed at promoting a healthy diet were key to their success, in terms of reach, acceptability and effectiveness?
2. Which intervention elements applied in these behavioural interventions did not contribute to their effect?
3. How did these patterns differ between the different subgroups and contexts (like age, ethnicity, socioeconomic status, etc)?

The answers to these questions will enable us to make specific recommendations for targeted strategies to effectively reach South Asian-origin populations in preventive interventions to reduce their T2D risk.

Design, methods and analysis

Within WP 4, several steps leading to a better understanding of the acceptability and effectiveness of current intervention strategies were followed:

WP 4.1. A narrative synthesis of dietary and physical activity strategies to prevent type 2 diabetes in South Asian adults

A systematic search strategy was developed in collaboration with a clinical librarian from the Academic Medical Center in Amsterdam, and included PUBMED, Embase, Cochrane library and Web of Science. The search strategy was restricted by the time span (start of the database to August 2016) and language (English). Further details of the methodology used for this work can be found in Annex 1. In addition to a description of the study aims, methods, numbers and outcomes, detailed information on the interventions as described in the selected papers was gathered following a list of characteristics designed to answer the questions regarding *how* effectively change behaviour in these groups was/was not achieved. We searched the papers for information about the different intervention elements, the theoretical background for the adaptation of the intervention, the involvement of the community at the different stages of the study design, the extent to which the advice was adapted to the cultural norms, the intensity of the intervention and the involvement of the family or other social groups. As shown in Annex 1, we used both a 26-item taxonomy of behaviour change techniques (6) and a toolkit of adaptation approaches for behaviour change interventions to improve the health of racial and ethnic minority populations specifying 33 types of adaptations (7) to further classify the elements of the interventions.

WP 4.2. Effectiveness of dietary and physical activity interventions to reduce the risk of type 2 diabetes in South Asians across population subgroups: Individual participant data meta-analysis of randomized controlled trials identified in a systematic review

First, following the same systematic review described above, quality was assessed for the four European studies identified using the Quality Assessment Tool for Quantitative studies, and individual participant data for these studies were included in a meta-analysis of randomized controlled trials using fasting glucose and 2 hour-glucose as primary outcomes and weight, and waist circumference as secondary outcomes.

Second, in 2017, we planned an extended search and a new meta-analysis also including diabetes incidence as an outcome (PROSPERO registration CRD4217078003) for randomized controlled trials on life style modifications in South Asian adults worldwide. Further information on this WP can be found in Annex 2.

WP 4.3. Qualitative evaluation of intervention elements from focus group and interview data

Based on the narrative synthesis of the studies selected through the systematic review, qualitative interviews with the main researchers or projects leaders of already implemented interventions were conducted for in-depth discussion of the key elements of the culturally adapted interventions, especially regarding questions that were not well described in the published literature. Specific attention was given to the adaptations made in these interventions to serve the needs of their specific populations. Two different datasets were used in the analyses, as shown in Table 1, which also shows which studies were included in WP4.1. The first dataset consisted of a sub-sample of six interviews previously conducted on how to adapt health promotion interventions to ethnic minority population as part of the PODOSA study (8) relevant for South Asian populations and for diet and exercise. These interviews were re-analysed in the light of the finding of WP 4.1. The second dataset consisted of five new in-depth qualitative interviews conducted specifically for this project. Although cultural adaptation was not necessary for Indians living in India, we decided to include researchers from the Indian study in order to explore if there were similar “key factors” of success in intervention conducted among South Asians living in their home country as compared to as those in a migration contexts. Details of the methodology used and the interview guide specifically designed to target questions regarding the development of culturally adapted interventions that were not addressed either in the published literature or in previous interviews can be found in Annex 3.

Results

This report presents a synthesis of the results of the previously described WP 4.1, 4.2 and 4.3, with the emphasis on integration of these findings. For more detailed information about each of the packages, see Annexes 1 to 3.

The systematic search for scientific literature regarding the effectiveness of intervention strategies to bring behavioural change, in particular diet and physical activity, for prevention T2D among South Asian adults, resulted in 3269 records (Figure 1). From the 39 full-text records that were assessed for eligibility, 14 records were included in the review and description of health promotion strategies. Four studies were conducted in Europe: the PODOSA study in Scotland (9), the DHIAAN study in the Netherlands (4) and the INNVA-Dia and the PAMH studies in Norway (10, 11). Additionally, eight studies from India (12-19), one from New Zealand (20) and from USA (21) were identified. Although the primary scope for WP 4 included only the four studies conducted in Europe, in the light of the preliminary analyses, we decided to include studies conducted in US, Australia and India as well for WP 4.1 and some of them for WP 4.3 (Table 1).

Tables 1a and 1b in Annex 1 describe the characteristics of the European and Indian included studies separately. The studies were generally short, with a duration range of 6 to 36 months. Most interventions focused primarily on eating healthy diet and PA, in addition three focused on stress management as well (12, 13, 21). Among the studies in India, three studies specifically studied clinical sub-populations like those with low D-vitamin levels (19, 20) or born with low birth weight (17) and gave little insight into the development or effect of the interventions in the broader population. All studies but one (12) included adults only, and focused specifically on those with pre-diabetes (impaired fasting glucose (IFG) or impaired glucose tolerance (IGT)).

Although information about the development of the interventions was generally scarce in the published studies, the narrative study of the methodology of these trials elicited important information described in Annex 1. Recruitment and attrition levels have often been considered challenging in studies including immigrants. Two of the studies in Europe (4, 9) recruited participants from primary health care and explicitly described challenges in recruitment that resulted in lower numbers of participants than anticipated. The studies conducted in India more often recruited participants including the whole population (rural studies) or recruited at working place. Follow-up rates calculated from the study information ranged from 62 -100%, being generally higher in the studies conducted in India. Shorter studies (16, 18) and studies with fewer physical contacts between the participants and the researcher in India (15, 22) were among those with lowest attrition rates. Also the PODOSA study, including several visits, had low attrition rates, but the intervention was performed at

home, thus arguably disturbing less the life of the participants in terms of travelling and appointments (9).

Several theoretical backgrounds and strategies of health promotion for the delivery of the intervention were described, although seldom distinguished between theories supporting the need of adaptation or the theoretical bases for the development, for instance citing theories of deep and surface structure cultural adaptations in the Resnicow's early study (23) (as opposed to describing the process) and the theoretical background for behavioural change, like stages of change model or motivational interviewing. Some studies described in more detail an active inclusion of the community studied through several phases of the study (11-13, 21), while others did not include much information of the processes, probably because of space constraints typical for peer-reviewed journals.

The quality of the studies as assessed in the systematic review did not seem to be associated with their effectiveness, and none of the studies described differences in effectiveness of the interventions with regards to sub-groups such as age or gender. Clear patterns of successful elements did not appear, and the use of well-known taxonomies and classifications only partly helped us to disentangle successful or unsuccessful elements of the interventions, but helped us to identify gaps in knowledge, like the absence of theoretical frameworks to explain both the need and the development of the cultural adaptations. We also registered an overlapping of the typologies of the adaptation recommended (24). The information gathered through this exercise was however essential to prepare the interview guide for qualitative interviews of the principal investigators and other key researchers for studies in Europe and India that have improved our understanding of the development and deliveries of the interventions, as explained under.

The meta-analysis of the four studies conducted in Europe included individual participant data for 775 South Asians. The pooled results showed clinically small, but sustained effects in the intervention groups compared to controls, and differential effects for women and men for weight reduction, but there was not enough power to study diabetes incidence and contexts. The extended search in 2017 identified six eligible trials, and we were able to obtain individual participant data from all these trials, for 1816 participants, including data from the two previously identified Indian studies. Here, we found a consistent reduction in diabetes incidence (with no subgroup effect) and there was no longer a subgroup difference in weight reductions between women and men (Annex 2)

Despite the information gathered through the narrative approach, there were still a number of unsolved issues due to the lack of information presented in the publications of the referred studies. Thus, our approach in WP 4.3 was to contact the researchers to obtain previously unpublished information relating to elements in the development and implementation of the intervention that

contributed to the effectiveness or lack thereof in specific groups: from the very design of the intervention itself, to recruitment and involvement of participants and culturally adaptation of the intervention. The results of these interviews are further detailed in Annex 3 and led to the identification of seven main themes, namely: “Time”; “Approaching the community in the right way and at the right time”; “Presence of an organized community”; “Make people feel comfortable”; “Cultural adaptation”; “Theoretical framework” and “Political & Scientific Environment” (For a detailed list of themes and subthemes see Table 2 in Annex 3).

All in all, the cumulative information of the narrative review of the available studies together with the interviews analysed, confirmed several characteristics of the studies previously described (25) as key to success, like the early involvement and tight contact with the community throughout the study, the integration of existing networks and social support mechanisms through the programs. Other features that appeared from our analyses were the probably higher relevance of deep-structure adaptations as compared to surface structure ones, and the importance of considering low disruption in participants’ daily life (short time to exercise places, low cost of change diets, etc) and even moderately intense diet and exercise strategies compared to more intense ones. On the other side, time constrained seemed to be crucial and may be in relation to that, few studies had conducted quality assessment interviews with both personal and participants throughout the study to correct deviations from the protocol or non-adequate elements or include follow up evaluation after the study was finished as part of the intervention. These last strategies could have improved the effect and learning of the studies that were not successful.

Discussion

Through qualitative and quantitative perspectives, the synthesis of the three WP provided detailed insights into existing strategies aimed at promoting healthy diet and physical activity for prevention of T2D within South Asian-origin people living in Europe. Especially, we focused on the development of the interventions and intervention elements key to success or failure in addition to the cultural adaptations.

As none of the studies had high numbers of participants and with one previous study showing no effect, a question not previously answered was if the adapted interventions to reduce risk for diabetes for South Asians living in Europe were effective when pooling data from several studies. From our analyses we can conclude that the interventions achieved clinically small but sustained effects compared to controls. Also, the first meta-analyses suggested interesting differential effects for women and men that should be further investigated and taken into account in the development of future interventions. These findings were not confirmed in the extended study, however, here we found consistent and clinically important effects across subgroups on diabetes incidence.

As stated above, the quality of the studies as assessed in the systematic review was not associated with their effectiveness. Furthermore, it proved complicated to agree on a gold standard to define “good quality” in terms of the interventions themselves. With a few exceptions, a common feature of the fourteen identified studies was the lack of thorough description of the development of the interventions, including the theories and processes informing the cultural adaptations as well as the involvement of the communities and the role of the researchers both in the design and the implementation of the projects. In accordance with an earlier review (26), few papers explained how and/or why the original (‘general population’) intervention was inadequate, the adaptation design, the pilot tests conducted, or the refinement of the adaptation. Also, most studies included complex interventions and targeted both individuals and community-groups of various types without disentangling the effect of the different elements in the success or failure of the study.

However, the information gathered from the publications was useful to develop the interview guide for the interviews. Putting the information together, we were able to shed further light on our three specific research questions regarding development of the intervention and intervention elements a) considered key to success, b) probably did not contribute to their effect and c) how did these patterns differ between the different subgroups and contexts.

Development of the intervention and intervention elements key to success

Concurring with previous studies (25), according to the interviewees, early engagement and close contact over time with the community to be studied seemed to be the main key factor for success. This was included flexibility during the development of goals and the development of the intervention itself, for instance when choosing the type of physical activity or the location to implement it that suit participants best. The use of specially trained community members and community health workers and the use of natural community gathering events both for recruitment, delivery and process seemed to be positive for the effectiveness of the interventions. Furthermore, the importance of the community and of adapting interventions was further extended to the importance of a “culture for cultural adaptation” meaning the efforts needed in the involvement of local society and socio-political arenas (like municipalities) into a common agreement of the necessity of the adaptations when they challenged the ideals of equal solutions for all citizens. All these factors are naturally more challenging for studies conducted outside India and might partially explain differences in attrition and adherence to interventions among immigrants. However, differences in the content of the advices needed because of integration of new generations and availability of other products was not explored and should be further considered.

Studies that “kept it simple” and made the participants feel comfortable seem to be more effective: too much travel or many contacts might increase attrition rates, while reminders, especially through mobile telephones, seemed to be positive for effectiveness in some studies, especially in India, but might work differently in Europe. Intensive interventions appeared effective only when conducted at the home of the participants, but this strategy increased the cost of the project and was not universally welcome.

According to Resnicow et al, cultural adaptation needs to go beyond the “surface structure” of interventions and reach its “deep structure” (23). Surface structure refers to observable characteristics, as language, and was successfully targeted in all the studies. However, the deep structure, encompassing cultural, social, environmental and psychological factors were less often targeted in general, but often adequately addressed in effective studies with low attrition rates as explained under.

Development of the intervention and intervention elements that probably did not contribute to their effect

Time constraints in several modalities were often named during the interviews, making a well known issue relevant: well-designed interventions are not to be developed or implemented in a hurry. On the other hand, time investment in the earlier phases in developing of trust relationships with the community and in accommodation of the interventions to the desires and necessities of the participants can spare time in the subsequent phases. Also regarding recruitment, it appeared as if recruitment at the community level and through locally used religious and other natural meeting points worked better in terms of adherence than recruitment through health professionals. This might be especially so for prevention interventions rather than treatment interventions, as patients with diseases recruited at health centres might be more interested in participating in clinical research projects.

Although most studies referred to theories back the implementation of the intervention, nearly none of the studies justified the need for adaptation of the interventions or the theories used to adapt the interventions within the main papers. Furthermore, those who described the adaptation tended to make a description of the ideal processes and very few described the gaps between theory and practice regarding the intervention processes. With a few exceptions, barriers in the development and implementation of the projects firstly appeared in the in-depth interviews. Though understandable because of space constraints when reporting this type of studies, this lack of theoretical development diminished replicability, comparability and further development of the field towards more effective solutions.

On the other hand, theoretical knowledge and practical relationships did not necessarily come together. To some degree, studies with less theoretical reflection appeared to have had at least as

good, if not better contact with the communities. The scarcity of practical day-to-day knowledge of the individuals belonging to a community but at the same time in different stages of the acculturation processes, like second generation immigrants, could sometimes have resulted in rigid interventions, and negatively affect recruitment and permanence in the study.

Most interventions targeted individuals often with a simple presumption that education on its own would be sufficient to result in behaviour change, regardless of the multiplicity of structural vulnerability factors that are often clustered together (27) acting as barriers to effectiveness.

Regarding the living environment, although several studies invited family members to participate as a small part of the intervention, this strategy was not clearly effective, and did not work well in either the PODOSA or DHIAAN studies. Other small social groups, like the workplaces in India, or social gathering during or after physical activity for discussion in Norway seemed to better support participants in maintaining healthy behaviour. For instance, theoretical education in groups seemed to be less effective than small group discussions, especially when these are based on personal goals, if possible based on physical measurements as in one of the Norwegian studies (11). We recommend that researchers consider the importance of the community at its different levels in lifestyle changes and structural or socio-ecological as well as individual level interventions.

A lot of work was dedicated to adapt the content of the information to the target population, but most of it could be labelled as changes in the “surface structure”. A recurring statement in this regard was that the participants preferred visual and oral communication to written messages. However, the personal engagement and popularity of the personal implementing the interventions seemed to be as important as carefully translated messages. Also, compared to very elaborated adapted recommendations for dietary habits, relatively simple messages given often (by SMS) might be as effective and should be further studied.

How did these patterns differ between the different subgroups and contexts

Studies conducted in India were generally more effective and met fewer challenges than the European studies. However, no studies either in India or elsewhere stratified the results of the intervention by gender, age, social class or body weight, making other comparisons difficult. As stated previously, the pooled results of the meta-analyses, however, showed differential effects for women and men for the different outcomes. Also during the in-depth interviews, investigators reflected upon women and men probably needing different adaptations, specially taking the social roles of South Asian women (work, children, family) into account. The importance of addressing differences between first and second generations was also mentioned in the interviews.

Cost-effectiveness analyses in the field are scarce (28), and among the effective studies only the PODOSA study (9) reported such data. Last, no study assessed negative outcomes, such as stigmatization, medical mistrust or experiences of discrimination.

Limitations

Although our original aim was to elicit the effectiveness of each of the elements of the interventions, the nature of the interventions and the report of results did not allow us to reach such detail in our conclusions. We did not find a set of criteria to clearly define interventions as effective or not, as the studies had different objective outcomes and subjective degree of self-reflection regarding their own limitations especially about design and implementation of the interventions. Therefore, an important task for the next steps of the project should be to state a clear set of characteristics upon which the new elements can be evaluated.

Also, the use of both a taxonomy of behaviour change techniques (6) and a toolkit of adaptation approaches for behaviour change interventions to improve the health of racial and ethnic minority populations (7) helped only to a certain degree to classify the elements of the interventions to increase our insight into strategies to effectively reduce the risk of T2D among South Asians in Europe. Thus, multi-components interventions could not be disaggregated into their core elements, so our question on which element was effective for each study remains.

Focus group discussions with the users/ participants were planned as an additional source of information to understand the effectiveness of intervention. However, the interventions had taken place years ago, and even the researchers had to make an effort to recall the details of the projects, which can constitute a bias to our results in itself. Thus, we considered that we could not expect the participants to remember all details, or know what happened during the interventions. For this reason, we skipped this part of the data collection, while preserving the original research question. If possible, these interviews should be conducted within the exploration of new interventions in the coming work packages.

Suggestions for further work packages and future interventions

The next step in the project will be to select promising elements for future interventions and test them against criteria for success and failure within small-scale clinical experiments. For that purpose, our suggestions confirm previously identified characteristics and suggest new ones that might be considered in the next steps of the project:

1. Time

Use the necessary time and effort to build a solid relationship with the community
When possible, apply for resources over a long time span

2. Approaching the community/informants in the right way

Identify key person to be introduced in the community
When possible, include members of the same ethnic background as the study group in the research team either as researcher or as consultants
Define and plan the intervention together with the community
For preventive studies, health centres might not be adequate settings for recruitment

3. Presence of an organized community

Use as much as possible existing networks and places of encounter socialization that are important for ethnic minorities both for recruitment and implementation
Involve committed field workers, if possible from within the community

4. Make people feel comfortable

Investigate the community's preference for home/community-based interventions
Introduce small changes gradually **and taking** into consideration economical aspects

5. Cultural adaptation

Prioritize deep-structure adaptations in addition to surface structure ones
Put less effort in developing of written material but consider SMS or other electronic devices for communication. Oral and technology seem to triumph written material
Conduct less intense interventions in terms of face to face contact, but invest in reminders as preferred by the communities (phone/SMS?)
Address personal goals and, if possible, discuss at individual level and together with other members of the community in small guided groups

6. Theory

Describe the need for and the theoretical framework of the adaptation
Conduct quality assessment interviews with both personal and participants throughout the study to correct deviations from the protocol or non-adequate elements
Consider enrolling/adapting of interventions separately for women and males
Include follow up evaluation after the study is finished as part of the intervention

7. Political/Scientific Environment

Contribute to the creation of a "culture of cultural adaptation"

References

1. Razum O, Spallek J. Addressing health-related interventions to immigrants: migrant-specific or diversity-sensitive? *Int J Public Health*. 2014;59:893-5.
2. Agyemang C, Beune E, Meeks K, Addo J, Aikins AD, Bahendeka S, et al. Innovative ways of studying the effect of migration on obesity and diabetes beyond the common designs: lessons from the RODAM study. *Annals of the New York Academy of Sciences*. 2016.
3. Gujral UP, Pradeepa R, Weber MB, Narayan KM, Mohan V. Type 2 diabetes in South Asians: similarities and differences with white Caucasian and other populations. *Annals of the New York Academy of Sciences*. 2013;1281:51-63.
4. Admiraal WM, Vlaar EM, Nierkens V, Holleman F, Middelkoop BJ, Stronks K, et al. Intensive lifestyle intervention in general practice to prevent type 2 diabetes among 18 to 60-year-old South Asians: 1-year effects on the weight status and metabolic profile of participants in a randomized controlled trial. *PLoS One*. 2013;8(7):e68605.
5. Zeh P, Sandhu HK, Cannaby AM, Sturt JA. The impact of culturally competent diabetes care interventions for improving diabetes-related outcomes in ethnic minority groups: a systematic review. *Diabet Med*. 2012;29(10):1237-52.
6. Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy. *Psychol Health*. 2011;26(11):1479-98.
7. Davidson E, Liu JJ, Bhopal R, White M, Johnson MRD, Netto G, et al. Behavior Change Interventions to Improve the Health of Racial and Ethnic Minority Populations: A Tool Kit of Adaptation Approaches. *The Milbank Quarterly*. 2013;91(4):811–51.
8. Liu J, Davidson E, Bhopal R, White M, Johnson M, Netto G, et al. Adapting health promotion interventions to meet the needs of ethnic minority groups: mixed-methods evidence synthesis. *Health technology assessment*. 2012;16(44):1-469.
9. Bhopal RS, Douglas A, Wallia S, Forbes JF, Lean ME, Gill JM, et al. Effect of a lifestyle intervention on weight change in south Asian individuals in the UK at high risk of type 2 diabetes: a family-cluster randomised controlled trial. *Lancet Diabetes Endocrinol*. 2014;2(3):218-27.
10. Telle-Hjellset V, Raberg Kjollesdal MK, Bjorge B, Holmboe-Ottesen G, Wandel M, Birkeland KI, et al. The InnvaDiab-DE-PLAN study: a randomised controlled trial with a culturally adapted education programme improved the risk profile for type 2 diabetes in Pakistani immigrant women. *Br J Nutr*. 2013;109(3):529-38.
11. Andersen E, Hostmark AT, Anderssen SA. Effect of a physical activity intervention on the metabolic syndrome in Pakistani immigrant men: a randomized controlled trial. *Journal of immigrant and minority health / Center for Minority Public Health*. 2012;14(5):738-46.
12. Balagopal P, Kamalamma N, Patel TG, Misra R. A community-based diabetes prevention and management education program in a rural village in India. *Diabetes Care*. 2008;31(6):1097-104.
13. Balagopal P, Kamalamma N, Patel TG, Misra R. A community-based participatory diabetes prevention and management intervention in rural India using community health workers. *The Diabetes educator*. 2012;38(6):822-34.
14. Ramachandran A, Snehalatha C, Mary S, Mukesh B, Bhaskar AD, Vijay V, et al. The Indian Diabetes Prevention Programme shows that lifestyle modification and metformin prevent type 2 diabetes in Asian Indian subjects with impaired glucose tolerance (IDPP-1). *Diabetologia*. 2006;49(2):289-97.

15. Ramachandran A, Snehalatha C, Ram J, Selvam S, Simon M, Nanditha A, et al. Effectiveness of mobile phone messaging in prevention of type 2 diabetes by lifestyle modification in men in India: a prospective, parallel-group, randomised controlled trial. *Lancet Diabetes Endocrinol.* 2013;1(3):191-8.
16. McDermott KA, Rao MR, Nagarathna R, Murphy EJ, Burke A, Nagendra RH, et al. A yoga intervention for type 2 diabetes risk reduction: a pilot randomized controlled trial. *BMC Complement Altern Med.* 2014;14:212.
17. Madsen C, Mogensen P, Thomas N, Christensen DL, Bygbjerg IC, Mohan V, et al. Effects of an outdoor bicycle-based intervention in healthy rural Indian men with normal and low birth weight. *J Dev Orig Health Dis.* 2015;6(1):27-37.
18. Hegde SV, Adhikari P, Shetty S, Manjrekar P, D'Souza V. Effect of community-based yoga intervention on oxidative stress and glycemic parameters in prediabetes: a randomized controlled trial. *Complement Ther Med.* 2013;21(6):571-6.
19. Dutta D, Mondal SA, Choudhuri S, Maisnam I, Hasanoor Reza AH, Bhattacharya B, et al. Vitamin-D supplementation in prediabetes reduced progression to type 2 diabetes and was associated with decreased insulin resistance and systemic inflammation: an open label randomized prospective study from Eastern India. *Diabetes Res Clin Pract.* 2014;103(3):e18-23.
20. Hurst PRv, Stonehouse W, Coad J. Vitamin D supplementation reduces insulin resistance in South Asian women living in New Zealand who are insulin resistant and vitamin D deficient – a randomised, placebo-controlled trial. *British journal of Nutrition.* 2010;103:549-55.
21. Islam NS, Zanolwiak JM, Wyatt LC, Kavathe R, Singh H, Kwon SC, et al. Diabetes prevention in the New York City Sikh Asian Indian community: a pilot study. *Int J Environ Res Public Health.* 2014;11(5):5462-86.
22. Ramachandran N, Srinivasan M, Thekkur P, Johnson P, Chinnakali P, Naik BN. Mobile Phone Usage and Willingness to Receive Health-Related Information Among Patients Attending a Chronic Disease Clinic in Rural Puducherry, India. *J Diabetes Sci Technol.* 2015;9(6):1350-1.
23. Resnicow K, Baranowski T, Ahluwalia JS, Braithwaite RL. Cultural sensitivity in public health: defined and demystified. *Ethn Dis.* 1999;9(1):10-21.
24. Davidson EM, Liu JJ, Bhopal R, White M, Johnson MR, Netto G, et al. Behavior change interventions to improve the health of racial and ethnic minority populations: a tool kit of adaptation approaches. *The Milbank quarterly.* 2013;91(4):811-51.
25. Netto G, Bhopal R, Lederle N, Khatoon J, Jackson A. How can health promotion interventions be adapted for minority ethnic communities? Five principles for guiding the development of behavioural interventions. *Health Promot Int.* 2010;25(2):248-57.
26. Joo JY. Effectiveness of culturally tailored diabetes interventions for Asian immigrants to the United States: a systematic review. *The Diabetes educator.* 2014;40(5):605-15.
27. Grabovschi C, Loignon C, Fortin M. Mapping the concept of vulnerability related to health care disparities: a scoping review. *BMC Health Serv Res.* 2013;13:94.
28. Truong M, Paradies Y, Priest N. Interventions to improve cultural competency in healthcare: a systematic review of reviews. *BMC Health Serv Res.* 2014;14:99.

Figure 1. Study selection

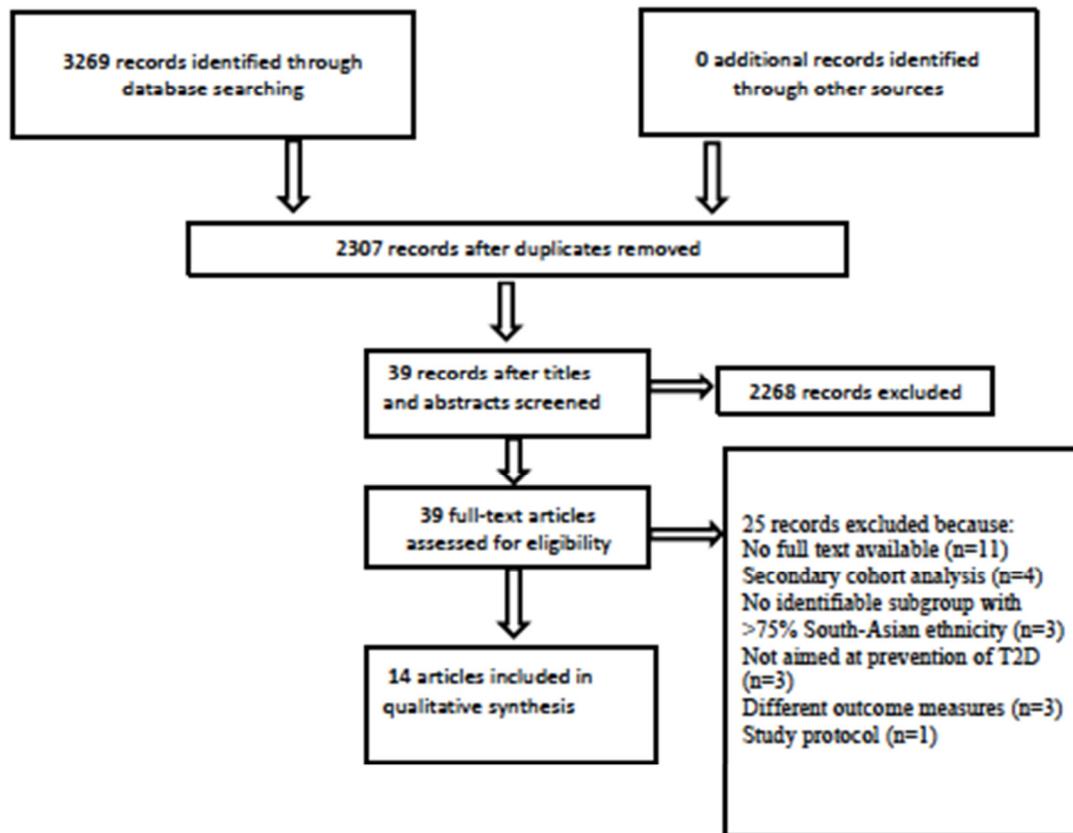


Table 1. List of the studies included in WP 4.1 and WP 4.3 (Dataset I,II)

Article referring to the study	Country where the study was conducted	Included in Work package 4.1, 4.3
Rush (2007)	New Zealand	WP4.3,I
Kousar (2008)	Australia	WP4.1 & WP4.3,I
Ramachandran (2006, 2013)	India	WP4.1 & WP4.3,II
Hurst (2010)	New Zealand	WP4.1
Balagopal (2012)	India	WP4.1 & WP4.3,II
Admiraal (2013)	The Netherlands	WP4.1 & WP4.3,II
Andersen (2013)	Norway	WP4.1 & WP4.3,II
Hegde (2013)	India	WP4.1
Telle-Hjelset (2013)	Norway	WP4.1
Islam (2014)	United States	WP4.1
Bhopal (2014)	United Kingdom	WP4.1 & WP4.3,I&II
Dutta (2014)	India	WP4.1
McDermott (2014)	India	WP4.1
Madsen (2015)	India	WP4.1
Not published study	United Kingdom	WP4.3,I

ANNEX 1-3

ANNEX 1: EuroDHYAN WP 4.1

A NARRATIVE SYNTHESIS OF DIETARY AND PHYSICAL ACTIVITY STRATEGIES TO PREVENT TYPE 2 DIABETES IN SOUTH ASIAN ADULTS

Introduction

In combating chronic diseases there is a considerable amount of evidence suggesting the effect of behavioral interventions to bring about a change in lifestyle factors, such as diet and physical activity. However, the evaluation, replication and accumulation of evidence from interventions to change health behaviors is complicated as interventions to change health-related behaviours are usually complex, and have many, often interacting components [1]. Some interventions prove highly effective for the health outcomes while others fail to do so.

South Asians are not only at particularly high risk for type 2 diabetes (T2D), but also develop it at an earlier age as compared to their European counterparts [2-4]. This, in addition to being a risk in itself, also puts the person in danger of other metabolic disorders and complications, which adversely impact on quality of life and lifespan [5]. Diet and physical activity are key modifiable risk factors for T2D [6]. Several studies have shown that interventions with specific strategies targeting these behaviors may help to prevent or postpone T2D [7-9]. But if these strategies are as effective in bringing behavioral change among the ethnic minority population as they are in the general population is a matter of concern.

Recently, interventions targeting diet and physical activity have been implemented to reduce the risk of T2D among South Asian origin populations. However, the trials evaluating intensive lifestyle interventions in this group include different strategies and show only moderate effects [10-13]. Accordingly, a detailed overview of current strategies and its relevance to the South Asian population taking into account different perspectives, such as type of intervention, intensity, cultural adaptation if any, and involvement of the target population in the development of the intervention could help us identify the key elements involved in either the success or failure of the interventions. This will ultimately stimulate the development of better targeted and more effective preventive strategies. Therefore, we conducted a narrative review of different intervention studies analyzing in detail the characteristics/elements of the different interventions carried out among the South Asians.

The specific aims in this review were:

1. To determine the effective elements of the behavioral interventions in terms of reach, acceptability and effectiveness
2. To determine the not so effective intervention elements

3. To identify any differences in the intervention elements in terms of gender, context or specific groups

Methodological Characteristics and Quality Assessment

We included studies on dietary and / or physical activity interventions to prevent T2D in the South Asian adult population (≥ 18 years). Studies exclusively on drug and surgical interventions or on drugs and surgical interventions in combination with dietary and / or physical activity interventions were excluded. No studies were excluded due to the types of comparators. All types of intervention studies with randomized control trials (RCTs) or quasi-experimental evaluation were included. Studies were included if study outcomes were related to the effects of the intervention on the prevention of T2D, including incidence of T2D, indicators of T2D and anthropometric indicators of adiposity. Articles were included if at least an abstract was available in English; there were no language restrictions for the full-text articles.

We systematically searched PUBMED, Embase, Cochrane library and Web of Science from the start of the databases until 09-08-2016. To the best of our knowledge no relevant studies were published before the start of these databases. The search results were supplemented with reference list tracing of four key reviews[[6](#), [12](#), [14](#), [15](#)] and included studies [[13](#), [16-28](#)]. Unpublished and in-progress studies were identified by searching the World Health Organization International Clinical Trials Registry Platform, International Clinical Trials Registry Platform (ICTRP), ClinicalTrials.gov, ISRCTN (International Standard Randomised Controlled Trial Number) register, European Union clinical trials register, the Clinical Trials Register India (CTRI), the Sri Lanka Clinical Trials Registry (SLCTR), The Saudi Clinical Trials Registry (SCTR), UK Clinical Trials Gateway and Health Canada's Clinical Trials Database trial registries. Any missing studies were identified by expert consultations.

For the fourteen studies identified and included, we extracted information regarding participants and recruitment strategies, location, design, objectives, duration of the study, and response/follow-up rates. Also, a detailed description of the interventions as stated in the main result articles and information regarding behaviour change theories (if reported), behaviour change techniques (using the taxonomy of Susan Michie)[[29](#)] and the adaptations using the typology of adaptations [[30](#)] was extracted.

Results

The search for scientific literature resulted in 3269 records (Figure 1). No additional records were identified through other sources, although key reviews, reference lists of included papers and experts were consulted. After removing duplicates, 2307 records were left for title and abstract screening. From the 39 full-text records that were assessed for eligibility, 14 records were included in the review.

Tables 1a & 1b describe the characteristics of the 14 [10, 13, 18-28, 31] included studies based on studies conducted outside [10, 20, 23, 24, 28, 31] India and in India [13, 18, 19, 21, 22, 25-27]. Studies were selected only if they described in detail the intervention elements as well as the cultural adaptation done. Most of included studies were RCT's [13, 20-22, 25-27], one study did not have the classical intervention and control group but one group with low birth-weight and the other Normal birth-weight [25], two [18, 19] were Before After Studies (BAS) and one was quasi-experimental [24]. In a previous assessment of quality of the included studies [32], seven studies were rated as strong [10, 13, 20, 22, 23, 27, 31], five studies as moderate [18, 19, 21, 24, 28] and two were weak [25, 26].

Most interventions focused primarily on diet and physical activity (PA) [10, 13, 18-20, 24, 27, 28], four on physical activity (PA) only [22, 25, 26, 31], and two [21, 23] only on diet. In addition, three focused on stress management as well [18, 19, 24]. Most studies included populations of Indian ethnicity [13, 18-20, 22, 24-26], one Surinamese [10], two included Pakistanis as well [20, 28]. All had a wide age range 18-75 years, and focused specifically on those with pre-diabetes (impaired fasting glucose (IFG) or impaired glucose tolerance (IGT)), with study duration varying from 6 to 36 months and the number of participants ranging from 41 to 1681. Recruitment places included health care services, local and religious festivals, and recruitment through local papers and advertisements. In addition, work places and whole communities were recruited in India. Not all the studies reported response rates, but the reported follow-up rates were above 65% for all.

Tables 2a & 2b show information regarding behaviour change theories (if reported), behaviour change techniques (using the taxonomy of Susan Michie) [29] and the adaptations using the typology of adaptations [30]. Among the theoretical frameworks reported, three studies were based on the stages of change construct from the transtheoretical model [20, 27, 28], one study applied the social cognitive theory of behaviour change [31], one used social cognitive theory and motivational interviewing [10] and one study used a community-based participatory research approach [19].

Tables 3a & 3b describe the different interventions in detail. For the studies outside India, the interventions were tailored for the South Asian populations, for instance for diet it was culturally adapted to include their traditional food items, cooking demonstrations, translation of booklets,

formulation of recipes with healthy traditional ingredients, shopping tours, more focus on fruits and vegetables (Table 3a). In one study, for PA intervention participants were provided childcare, baby-friendly walking paths and walking shoes [28]. The intervention counsellors included dieticians, researchers, who were from the same community, spoke the same language, or of the same sex as the participants [10, 20, 24, 28]. However, for the studies done within India, the interventions were not as such culturally adapted, except inclusion of locally available food items and translation of the resources booklets into local languages (Table 3b). As regards PA, some studies used the daily occupation of the participants and asked them to maintain it [18, 19], one study provided the participants with bicycles to increase the level of PA [25], while two studies used yoga for their intervention [22, 26].

Tables 4a & 4b describe the different features of the interventions according to the RESET tool [30]. Most studies in Europe described several adaptations used at the same time and focused on the individual as main target of behaviour change, though with some familiar or community component. The majority of the studies were classified as high intensive and reinforced the participants by practical demonstration or training. The involvement of the users in the study design was described in half of the studies in Europe, but in less than half in India. Indian studies were also highly intensive, but less frequently involved the families, and reinforced participants by telephone contacts.

Further considerations

The review identified 14 studies [10, 13, 18-28, 31] evaluating interventions for diet and PA both in and outside India. As expressed in other studies trying to identify effective cultural interventions [30, 33] there was a wide variation in the number of participants, age ranges, recruitment places, objectives and complex cultural adaptations, making comparisons difficult. Overall, we could not find clear patterns that identified successful interventions, although some characteristics previously identified seemed corroborated, like the importance of the involvement of the community, of interventions incorporating a package of cultural adaptations, and specifically cultural adaptations that implied higher intensity [34]. However, other previously identified positive characteristics like the effectiveness of including the families [34] did not appear so clearly. The use of well-known taxonomies and classifications only partly helped us to disentangle successful or unsuccessful elements of the interventions, but helped us to identify gaps in knowledge, like the absence of theoretical frameworks to explain both the need and the development of the cultural adaptations or the overlapping of the typologies of the adaptation recommended [30]. The information gathered through this exercise was used to prepare an interview guide for qualitative interviews of the principal investigators and other key researchers for studies in Europe and India that have been conducted to improve our understanding of the development and deliveries of the interventions.

References

1. Craig, P., et al., *Developing and evaluating complex interventions: the new Medical Research Council guidance*. BMJ, 2008. **337**: p. a1655.
2. Gujral, U.P., et al., *Type 2 diabetes in South Asians: similarities and differences with white Caucasian and other populations*. Ann N Y Acad Sci, 2013. **1281**: p. 51-63.
3. Meeks, K.A., et al., *Disparities in type 2 diabetes prevalence among ethnic minority groups resident in Europe: a systematic review and meta-analysis*. Intern Emerg Med, 2015.
4. Sattar, N. and J.M.R. Gill, *Type 2 diabetes in migrant south Asians: mechanisms, mitigation, and management*. The Lancet Diabetes & Endocrinology. **3**(12): p. 1004-1016.
5. IDF, *Global guideline for type 2 diabetes*. 2012, International Diabetes Federation.
6. Ramachandran, A., et al., *Primary prevention of Type 2 diabetes in South Asians--challenges and the way forward*. Diabet Med, 2013. **30**(1): p. 26-34.
7. Alberti, K.G., P. Zimmet, and J. Shaw, *International Diabetes Federation: a consensus on Type 2 diabetes prevention*. Diabet Med, 2007. **24**(5): p. 451-63.
8. Lindström, J., et al., *The Finnish Diabetes Prevention Study (DPS): Lifestyle intervention and 3-year results on diet and physical activity*. Diabetes Care, 2003. **26**(12): p. 3230-3236.
9. Group, T.D.P.P.R., *The Diabetes Prevention Program (DPP): Description of lifestyle intervention*. Diabetes Care, 2002. **25**(12): p. 2165-2171.
10. Admiraal, W.M., et al., *Intensive Lifestyle Intervention in General Practice to Prevent Type 2 Diabetes among 18 to 60-Year-Old South Asians: 1-Year Effects on the Weight Status and Metabolic Profile of Participants in a Randomized Controlled Trial*. Plos One, 2013. **8**(7).
11. Wallia, S., et al., *Culturally adapting the prevention of diabetes and obesity in South Asians (PODOSAs) trial*. Health Promot Int, 2014. **29**(4): p. 768-79.
12. Brown, T., et al., *Diet and physical activity interventions to prevent or treat obesity in South Asian children and adults: a systematic review and meta-analysis*. Int J Environ Res Public Health, 2015. **12**(1): p. 566-94.
13. Ramachandran, A., et al., *The Indian Diabetes Prevention Programme shows that lifestyle modification and metformin prevent type 2 diabetes in Asian Indian subjects with impaired glucose tolerance (IDPP-1)*. Diabetologia, 2006. **49**(2): p. 289-297.
14. Chapman, J., N. Qureshi, and J. Kai, *Effectiveness of physical activity and dietary interventions in South Asian populations: a systematic review*. Br J Gen Pract, 2013. **63**(607): p. e104-14.
15. Chowdhury, T.A. and G.A. Hitman, *Type 2 diabetes in people of South Asian origin: potential strategies for prevention*. The British Journal of Diabetes & Vascular Disease, 2007. **7**(6): p. 279-282.
16. Admiraal, W.M., et al., *Intensive lifestyle intervention in general practice to prevent type 2 diabetes among 18 to 60-year-old South Asians: 1-year effects on the weight status and metabolic profile of participants in a randomized controlled trial*. PLoS One, 2013. **8**(7): p. e68605.
17. Andersen, E., N.W. Burton, and S.A. Anderssen *Physical activity levels six months after a randomised controlled physical activity intervention for Pakistani immigrant men living in Norway*. International journal of behavioral nutrition and physical activity, 2012. **9**, 47 DOI: 10.1186/1479-5868-9-47.

18. Balagopal, P., et al., *A community-based diabetes prevention and management education program in a rural village in India*. *Diabetes Care*, 2008. **31**(6): p. 1097-104.
19. Balagopal, P., et al., *A community-based participatory diabetes prevention and management intervention in rural India using community health workers*. *Diabetes Educ*, 2012. **38**(6): p. 822-34.
20. Bhopal, R.S., et al., *Effect of a lifestyle intervention on weight change in south Asian individuals in the UK at high risk of type 2 diabetes: A family-cluster randomised controlled trial*. *The Lancet Diabetes and Endocrinology*, 2014. **2**(3): p. 218-227.
21. Dutta, D., et al., *Vitamin-D supplementation in prediabetes reduced progression to type 2 diabetes and was associated with decreased insulin resistance and systemic inflammation: An open label randomized prospective study from Eastern India*. *Diabetes Research and Clinical Practice*, 2014. **103**(3): p. e18-e23.
22. Hegde, S.V., et al. *Effect of community-based yoga intervention on oxidative stress and glycemic parameters in prediabetes: A randomized controlled trial*. *Complementary therapies in medicine*, 2013. **21**, 571-6 DOI: 10.1016/j.ctim.2013.08.013.
23. Hurst, P.R., W. Stonehouse, and J. Coad *Vitamin D supplementation reduces insulin resistance in South Asian women living in New Zealand who are insulin resistant and vitamin D deficient - a randomised, placebo-controlled trial*. *British journal of nutrition*, 2010. **103**, 549-55 DOI: 10.1017/S0007114509992017.
24. Islam, N.S., et al., *Diabetes prevention in the New York City Sikh Asian Indian community: a pilot study*. *Int J Environ Res Public Health*, 2014. **11**(5): p. 5462-86.
25. Madsen, C., et al., *Effects of an outdoor bicycle-based intervention in healthy rural Indian men with normal and low birth weight*. *J Dev Orig Health Dis*, 2015. **6**(1): p. 27-37.
26. McDermott, K.A., et al. *A yoga intervention for type 2 diabetes risk reduction: a pilot randomized controlled trial*. *BMC complementary and alternative medicine*, 2014. **14**, 212 DOI: 10.1186/1472-6882-14-212.
27. Ramachandran, A., et al., *Effectiveness of mobile phone messaging in prevention of type 2 diabetes by lifestyle modification in men in India: a prospective, parallel-group, randomised controlled trial*. *Lancet Diabetes Endocrinol*, 2013. **1**(3): p. 191-8.
28. Telle-Hjellset, V., et al., *The InnvaDiab-DE-PLAN study: a randomised controlled trial with a culturally adapted education programme improved the risk profile for type 2 diabetes in Pakistani immigrant women*. *British Journal of Nutrition*, 2013. **109**(3): p. 529-538.
29. Michie, S., et al., *A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALORE taxonomy*. *Psychology & Health*, 2011. **26**(11): p. 1479-1498.
30. Davidson, E.M., et al., *Behavior change interventions to improve the health of racial and ethnic minority populations: a tool kit of adaptation approaches*. *Milbank Q*, 2013. **91**(4): p. 811-51.
31. Andersen, E., et al. *Intervention effects on physical activity and insulin levels in men of Pakistani origin living in Oslo: a randomised controlled trial*. *Journal of immigrant and minority health / Center for Minority Public Health*, 2013. **15**, 101-10 DOI: 10.1007/s10903-012-9686-3.

32. Mirthe Muilwijk, M.N., Samera A. Qureshi, Carlos Celis-Morales, Jason M. R. Gill, Aziz Sheikh, Erik Beune, Anne Karen Jenum, Karien Stronks, Irene G.M. van Valkengoed, *Dietary and physical activity strategies to prevent type 2 diabetes in South Asian adults: a systematic review*. 2016.
33. Liu, J., et al., *Adapting health promotion interventions to meet the needs of ethnic minority groups: mixed-methods evidence synthesis*. Health Technol Assess, 2012. **16**(44): p. 1-469.
34. Nierkens, V., et al., *Effectiveness of cultural adaptations of interventions aimed at smoking cessation, diet, and/or physical activity in ethnic minorities. a systematic review*. PLoS One, 2013. **8**(10): p. e73373.

Figure 1: Study selection.

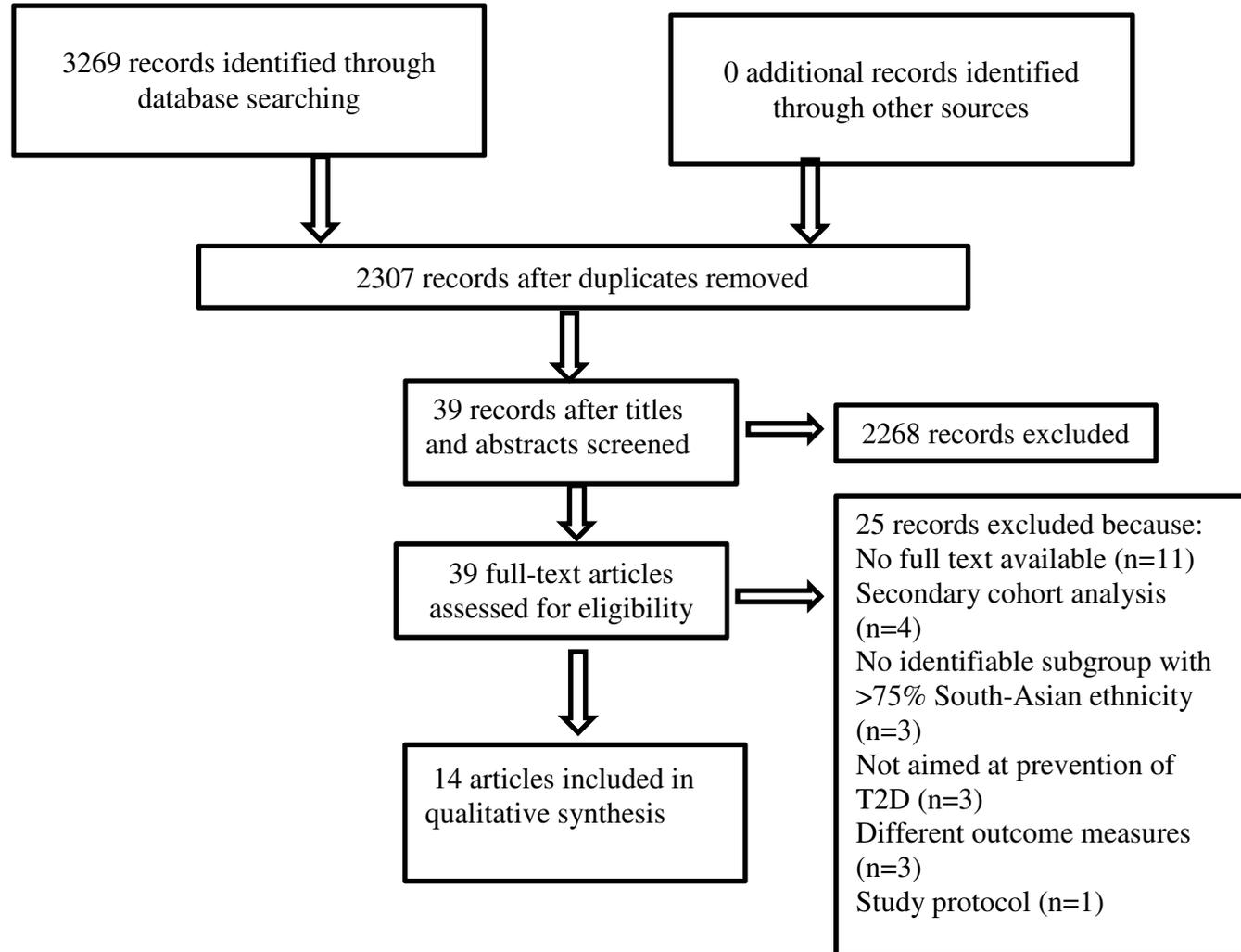


Table 1a: Overview of the selected studies outside India

Study ID	Study design	Location/ Target Population (Selection Criteria)	Age (years)	Size (n)	Duration (months)	Response /Follow-up rate	Recruitment	Intervention objective	Quality Assessment
Hurst et al. 2010[23]	RCT	New Zealand/ South Asian (Hypovitaminosis D and insulin resistance)	23-68	106	6	76%	Advertisements in newspapers, and Indian media. Posters and leaflets distributed in a number of venues such as General Medical Practices with high numbers of South Asian patients, clubs, and temples.	Diet	Strong
Admiraal et. al, 2013 (DHIAAN[10])	RCT	Netherlands/ SA Surinamese (IFG, IGT)	18-60	536	12	62%	General practitioners	Diet, PA	Strong
Andersen et.al, 2013 (PAMH[17])	RCT	Norway/ Pakistani men (Not physically active)	25-60	150	5	84%	Mosques, Religious Festivals, with the help of the community	PA	Strong
Telle-Hjelset et.al, 2013 (InnvaDiab-DE-PLAN [28])	RCT	Norway/Pakistani women	25-62	198	7	80%	Telephone contact	Diet, PA	Moderate
Bhopal et.al, 2014 (PODOSA [20])	RCT	UK/Pakistani and Indians (WC ≥90 men ≥80 women, IGT or IFG)	35-80	171	36	98%	NHS Direct referrals General practices. Community	Diet, PA	Strong

							Snowball/contacts Community Groups Research team recruitment		
Islam et.al, 2014 (RICE[24])	Quasi- experi- mental	US/Indians (High risk T2D)	18-75	126	6	86%	Participants re- cruited at health fairs and cultural fairs at gurdwaras (Sikh religious institutions) and other community settings	Diet, PA, Stress	Moderate

[IFG: Impaired Fasting Glucose; IGT: Impaired Glucose Tolerance; RCT: Randomized Control Trial; PA: Physical Activity]

Table 1b: Overview of the selected studies in India

Study ID	Study design	Location/ Target Population (Selection Criteria)	Age (years)	Size (n)	Duration (months)	Response /Follow-up rate	Recruitment	Intervention objective	Quality Assessment
Ramachandra n et.al, 2006 (IDPP-1[13])	RCT	India/(IGT on 2 OGTT)	35-55	531	30	95%	Work place	Diet, PA	Strong
Balagopal et.al, 2008 (DPM[18])	BAS	India/Tamil Indians. Alamarupatti village. (All inhabitants)	>18	585	7	74/84%	All adults of Village of Alamarathupatti, Gandhigram Rural Institute	Diet, PA, Stress	Moderate
Balagopal et.al, 2012 (DPP[19])	BAS	India/Gujarati Indians. (All inhabitants)	>18	1681	6	97%	All adults, from a rural community, Gujrat. India	Diet, PA, Stress	Moderate
Hegde et al. 2013[22]	RCT	India/ (Pre-diabetes, non-alcoholic, non-	30-75	29	3	100%	Media advertisements.	PA	Strong

		smoker)							
Ramachandran et al. 2013[27]	RCT	India/ (IGT on 2 OGTT)	35-55	537	20		Work place	Diet, PA	Strong
Dutta et al. 2014[21]	RCT	India/ (IFG and/or IGT in 2 OGTTs in one week)	30-80	170	28	80%	Family members of patients of diabetes from the Diabetic Clinic OPD services and individuals from screening camps	Diet	Moderate
McDermott et al. 2014[26]	RCT	India/ (FBG \geq 5.6 mmol/l 1 st degree relative T2D)	30-65	41	2	93%	Advertisements in primary care and diabetes clinics, as well as strategic locations.	Diet, PA	Weak
Madsen et al. 2015[25]	LBW vs NBW	India	18-22	117	1,5	88%	From another on-going study	PA	Weak

[BAS: Before and After Studies, RCT: Randomized Control Trial; LBW: Low Birth Weight; NBW: Normal Birth Weight; IFG: Impaired Fasting Glucose; IGT: Impaired Glucose Tolerance; OGTT: Oral Glucose Tolerance Test; FBG: Fasting Blood Glucose; PA: Physical Activity]

Table 2a: Behavioural theory, Techniques and the typology of the interventions used in different studies outside India

Study	Theoretical Framework	Behavioral technique	Typology of adaptation used
Hurst et.al, 2010[23]	Not reported	Not available	Collaborative working 0 Team 0 Endorsement Materials Messages Delivery
Telle Hjellset et.al, 2013[28]	Stages of change model	5- goal setting behavior 29- social support	Collaborative working 1, 2 Team 7 Endorsement 12, 16 Materials 17, 18 Messages 0 Delivery 36, 44
Admiraal et.al, 2013[10]	Social cognitive theory, cultural adaptations, both deep and surface structure	5- goal setting (behavior) 20-provide info on when and where 21-provide instruct on how 22-model demonstrate behavior 23-Teach to use prompts 28-Social comparison 29-plan social support/social change 37- MI	Collaborative working 1, 2 Team 7, 11 Endorsement Materials 17,18 Messages 28, 26, 34 Delivery 44
Andersen et.al, 2013 [31]	Social cognitive theory	5- goal setting (behavior) 7- action planning 8- barrier identification 29-plan social support/social change	Collaborative working 1, 2, 4 Team 7 Endorsement 0 Materials 0 Messages Delivery 44

Bhopal et.al, 2014[20]	Stages of change model	20-provide info on when and where 21-provide instruct on how 22-model demonstrate behavior 23-Teach to use prompts 29-plan social support/social change	Collaborative working 1, 2 Team 7, 11 Endorsement 15 Materials 17,18, 19, 21 Messages 26, 28,29,30 Delivery 44
Islam et.al, 2014 [24]	Not described	7- Action planning 20-provide info on when and where 21-provide instruct on how 22- model demonstrate behavior 28- Social comparison 29- social support 36-stress management	Collaborative working 1, 2 Team 7, 11 Endorsement 14 Materials 17, 18, 19 Messages 27, 28,29, 34 Delivery 41,42, 46, 38, 37, 44

Table 2b: Behavioural theory, Techniques and the typology of the interventions used in different studies outside India

Study	Theoretical Framework	Behavioral technique	Typology of adaptation used
Ramachandran et.al, 2006 [13]	Not described	20- provide info on when and where 21- provide instruct on how 22-model demonstrate behaviors 23-Teach to use prompts	Collaborative working 1, 2 Team 7 Endorsement Materials Messages 26 Delivery 42
Balagopal et.al, 2008 [18]	Not described	20-provide info on when and where 21-provide instruct on how 22-model demonstrate behaviors 28- Social comparison 36-stress management	Collaborative working 3,4 Team 0, Endorsement 14 Materials 19, 20 Messages Delivery 36, 42, 44
Balagopalet.al, 2012 [19]	Not described	20-provide info on when and where 21- provide instruct on how 22- model demonstrate behavior 36-stress management	Collaborative working 1, 2 Team 7 Endorsement Materials Messages 26 Delivery 42
Ramachandran et.al, 2013 [27]	Transtheoretical model of behavioral change	23-Teach to use prompts	Collaborative working 1, 2 Team 7 Endorsement Materials Messages 26 Delivery 42
Hegde et.al, 2013 [22]	Not described	20- provide info on when and where 21- provide instruct on how 22-model demonstrate behaviors	Collaborative working 1, 2 Team 7 Endorsement 0 Materials 0 Messages 26 Delivery 42

Dutta et.al, 2014 [21]	Not described	Not available	Collaborative working 0 Team 0 Endorsement 0 Materials 0 Messages 0 Delivery 0
McDermott et.al, 2014 [26]	Not described	Not available	Collaborative working 0 Team 0 Endorsement 0 Materials 0 Messages 0 Delivery 0
Madsen et.al, 2015 [25]	Not described	Not available	Collaborative working 0 Team 0 Endorsement 0 Materials 0 Messages 0 Delivery 0

Table 3a: Detailed description of the intervention in selected studies outside India

Study	Aims	Intervention Group/Adaptation	Control
Hurst et.al, 2010 [23]	To investigate the effect of vitamin D on markers of metabolic syndrome, primarily insulin resistant, in South Asian women who were insulin resistant and vitamin D deficient	Vitamin D3 100mcg daily for 6 months	Placebo was given daily for 6 months
Admiraal et.al, 2013 [10]	To prevent type 2 diabetes and cardiovascular risk factors	<p><u>Diet & PA</u> Motivational interviewing (MI) to base the culturally appropriate, intensive, lifestyle intervention on individual lifestyle counselling.</p> <p><u>Cooking Class</u> Participants could also attend two cooking</p> <p><u>PA</u> The offered to supervise a 20-week physical activity programme with trained coaches</p> <p><u>Family</u> The participants had a family session with the dietician to decrease the social pressure to eat unhealthily and to increase the social support for a healthful lifestyle within the family.</p>	<p>Invited to join two group sessions led by student dieticians</p> <ul style="list-style-type: none"> • generic information about diabetes, • discuss the current guidelines for diet and PA, • list methods for achieving the recommended PA, and present some cases. <p>Two flyers (at 3 months and 9 months) with simple, generic lifestyle advice. Both flyers offer participants a chance to phone in during preset hours to obtain personal advice from a dietician.</p>
Andersen et.al, 2013 [31]	To increase Physical activity(PA) and its effect on plasma glucose	<p>Intervention was developed in collaboration with the community.</p> <p><u>PA</u> Physical activity was promoted by:</p>	organised exercise, one group lecture and written material following completion of the intervention period

		<ul style="list-style-type: none"> • structured group exercise to provide opportunities for PA to increase social support, promote mastery learning through skill training, improve knowledge to skills • group lectures and individual counselling on how to improve knowledge and incorporation of PA into daily routine, improving problem solving of PA barriers • phone calls to provide feedback, reinforce problem solving and providing encouragement 	
Telle-Hjellset et.al, 2013 [28]	To investigate whether a culturally adapted education programme, focusing on blood glucose physiology and its regulation by physical activity and nutrition, would improve the T2D-related risk factor profile, including reducing the Metabolic Syndrome.	<ul style="list-style-type: none"> • Educational program was culturally adapted ▪ Knowledge about the Pakistani lifestyle in Pakistan and Norway was given ▪ Dietary advices in line with traditional Pakistani diet ▪ Culturally adapted pictures and figures ▪ Communication were carried out in the preferred languages ▪ All the participants and research personals were females ▪ The program was tailored to meet the participants' everyday lives and challenges as mothers and providers for their family ▪ Any lifestyle change that would fit their cultural, social and family situation 	Lifestyle advice
Bhopal et.al, 2014 [20]	A reduction of weight and changes in waist/hip, BMI, blood glucose, physical activity and progression to diabetes	<p>Diet</p> <ul style="list-style-type: none"> • Delivery in the home • Involvement of the cook and family helpers • Multilingual panel to help prepare materials • Development of dietitian's toolkit, with translations in Urdu and Gurmukhi <p>PA</p> <ul style="list-style-type: none"> • Walking relevant & achievable 	Standardized written and verbal advice on healthy eating, diabetes prevention, promotion of physical activity, and on accessing other weight control and physical activity services

		<ul style="list-style-type: none"> • Self-chosen out door or Gym activity • Education materials used images of: yoga, Bollywood dancing, People in South Asian clothes • Bilingual, research dietitians 	
Islam et.al, 2014 [24]	Pilot study to explore the impact, acceptability, and feasibility of an intervention to improve health behaviours and health outcomes related to diabetes prevention	<p>Diet</p> <ol style="list-style-type: none"> 1. Dispelling common cultural misconceptions regarding diabetes Incorporation of culturally appropriate images and language 2. Healthy elements in traditional Indian cooking 3. Identifying and limiting deep-fried snacks high in salt and sweets high in fat and sugar; substituting sweets with fruits 4. Reading food labels 5. Working with women participants to improve nutrition in the entire household 6. Incorporation of culturally appropriate images and language <p>PA</p> <ol style="list-style-type: none"> 7. encouragement to practice similar discipline in physical activity as in prayer 8. Home-based exercise/activities <p>Practice Activity</p> <ol style="list-style-type: none"> 9. All curriculum materials in Punjabi 	Standard health-care. Additionally, all participants were invited to receive the full intervention after serving as a control for the 6-month study period.

[PA: Physical Activity; MI: Motivational Interviewing; BMI: Body Mass Index]

Table 3b: Detailed description of the intervention in selected studies in India

	Aims	Intervention Group/Adaptation	Control
Ramachandran et.al, 2006 [13]	To determine whether the incidence of type 2 diabetes could be modified by interventions like lifestyle modifications, metformin or both.	<p>Participants with IGT were randomized into four groups:</p> <ol style="list-style-type: none"> 1. Group 1 was the Control 2. Group 2 was given advice on lifestyle modification(LSM) 3. Group 3 was treated with metformin (MET) 4. Group 4 was given LSM plus MET <p>Physical activity Physically active participants were asked to continue their routine activities. Participants engaged in sedentary or light physical activity were advised and regularly motivated to walk briskly for at least 30 min each day.</p> <p>MET+LSM Participants in the MET and LSM + MET groups received metformin tablets and were given diaries to record their daily consumption of tablets, particularly whether any doses were missed. Three months' supply was provided, and leftover tablets were counted to assess the compliance. LSM included advice on healthy diet and regular physical activity</p> <p>Motivation and adherence The intervention procedure was explained individually at the time of randomisation, then again by telephone after 2 weeks or by letter. Thereafter, monthly telephonic contacts were maintained for continued motivation. Personal sessions were conducted at 6-monthly intervals</p>	Health controls once a year
Balagopal et.al, 2008 [18]	To evaluate the effectiveness of a nonpharmacological lifestyle	<p>Design of study Initial participatory rural analysis of the village enabling</p>	No control group

	intervention aimed at reducing risk factors and improving disease self-management.	<p>the involvement of the community in the planning and implementation phases</p> <p>Diet Culturally sensitive and linguistically appropriate (Tamil language) sessions on dietary modification (increasing fibre, reducing fat, and portion control)</p> <p>PA Physical activity was promoted and reinforced with demonstrations, competitive fun events, and dancercise events for the younger respondents.</p>	
Balagopal et.al, 2012 [19]	To test the effectiveness of a community-based diabetes prevention and management program in rural Gujrat, India.	<p>Diet Advice on healthy diet. For overweight/obese individuals, weight loss education was provided in group sessions. Dietary education focused on the benefits of fibre and protein intake from local, low-cost resources.</p> <p>Cooking methods To demonstrate healthier dietary approaches through cooking competitions and model meals, the latter of which demonstrated how to improve the taste of high fibre substitute, sprouted legumes, and vegetables.</p> <p>PA Stratified by occupation levels for adults. Agricultural farmworkers, manual labourers, or those who were physically active were requested to continue their routine. Those engaged in sedentary to light physical activity were advised (and regularly motivated) to be physically for at least 30 minutes per day</p> <p>Educational materials Handouts in Gujarati downloaded from National Diabetes Education Program. However, the majority of participants preferred discussions and demonstrations.</p>	No control group

Hegde et.al, 2013 [22]	To study the effectiveness of yoga intervention on oxidative stress, glycaemic status, blood pressure and anthropometry in prediabetes.	Yoga sessions for 3-months with yoga instructor (4 community diabetes clinics chosen for yoga centers) Telephoned monthly to monitor their adherence, improve their enthusiasm and to assist with any problems encountered with the study	Waiting list
Ramachandran et.al, 2013 [27]	To assess whether mobile phone messaging that encouraged lifestyle change could reduce incident type 2 diabetes in Indian Asian men with impaired glucose tolerance	<p><u>Dietary recommendations</u> Individualized dietary recommendations to balance food intake and physical activity and to maintain appropriate body weight. The advice included:</p> <ul style="list-style-type: none"> • Avoidance of simple sugars and refined carbohydrates • Reduce total fat intake (<20 g per day) • Restrict use of saturated fat • Include more fiber-rich food eg, whole grains, legumes, vegetables, and fruits <p><u>Physical activity recommendation</u></p> <ul style="list-style-type: none"> • To enhance aerobic exercise like walking, cycling, and jogging in sedentary patients • Brisk walk for a minimum of 30 min per day (or equivalent), as a realistic goal with proven effectiveness • Walk 3–4 km in 30 min at least 5 days a week • Cycle 6–7 km in 30 min • If occupation involves strenuous 	At baseline, all participants received personalised education and motivation about healthy lifestyle, diet and physical activity.
Dutta et.al, 2014 [21]	To evaluate the role of Vitamin-D supplementation on progression of prediabetes to diabetes and/or reversal to normoglycemia and its effect on IR, systemic inflammation and lipid profile	Group-A: IPD with low Vit D receiving Vitamin-D supplementation, cholecalciferol 60,000 IU once weekly for 8 weeks and then monthly + 1250 mg of calcium carbonate/day equivalent to elemental calcium 500 mg Group-B: IPD with low Vit D receiving 1250mg calcium carbonate/day for study duration Group-C: IPB with higher Vit D receiving same 1250mg calcium carbonate/day for study duration All received therapeutic lifestyle interventions	No treatment

<p>Mc Dermott et.al, 2014 [26]</p>	<p>Feasibility study studying recruitment, retention and adherence goals and to collect preliminary efficacy data on changes in T2DM risk factors and psychological well-being</p>	<p>One day long (eight hour) group counseling session on healthy lifestyle changes with topics on healthy diet, increasing physical activity and smoking cessation. Spouses were invited to attend this group counseling session as well.</p> <p>At least three, and up to six, yoga classes per week over eight weeks. Yoga classes offered on six days of each week, in a community hall and taught by two registered Ayurveda medical practitioners</p> <p>Participants were asked to do a home practice if unable to attend at least three classes in a given week and asked to keep track of each home practice in a daily diary</p>	<p>Same day-long intervention, Walking control in the park</p> <p>Group counseling session on lifestyle changes with spouses. Two study volunteers monitored control group participants' attendance at daily walks in the park.</p>
<p>Madsen et.al, 2015 [25]</p>	<p>To assess the effect of a bicycle intervention on body composition, insulin sensitivity and insulin secretion in young rural Indian men born with LBW (low birth weight) compared with NBW (normal birth weight) controls.</p>	<p>Individuals were categorized into groups of low, moderate or high level of physical activity</p> <p>All participants were given bicycle and instructed to exercise for at least 45 min a day for 6-weeks. Participants were asked to keep a diary for recording their cycling sessions; this was checked on a daily basis by field workers.</p> <p>Some participants were monitored on a weekly basis in the field or through telephonic monitoring</p>	<p>No control group</p>

[MET: Metformin; LSM: Life Style Modifications; PA: Physical Activity; DPM: Diabetic Prevention and Management; IPD: Individuals with prediabetes]

Table 4a: Different features of the interventions of studies outside India

Study	No. of cultural Adaptations used		Family involvement		Intervention component		Intensity		User involvement in study Design		Intervention Counsellor	Motivation by Re-enforcement	
	Many	One	Yes	No	Individual	Community	High	Medium	Yes	No		Telephone	Practical demonstration Cooking classes
Hurst 2010 [23]				x	x		x			x			
Admiraal 2013 [10]	x		x		x		x		x		Trained Dietician		x
Andersen 2013 [17]				x	x			x	x		Exercise physiologist	x	x
Telle- Hjellset 2013 [28]	x				x			x		x	Researcher		
Bhopal 2014 [20]	x		x		x		x			x	Dietician		x
Islam 2014 [2]	x			x		x	x		x		Community worker	x	x

Table 4b: Different features of the interventions of studies in India

Study	No. of cultural Adaptations used		Family involvement		Intervention component		Intensity		User involvement in study Design		Intervention Counsellor	Motivation by Re-enforcement	
	Many	One	Yes	No	Individual	Community	High	Medium	Yes	No		Telephone	Practical demonstration Cooking classes
Ramachandran 2006 [13]**				x	x		x			x	Team work	x	
Balagopal 2008 [18]	x			x		x	x		x		Community worker		x
Balagopal 2012 [19]	x		x			x	x		x		Community worker		x
Hegde 2013[22]				x	x		x			x	Researcher	x	
Ramachandran 013[27]				x	x		x			x	?	x	
McDermott 2014[26]			x		x		x			x	?	x	
Dutta 2014[21]				x	x		x			x	?		
Madsen 2015[25]				x	x			x		x	Social worker	x	

ANNEX 2. EuroDHYAN WP 4.2 (Summary)

EFFECTIVENESS OF DIETARY AND PHYSICAL ACTIVITY INTERVENTIONS TO REDUCE THE RISK OF TYPE 2 DIABETES IN SOUTH ASIANS LIVING IN EUROPE ACROSS POPULATION SUBGROUPS INDIVIDUAL PARTICIPANT DATA META-ANALYSIS OF EUROPEAN RANDOMIZED CONTROLLED TRIALS IDENTIFIED IN A SYSTEMATIC REVIEW

Anne Karen Jenum, Idunn Brekke, Ibrahimu Mdala, Kåre Rønn Richardsen, Mirthe Muilwijk, Samera A. Qureshi, Marte Kjøllesdal, Eivind Andersen, Anne Douglas, Genevieve Cezard, Aziz Sheikh, Carlos Celis-Morales, Jason M.R. Gill, Naveed Sattar, Erik Beune, Karien Stronks, Per Olav Vandvik, Bernadette Nirmal Kumar, Irene G.M. van Valkengoed

Abstract (First summary based on four European studies)

Background: Randomized controlled intervention trials (RCTs) in South Asians to prevent type 2 diabetes seem to be less effective than in populations with European origin.

Aims: To assess the effect of dietary and/or physical activity interventions to prevent type 2 diabetes among South Asians in Europe, overall, and for pre-specified subgroup analyses.

Methods: Primary outcomes: fasting glucose, 2 hour-glucose. Secondary outcomes: weight, waist circumference. A systematic review was performed to identify relevant RCTs worldwide and thereafter those from Europe. The study quality was assessed by the Quality Assessment Tool for Quantitative studies. Individual participant data (IPD) meta-analysis is the gold-standard for synthesizing evidence of effect across clinical studies. Compared with meta-analyses from aggregate data from published papers, IPD increases the precision in the estimates, facilitates standardization of analyses and increases the quality of sub-group analyses. Anonymous data for all studies (study duration 36, 24, 7 and 5 months), were received. The IPD meta-analyses proceeded in two stages: 1) Multilevel linear regression models with random effects at individual level and group allocation as fixed effect, were used to analyse pooled individual data, adjusted for age and gender, and baseline values for the outcome variable of interest, using Stata 13. For studies with only one follow-up, GLM was used. 2) Model estimates obtained from the multilevel models were used to estimate weighted averages across the studies by accounting for between-study heterogeneity using Review Manager (Revman 5.3). Subgroup analyses were performed for gender, baseline age ± 44 years, BMI ± 27.5 kg/m² and by study duration (short- and long-term).

Results: Of the fourteen RCTs identified by a systematic review, four were from Europe (The PODOSA study (Scotland) of 3 years duration, the DHIAAN study of two years duration (The Netherlands), the INNVA-Dia study of 7 months duration with women only (Norway) and the PAMH study of 5 months duration with men only (Norway)). The interventions combined dietary and physical activity in all but the PAMH study which used physical activity only. The study quality was found to be strong to moderate. Individual participant data for 775 South Asians were included. Significant reductions in the intervention groups compared to controls (Figure 1) for

fasting glucose (-0.11 (95% confidence interval: -0.22 to 0.00); P 0.04, I2 0%), 2hour glucose (0.27 mmol/l (-0.53 to -0.01); P: 0.04, I2 0 %), weight (1.13 kg (-1.81 to -0.46); P: 0.0009, I2 62 %) and waistcircumference (-1.59 cm (-2.94 to -0.24); P: 0.02, I2 77 %) were found. A subgroup effect was found only for gender (Figure 3) for weight ((men 1.91 kg (-2,61 to -1.22), women (0.34 kg (-0.90 to 0.22), P for interaction: 0.0005)) (Figure 2).

Conclusions: IPD meta-analyses of all RCT's among South Asians in Europe revealed clinically small, but consistent effects on glucose measures, weight and waist circumference, and a stronger effect on weight reduction in men than in women.

Update of abstract based on extended analyses as per May 29.th 2018;

Previous analysis, extended with two eligible trials from India, with new title:

EFFECTS OF DIETARY AND PHYSICAL ACTIVITY INTERVENTIONS ON THE RISK OF TYPE 2 DIABETES IN SOUTH ASIANS: INDIVIDUAL PARTICIPANT DATA META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

(Paper in progress, full paper will be submitted soon)

Background: The effectiveness of diet and/or physical activity lifestyle modification interventions on prevention of type 2 diabetes in South Asians is unclear. We performed an individual participant data meta-analysis of randomised controlled trials (RCTs) in this high-risk population.

Methods: We searched PUBMED, Embase, Cochrane Library and Web of Science (to September 30th 2017) for RCTs on lifestyle modification interventions in South Asian adults, and obtained individual participant data on 1816 participants from all six eligible trials (from Europe and India) identified. Applying a 2-step approach, we generated hazard estimates for incident diabetes and mean differences for fasting glucose, 2-hour glucose, weight and waist circumference, using fixed-effect meta-analysis overall, and by pre-specified subgroups. We applied the GRADE system to rate the quality of evidence. (PROSPERO registration CRD4217078003).

Results: In high-risk South Asian populations, lifestyle modification interventions resulted in modest adiposity and postprandial glucose changes, but a 35% relative reduction in diabetes incidence, consistent across subgroups.

Implication: Given the increasing global burden of disease from diabetes, lifestyle modification interventions strategies should be more widely used to improve the diet and promote physical activity, and through so doing substantially reduce the risk of diabetes in populations of South Asian origin, known to be at high risk. We also need to find better ways or adapt interventions to try to achieve greater benefits.

ANNEX 3. EuroDHYAN WP 4.3

QUALITATIVE EVALUATION OF INTERVENTION ELEMENTS FROM INTERVIEW DATA

Developing culturally adapted lifestyle interventions for South Asian migrant populations: a qualitative study of the key success factors and main challenges

Laura Terragni^{a,b}, Erik Beune^c, Karien Stronks^c, Emma Davidson^d, Samera Qureshi^a,

Bernadette Kumar^{a,e} and Esperanza Diaz^{a,f}

^aNorwegian Centre for Migration and Minority Health Research (NAKMI), Oslo, Norway.

^bInstitute of Nursing and Health Promotion, Department of Health, OsloMet – Oslo Metropolitan University., Oslo, Norway

^cDepartment of Public Health, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands

^dUsher Institute of Population Health Sciences and Informatics, University of Edinburgh, Scotland

^eDepartment of Community Medicine, Institute of Health and Society, University of Oslo, Oslo, Norway

^fDepartment of Global Public Health and Primary Care, University of Bergen, Norway

Corresponding author:

Laura Terragni, Institute of Nursing and Health Promotion, Department of Health, OsloMet – Oslo Metropolitan University. Postboks 4 St. Olavs plass, 0130 Oslo, Norway. +47 67236522; laura.terragni@oslomet.no

Full post address and e-mail addresses of the other authors:

Erik Beune, Department of Public Health, Academic Medical Center, University of Amsterdam Meibergdreef 9 1105 AZ Amsterdam; e.j.beune@amc.uva.nl

Karien Stronks, Department of Public Health, Academic Medical Center, University of Amsterdam Meibergdreef 9 1105 AZ Amsterdam k.stronks@amc.uva.nl

Emma Davidson, Usher Institute of Population Health Sciences and Informatics, University of Edinburgh, Old Medical School, Teviot Plac, Edinburgh EH8 9AG; Emma.Davidson@ed.ac.uk

Samera. Qureshi, Centre for Migration and Minority Health Research (NAKMI), Oslo universitetssykehus Postboks 4959 Nydalen 0424 Oslo; samera@nakmi.no

Bernadette Kumar, Centre for Migration and Minority Health Research (NAKMI), Oslo universitetssykehus Postboks 4959 Nydalen 0424 Oslo; Bernadette.Kumar@nakmi.no

Esperanza. Diaz, Department of Global Public Health and Primary Care, Bergen University PO.box 7804 N-5020 Bergen; Esperanza.Diaz@uib.no

Abstract

Objectives: South Asian migrant populations have a high risk of non-communicable diseases, such as type 2 diabetes (T2D). The aim of this study is to provide in-depth insight into key success factors and challenges in developing culturally adapted lifestyle interventions to prevent T2D within South Asian migrant populations.

Study design: Qualitative research study.

Methods: In-depth interviews, using a semi-structured interview guide, were conducted with eight researchers and project leaders from five studies of culturally adapted lifestyle interventions for South Asian migrant populations. Data were analysed using a grounded theory approach.

Results: Four main themes emerged as key factors for success: ‘approaching the community in the right way’, ‘the intervention as a space for social relations’, ‘support from public authorities’, and ‘being reflexive and flexible’. Two themes emerged as challenges: ‘struggling with time’ and ‘overemphasising cultural differences’.

Conclusions: Our findings augment existing research by establishing the importance of cooperation at the organisational and institutional levels, of fostering the creation of social networks through interventions and of acknowledging the multiplicity of identities and resources among individuals of the same ethnic origin.

Keywords

Cultural adaptation; lifestyle interventions; key factors for success, main challenges, South Asians; qualitative study

Introduction

Today, more than five million people of South Asian origin live in Europe. People of South Asian origin have a higher risk of developing type 2 diabetes (T2D) at a younger age and at a lower body weight than their European counterparts.^{1,2} This increased risk is partly because of lifestyle changes and nutritional transition following migration.^{2,3} Consequently, prevention of T2D for South Asian people living in Europe is a priority to improve their wellbeing and to reduce inequalities in health.^{4,5}

Existing studies indicate that diet and physical activity interventions are effective in preventing T2D.^{6,7} However, interventions appear to be more effective for host (European origin) populations than for South Asian migrant populations.^{3,8,9} Culture is a key component of health maintenance and health promotion,¹⁰⁻¹² and there is growing awareness that interventions need to be culturally adapted to meet the needs of, and thereby be effective for, specific population groups.^{13,14} Cultural adaptation aims to enhance the effectiveness of interventions by grounding them in the lived experience of the participants.¹⁵ More specifically, cultural adaptation has been defined as ‘the systematic modification of an evidence-based treatment (EBT) or intervention protocol to consider language, culture, and context in such a way that it is compatible with the client’s cultural patterns, meanings, and values’.¹⁵ As Resnicow pointed out, cultural adaptation needs to go beyond the ‘surface structure’ of interventions and reach its ‘deep structure’.¹³ Surface structure refers to observable characteristics, such as language, while deep structure encompasses cultural, social, environmental and psychological factors. Strategies for culturally adapting health promotion interventions have been described in several studies.^{9,16-20} Evidence regarding the effectiveness of cultural adaptations is promising but not conclusive.^{8,19,}

²¹⁻²³ For instance, an evaluation of culturally adapted lifestyle interventions targeting South Asian populations showed only moderate effect.²⁴ This raises the question of whether the strategies used in these interventions are entirely appropriate and indicates that much remains to be learned about how to adapt interventions to best meet the needs of South Asian migrant populations to reduce their risk of T2D.^{24, 25} As a part of the EU project ‘Innovative Prevention Strategies for T2D in South Asians Living in Europe’ (www.eurodhyan.eu), a systematic review of lifestyle interventions to prevent T2D among South Asian populations was performed to identify which elements contribute to their acceptability, reach and effectiveness^{24, 26}. With a few exceptions, the articles included did not provide much detail about how the development and implementation of interventions actually took place—what functioned well and what did not. Therefore, we decided to gather more information by conducting qualitative interviews with key researchers involved in interventions of this type. The aim of this study is to provide in-depth insight into the success factors and challenges in developing these culturally adapted interventions to prevent T2D within South Asian migrant populations. The results of this study will provide valuable information for designing health promotion initiatives for South Asians at risk of developing T2D.

Methods

Qualitative research is particularly useful to understand how people interpret their experiences, explore meanings and provide new understanding of a phenomenon.²⁷ This study is based on qualitative interviews with key researchers who conducted lifestyle interventions for the prevention of T2D with South Asian migrant populations.^{21, 28-34} Research interventions from which qualitative insights might be

gained were identified from two systematic reviews conducted; the one already mentioned²⁶ and another previously conducted members of our research team³⁵. Five relevant studies were selected, based on the effect of the intervention and the relevance in terms of cultural adaptation, the research design and the relevance of the population. Members of our team had already interviewed five researchers involved in three of these studies as part of a previous study on cultural adaptation of intervention for smoking cessation, physical activity, and healthy eating for African-, Chinese- and South Asian-origin groups. Given the common purpose between the two studies, we agreed to include and reanalyse those interviews in the light of the research questions of the current study. Despite some possible methodological limitations, secondary analysis of interviews can prove fruitful for focussing on concepts that were present but not specifically addressed in the first analysis.^{36, 37} In addition, three new interviews were conducted, resulting in data being analysed from a total of eight interviews related to five interventions. The interview guide for these three new interviews was modelled on the existing topic guide, to include the same themes and questions. All project leaders of the five selected research interventions were interviewed as, because of their role, they could provide experiences on the whole process. In addition, for two interventions, we interviewed two researchers and one dietitian, this was due to the complexity of the interventions and the utility of gathering experiences with informants having different roles in the project and therefore could contribute with different views on the process of cultural adaptation. The field researchers and dietician's roles provide insights more closely reflecting how it would actually be to try and operationalise such health programmes within these communities. Detailed information about the interventions included in the study and the informants are provided in table 1.

A specific semi-structured interview guide was developed for the new interviews conducted in this study. The interview guide for the three new interviews included topics that were also asked about in the existing interviews to facilitate the secondary analysis.³⁷ Informants were asked to describe the intervention design and participants; the implementation; the most important contextual factors to consider when designing an intervention for South Asian populations; and, finally, the lessons learnt. Interviews were conducted either face to face or by phone, with durations varying from 60 to 90 minutes. All eight interviews were audio-recorded and transcribed verbatim.

Analysis of the interviews

Data analysis was conducted using grounded theory.³⁸ Coding was aimed to identify emerging themes related to developing and conducting these interventions. Codes were generated using an iterative inductive process.³⁸ Line-by-line coding and the informants' own words were used to generate the first series of codes. Two researchers (LT and EZ) independently analysed the interviews and agreed on a preliminary code list and emerging themes. Codes were then revised and synthesised into categories and theoretical codes. A preliminary analysis was presented and discussed among the research team. Theoretical codes and main categories are described in table 2. The transcripts were coded using NVivo.10.

Results

Informants appeared pleased to convey experiences from their research. They talked about how their projects were conceived, how they subsequently evolved, and their outcomes. They were open about obstacles that they faced and admitted that

interventions did not always progress as expected. Goals had to be revised, field work took more time than planned, and new aspects emerged as important. The interviews provided rich insights into the experience of developing culturally adapted interventions. Six main themes emerged. Four related to the key factors for success: ‘approaching the community in the right way’, ‘intervention as a place for social relations’, ‘support from public authorities/other relevant actors’ and ‘being reflexive and flexible’. Two themes represented the main challenges: ‘struggling with time’ and ‘overemphasising cultural differences’ (Fig.1).

Key factors for success

Approaching the community in the *right way*

A common theme among informants was their difficulty in establishing trust with intervention participants. They found that participants from South Asian communities were often sceptical, or even frightened, about being involved in a study.

‘I think minorities need to be reached appropriately. They need to be treated with a lot of respect because they are migrant, and they are always scared [...]’ (Inf.2).

Also, interviewees mentioned communities’ fear of exploitation and wariness at repeatedly being asked to participate in studies.

‘There’s been a lot of research on the South Asian community in the last few years, and people said to us, “Oh, you’re asking again, you know, well we never hear anything, and we never get anything back and, you know, this takes us time and energy”’ (Inf.3).

For these reasons, many informants emphasised the importance of approaching the community 'in the right way'.

'You cannot just knock on their door and say, "Okay, this is the paper; take it, read it, it is in your language, and follow the dietary guidelines" [...] I need to have an understanding, I need to engage this community, I need to identify the leadership which is within the community, I need to identify my community volunteers. I need to identify existing groups and I need to know the community' (Inf.2).

One strategy was to involve researchers or team members belonging to the same ethnic minority community. This created a bridge between the research team and intervention participants and facilitated trusting relationships.

'It probably did make a difference [...] that some of our team were very well known in the community, and I think they probably had more of [an] effect. I think in the South Asian community, you kind of build up gradually a sort of respect. [...] You know, [get] to know somebody, and then, they'll listen to you' (Inf.1).

Other strategies included finding the appropriate channels, establishing relationships built on trust, involving participants, and sharing the results with the community.

'I made contact with a woman of Pakistani origins. She introduced me to a politician. I met him, and there were other men, eight or ten. I talked to them, and they were extremely willing to cooperate. They helped me with everything [...] They helped me with the mosque, to get the right contacts. I asked them about everything' (Inf.6).

Interventions as a space for social relations

Some of the informants reported that a paucity of opportunities for social interactions characterised the lives of intervention participants.

'Migrant people aren't established, they aren't settled, they don't necessarily have wide social networks, and they don't have a lot of social capital' (Inf.5).

Interviewees found that making interventions a tool for fostering social relations with other members of the same community was an important factor, as this motivated people to participate to the intervention and in maintaining the new "good habits".

An informant recalled, for instance, that participating in the intervention contributed to creating stronger networks among women living in the same neighbourhood.

'It was not planned as part of the intervention. But because the women were from the same suburb, it happened that they had children attending the same school. Now, that actually evolved to the point where they were walking the children to school, and they would meet other women, who were also part of the trial at the school [...]' (Inf.1).

Similarly, in another intervention, the informant stated how playing floorball (a type of floor hockey) became a regular activity that continued after the intervention ended; the participants, who mostly had not known each other previously, gathered, gave each other suggestions and encouragement, and enjoyed being together and using their mother tongue.

'We decided to have only Pakistani men because they could function better as a group. Maybe it was not ideal in terms of integration [...] But I wanted a group that functioned. They talked much Urdu between them' (Inf.6).

Support from public authorities

Informants reported that promoting lifestyle changes was difficult and that support from the local community could make a difference. The importance of having the support of local authorities (or other relevant organisations) was stressed, particularly for interventions involving physical activity, in order to create appropriate environments that could facilitate the participation of ethnic minority communities. A typical example was the use of swimming pools for Muslim women.

'One of the big things we were able to actually implement was female-only swimming sessions at a couple of the local swimming pools. It was quite a battle to start with because [...] we were actually breaking equal opportunity laws by doing that. I thought it was fantastic in terms of what that was doing; yes, our Pakistani or Muslim women in the area felt comfortable enough to go to the pool and exercise' (Inf.1).

In other interventions, a lack of cooperation with local authorities was shown to represent an obstacle in keeping up physical activity after the intervention ended.

'The two activities they would like to do the most are walking or swimming, and they're sad that there's no longer free swimming. They're also sad because certain city councils used to offer swimming classes for women only, that had women as lifeguards, and they could do those things, but if [the classes are] not offered in that way then they can't attend' (Inf.4).

The importance of cooperation with public authorities was also emphasised by an informant working on an intervention in a routine healthcare setting. This intervention was unsuccessful, partially because of a lack of time, motivation and preparation on the part of the nurses in the project.

'I think if I were to carry out the whole study again, we would use specific research nurses. But we specifically went to standard care because we wanted to be able to

implement the study. [...] But there were some practical issues [...] I think there is a drawback to working with people in practice' (Inf.7).

Being reflexive and flexible

When informants described how cultural adaptation was carried out, some reflected upon their own roles (a researcher being part of the main population) and on the importance of having a reflexive attitude towards one's own conceptions and beliefs.

'Often, because you're a part of the mainstream, you do not realise that there are other ways of doing things, and you alienate people by having your own way of doing things' (Inf.2).

Several informants stated that the interventions, despite attempts to make them culturally adapted, were actually based on preconceptions and expectations modelled on 'ideal' populations and were often too ambitious: changes and compromises had to be made in order to move at the participants' pace.

For instance, an informant leading an intervention with a physical activity component admitted not expecting participants to be in '*such bad shape*' and confessed that someone was injured at the beginning of the intervention.

'Injuries were a challenge. That was something we learned: that we must lower the intensity of the exercises. We overestimated their physical shape. They were in extremely bad shape, worse than I had imagined. So you could say we had some reflection on the intensity level' (Inf. 6).

Stressing the importance of food in South Asian culture, a researcher mentioned having to proceed carefully in introducing dietary changes.

'We let them eat the same sort of foods but with a healthier element to them—just cooked with slightly less fat, slightly less sugar. The cooking method was changed; for example, instead of frying, we could say, "Well, why don't you try putting this into the oven and use less fat? So there was a slight adaptation of recipes' (Inf.4).

Main Challenges

Struggling with time

Time pressure was a recurring theme in the interviews. Most informants reported that considerable time was needed to recruit participants from ethnic minority communities, both given their lack of trust and the need to culturally adapt the intervention. Consequently, timelines had to be revised, and projects could not always be completed within the given time.

'Initially, the project was going to be far broader than it was, but we ended up having to narrow it down based on not only budgetary constraints but also the timeframe needed to actually get the work done' (Inf.3).

The reasons for delays were deeply connected with cultural adaptation and the time and resources needed for a 'cultural' translation.

'We had an English Urdu, English Hindi and English Punjabi speaker; we went through every single question and ensured that it was culturally valid and that the meaning of the question was the same in English, Punjabi, Urdu and Hindi' (Inf.3).

In addition, as mentioned above, time was needed to approach the communities and establish relationships built on trust in order to facilitate recruitment for the interventions.

'Our main challenge has been in recruiting people to come forward for the screening stage. This proved much more time-consuming, [...] challenging and costly than had been predicted' (Inf.3).

Overemphasising cultural differences

Although there was consensus among informants on the need for cultural adaptation, the risk of overemphasising cultural differences was also raised. Underestimating the intersectionality of factors such as social class, education, age and differences in acculturation when planning interventions was clearly a concern.

'I mean, we constantly get bombarded with the message that obesity is a poor man's issue effectively. So, I mean, you can define a sub-population anyway you like. This intervention just happened to generalise about people on the basis of their ethnicity without attention to their other personal characteristics' (Inf.5).

'Say, for example, older participants were more comfortable with stereotypical recommendations about Asian cooking methods, whereas younger people made much more diverse choices, you know, a hybrid of ethnic diet, and they were made uncomfortable by talking about traditional food preparation methods' (Inf. 5).

Discussion

The aim of this article was to provide in-depth insights on the key success factors and challenges in developing culturally adapted research interventions to prevent T2D for

South Asian migrant populations. Four themes emerged relating to the key success factors and two themes emerged relating to the key challenges. From these themes, main points can be distilled of how to approach future intervention development for ethnic minority communities. One is to start the work of co-creation with community leaders and target populations at an early stage—particularly to develop trust and design interventions that truly meet their preferences and needs. It is important to plan for more time when developing adapted interventions versus mainstream interventions. There is also a need to more carefully consider the heterogeneity within population groups and design interventions with attention to intersecting contexts, determining which are of prime relevance to the community. Finally, proactively working to gain support from public authorities or other relevant local actors has been highlighted as important to facilitating the cultural adaptation and sustainability of initiatives.

Most of these aspects are consistent with findings from previous literature on adapting interventions for migrants and ethnic minority populations.^{11, 17, 18, 21, 22} In particular, the importance of approaching the community in the right way and involving appropriate stakeholders;^{11, 12} building social relations and supportive social environments;¹¹ recognising heterogeneity within migrant populations, including the influences of acculturation;^{11, 12} and the logistical constraints on interventions in terms of funding and time.^{11, 16} Our study adds to the already-existing knowledge of cultural adaptation of interventions in that, by listening to researchers' own experiences and reflections, we got a better understanding of the process of cultural adaptation in practice and aspects affecting the 'deep structure' of interventions. The study has highlighted the tensions existing between the recognised need to adapt interventions and the lack of support for this process through constraints in both research processes

(time, funding) and health service settings (support from policy makers, appropriate training in the health sector). Generating ‘high level support’ or a ‘culture for cultural adaptation’ seems pivotal to moving forward. Recognising the specificity of promoting health interventions within migrant populations is also of fundamental importance. Recent studies on the determinants of diet and physical activity among minority populations³⁹⁻⁴¹ have identified the presence of overlapping determinants between majority and minority populations. However, they also indicated that the ‘migratory context’ emerged as a cross-cutting factor influencing these determinants. This correlates with our findings. For instance, approaching the migrant community in the right way is particularly important because minorities are likely to encounter segregation and stigmatisation.⁴² Awareness of this situation and efforts to build trusting relationships can increase the reach and acceptability of interventions. The importance of shaping interventions within a social context¹⁹ also appears particularly relevant in a migratory context, where individuals may suffer from isolation and a reduced social network.⁴³ Interventions that foster social relations can not only increase the retention of participants but also strengthen social capital at the community level, which has been associated with positive health-effects.^{44, 45} A challenge that remains is how to address diversity within a defined cultural or ethnic group. As has been underlined by previous studies, culture and ethnicity are not synonymous, and wide differences exist within groups due to many intersecting contexts, including socioeconomic status and acculturation.^{10, 15, 46} For this reason, new approaches that acknowledge the multiplicity of identities and resources among individuals with the same ethnic origin are needed.

A limitation of the study is that some of the interviews were collected in a previous study. The process of secondary analysis of qualitative data presents some methodological issues such as the degree to which the data are amenable to a secondary analysis, the extent to which the research purpose of the secondary analysis differ from that of the primary study and trustworthiness of interpretation.³⁶

According to Heaton, the data “fit” in qualitative secondary analysis depends on three considerations: first, the extent of missing data; second, the extent of the degree of convergence between the questions posed by the secondary and original research respectively; third, the methods used to produce the data.

Helping to overcome these challenges are the fact that the interview guide used for the second round was modelled in order to include the themes and questions that were present in the first one – this reduced the risk of “missing data; the studies were both on understanding how to do cultural adaptation of the lifestyle (physical activity and nutrition) interventions and with the same (South Asian) population and in both cases semi-structured qualitative interviews were used.

Conclusion

Migrant populations of diverse ethnic backgrounds are increasing within Europe, and South Asian populations are at particular risk of non-communicable diseases, such as T2D.⁴⁷ Therefore, it is of pivotal importance to implement appropriate health promotion initiatives for this population. This study sought researchers’ own reflections about their projects and has helped to disentangle the key success factors to pursue in future interventions and the key challenges that remain. Our research has highlighted the added dimensions of establishing cooperation at the organisational and

institutional levels and fostering the creation of social networks through interventions, which we perceived as ‘creating a supportive culture for adaptation’.

Acknowledgements

The authors would like to thank the researchers who shared their experiences with us and Prabhiot Kour for the assistance in transcribing the interviews and organising the fieldwork.

Ethics

The study was approved by the Committee for the Protection of Human Subjects (CPHS) and by the School of Health in Social Science from the University of Edinburgh’s Research Ethics Committee.

Funding

The study was funded by the Health Programme 2014–2020 from the European Union, Grant number 664609 HP-PJ-2014 (InPreSD - Innovative Prevention Strategies for Type 2 Diabetes in South Asians Living in Europe)

Competing interests

None declared.

Contributors. L.T. conducted the analysis of the interviews and drafted the manuscript; E.B. contributed to designing the study, interpreting the data and revising different versions of the manuscript; K.S. contributed to designing the study and commented on different versions of the manuscript; E.D. conducted some of the interviews and commented on different versions of the manuscripts; S.Q. contributed to designing the study, participated in the analysis and commented on different versions of the manuscript; B.K. designed the study, conducted some of the interviews, participated in the analysis and commented on different versions of the manuscript; E. D. contributed to designing the study, conducted some of the interviews, participated in the analysis and commented on different versions of the manuscript. All authors have approved of the final article, validated the contents.

References

1. Razum O, Steinberg H. Diabetes in Ethnic Minorities and Immigrant Populations in Western Europe. *Diabetes Mellitus in Developing Countries and Underserved Communities*: Springer; 2017. p. 225-33.
2. Gujral UP, Pradeepa R, Weber MB, Narayan K, Mohan V. Type 2 diabetes in South Asians: similarities and differences with white Caucasian and other populations. *Annals of the New York Academy of Sciences*. 2013; 1281:51-63.
3. Meeks KA, Freitas-Da-Silva D, Adeyemo A, Beune EJ, Modesti PA, Stronks K, et al. Disparities in type 2 diabetes prevalence among ethnic minority groups resident in Europe: a systematic review and meta-analysis. *Internal and emergency medicine*. 2016; 11:327-40.
4. Schulz AJ, Zenk S, Odoms-Young A, Hollis-Neely T, Nwankwo R, Lockett M, et al. Healthy eating and exercising to reduce diabetes: exploring the potential of social determinants of health frameworks within the context of community-based participatory diabetes prevention. *American Journal of Public Health*. 2005; 95:645-51.
5. Health WCoSDo, Organization WH. Closing the gap in a generation: health equity through action on the social determinants of health: Commission on Social Determinants of Health final report: World Health Organization; 2008.
6. Lindström J, Louheranta A, Mannelin M, Rastas M, Salminen V, Eriksson J, et al. The Finnish diabetes prevention study (DPS). *Diabetes care*. 2003; 26:3230-6.
7. Orozco LJ, Buchleitner AM, Gimenez-Perez G, Roqué i Figuls M, Richter B, Mauricio D. Exercise or exercise and diet for preventing type 2 diabetes mellitus. *The Cochrane Library*. 2008.
8. Diaz E, Ortiz-Barreda G, Ben-Shlomo Y, Holdsworth M, Salami B, Rammohan A, et al. Interventions to improve immigrant health. A scoping review. *European journal of public health*. 2017.
9. Lagisetty PA, Priyadarshini S, Terrell S, Hamati M, Landgraf J, Chopra V, et al. Culturally Targeted Strategies for Diabetes Prevention in Minority Population: A Systematic Review and Framework. *The Diabetes Educator*. 2017; 43:54-77.
10. Napier AD, Ancarno C, Butler B, Calabrese J, Chater A, Chatterjee H, et al. Culture and health. *The Lancet*. 2014; 384:1607-39.
11. Asad AL, Kay T. Toward a multidimensional understanding of culture for health interventions. *Social Science & Medicine*. 2015; 144:79-87.
12. Helman CG. *Culture, health and illness*: CRC Press; 2007.
13. Resnicow K, Jackson A, Braithwaite R, DiIorio C, Blisset D, Rahotep S, et al. Healthy Body/Healthy Spirit: a church-based nutrition and physical activity intervention. *Health Education Research*. 2002; 17:562-73.
14. Razum O, Spallek J. Addressing health-related interventions to immigrants: migrant-specific or diversity-sensitive? *International journal of public health*. 2014; 59:893-5.
15. Castro FG, Barrera Jr M, Holleran Steiker LK. Issues and challenges in the design of culturally adapted evidence-based interventions. *Annual Review of Clinical Psychology*. 2010; 6:213-39.
16. Liu JJ, Davidson E, Bhopal RS, White M, Johnson MRD, Netto G, et al. Adapting health promotion interventions to meet the needs of ethnic minority groups: mixed-methods evidence synthesis. 2012.
17. Netto G, Bhopal R, Lederle N, Khatoon J, Jackson A. How can health promotion interventions be adapted for minority ethnic communities? Five principles for guiding the development of behavioural interventions. *Health Promotion International*. 2010; 25:248-57.
18. Davidson EM, Liu JJ, Bhopal R, White M, Johnson MR, Netto G, et al. Behavior change interventions to improve the health of racial and ethnic minority populations: a tool kit of adaptation approaches. *Milbank Quarterly*. 2013; 91:811-51.
19. Nierkens V, Hartman MA, Nicolaou M, Vissenberg C, Beune EJ, Hosper K, et al. Effectiveness of cultural adaptations of interventions aimed at smoking cessation, diet, and/or physical activity in ethnic minorities. A systematic review. *PloS one*. 2013; 8:e73373.

20. Gumber A, Gumber L. Improving prevention, monitoring and management of diabetes among ethnic minorities: contextualizing the six G's approach. *BMC research notes*. 2017; 10:774.
21. Wallia S, Bhopal R, Douglas A, Bhopal R, Sharma A, Hutchison A, et al. Culturally adapting the prevention of diabetes and obesity in South Asians (PODOSA) trial. *Health promotion international*. 2013;dat015.
22. Truong M, Paradies Y, Priest N. Interventions to improve cultural competency in healthcare: a systematic review of reviews. *BMC Health Services Research*. 2014; 14:99.
23. Brown T, Smith S, Bhopal R, Kasim A, Summerbell C. Diet and physical activity interventions to prevent or treat obesity in South Asian children and adults: a systematic review and meta-analysis. *International journal of environmental research and public health*. 2015; 12:566-94.
24. Muilwijk M, Stronks K, Qureshi SA, Beune E, Celis-Morales C, Gill J, et al. Dietary and physical activity strategies to prevent type 2 diabetes in South Asian adults: protocol for a systematic review. *BMJ open*. 2017; 7:e012783.
25. Tabak RG, Sinclair KA, Baumann AA, Racette SB, Kuhlmann AS, Johnson-Jennings MD, et al. A review of diabetes prevention program translations: use of cultural adaptation and implementation research. *Translational behavioral medicine*. 2015; 5:401-14.
26. Muilwijk M, Nicolaou M, Qureshi SA, Celis-Morales C, Gill JMR, Sheikh A, et al. Dietary and physical activity strategies to prevent type 2 diabetes in South Asian adults: a systematic review
International Journal of Environmental Research and Public Health. 2018.
27. Merriam SB, Tisdell EJ. *Qualitative research: A guide to design and implementation*: John Wiley & Sons; 2015.
28. Admiraal WM, Vlaar EM, Nierkens V, Holleman F, Middelkoop BJ, Stronks K, et al. Intensive lifestyle intervention in general practice to prevent type 2 diabetes among 18 to 60-year-old South Asians: 1-year effects on the weight status and metabolic profile of participants in a randomized controlled trial. *PLoS One*. 2013; 8:e68605.
29. Andersen E, Burton NW, Anderssen SA. Physical activity levels six months after a randomised controlled physical activity intervention for Pakistani immigrant men living in Norway. *International Journal of Behavioral Nutrition and Physical Activity*. 2012; 9:47.
30. Andersen E, Høstmark AT, Holme I, Anderssen SA. Intervention effects on physical activity and insulin levels in men of Pakistani origin living in Oslo: a randomised controlled trial. *Journal of immigrant and minority health*. 2013; 15:101-10.
31. Bhopal RS, Douglas A, Wallia S, Forbes JF, Lean ME, Gill JM, et al. Effect of a lifestyle intervention on weight change in south Asian individuals in the UK at high risk of type 2 diabetes: a family-cluster randomised controlled trial. *The Lancet Diabetes & Endocrinology*. 2014; 2:218-27.
32. Kousar R, Burns C, Lewandowski P. A culturally appropriate diet and lifestyle intervention can successfully treat the components of metabolic syndrome in female Pakistani immigrants residing in Melbourne, Australia. *Metabolism*. 2008; 57:1502-8.
33. Nicolaou M, Vlaar E, Van Valkengoed I, Middelkoop B, Stronks K, Nierkens V. Development of a diabetes prevention program for Surinamese South Asians in the Netherlands. *Health promotion international*. 2014; 29:680-91.
34. Rush EC, Chandu V, Plank LD. Reduction of abdominal fat and chronic disease factors by lifestyle change in migrant Asian Indians older than 50 years. *Asia Pacific journal of clinical nutrition*. 2007; 16:671-6.
35. Liu J, Davidson E, Bhopal R, White M, Johnson M, Netto G, et al. Adapting health promotion interventions to meet the needs of ethnic minority groups: mixed-methods evidence synthesis. *Health Technology Assessment (Winchester, England)*. 2012; 16:1.
36. Hinds PS, Vogel RJ, Clarke-Steffen L. The possibilities and pitfalls of doing a secondary analysis of a qualitative data set. *Qualitative Health Research*. 1997; 7:408-24.
37. Heaton J. *Reworking qualitative data*: Sage; 2004.
38. Charmaz K. Constructionism and the grounded theory method. *Handbook of constructionist research*. 2008:397-412.

39. Osei-Kwasi HA, Nicolaou M, Powell K, Terragni L, Maes L, Stronks K, et al. Systematic mapping review of the factors influencing dietary behaviour in ethnic minority groups living in Europe: a DEDIPAC study. *International Journal of Behavioral Nutrition and Physical Activity*. 2016; 13:85.
40. Holdsworth M. Developing a systems-based framework of the factors influencing dietary and physical activity behaviours in ethnic minority populations living in Europe - A DEDIPAC study. 2017.
41. Langøien LJ. Systematic mapping review of the factors influencing physical activity and sedentary behaviour in ethnic minority groups in Europe: a DEDIPAC study.
42. Ahmad WI, Bradby H. Locating ethnicity and health: exploring concepts and contexts. *Sociology of health & illness*. 2007; 29:795-810.
43. Berry J, Sam D. *Acculturation: Conceptual background and theoretical perspectives*. Cambridge Handbook of Acculturation Psychology. Cambridge: Cambridge University Press; 2015.
44. Eriksson M, Emmelin M. What constitutes a health-enabling neighborhood? A grounded theory situational analysis addressing the significance of social capital and gender. *Social Science & Medicine*. 2013; 97:112-23.
45. Pickett KE, Wilkinson RG. People like us: ethnic group density effects on health. *Ethnicity & health*. 2008; 13:321-34.
46. Kreuter MW, Lukwago SN, Bucholtz DC, Clark EM, Sanders-Thompson V. Achieving cultural appropriateness in health promotion programs: targeted and tailored approaches. *Health Education & Behavior*. 2003; 30:133-46.
47. Rechel B, Mladovsky P, Ingleby D, Mackenbach JP, McKee M. Migration and health in an increasingly diverse Europe. *The Lancet*. 2013; 381:1235-45.

TABLE 1. Description of the main characteristics of the interventions conducted and researchers interviewed in this study

Name/topic of the project	Intervention design	Intervention components	Participants	Duration of the intervention	Location Year of intervention	Informants and Year of the interview
Culturally appropriate diet and lifestyle intervention to treat metabolic syndrome in female Pakistani immigrants residing in Melbourne. ³²	Intervention study Family focus	Both physical activity and diet	Pakistani women with metabolic syndrome (aged 20–50 years)	12 weeks	Melbourne Australia Study published in 2008	Project Leader (2010) Main Researcher (2010)
Reduction of abdominal fat and chronic disease factors by lifestyle change in migrant Asian Indians. ³⁴	Group intervention study	Both physical activity and diet	Asian Indians (both F & M) aged >50 years	5 months	Auckland (New Zealand) Study published in 2007	Project Leader (2010)
PODOSA-lifestyle intervention on weight change in south Asian individuals in the UK. ³¹	Family-clustered randomised controlled trial	Both physical activity and diet	Men and women of Indian and Pakistani origin, aged 35 years or older.	3 years	Scotland(UK 2007-2009	Project Leader (2009) Main Dietitian (2010), Researcher (2016)
DHIAAN lifestyle intervention in general practice to prevent type 2 diabetes among 18 to 60-year-old South Asians. ^{28,33}	Randomised controlled trial	Both physical activity and diet	Men and Women Hindustani-Surinamese	1 year	The Hague, The Netherlands	Main Researcher (2016)
Intervention effects on physical activity and insulin levels in men of Pakistani origin. ^{29,30}	Randomised controlled trial	Physical activity	Men of Pakistani origin	5 months	Oslo, Norway 2009	Main Researcher (2016)

Tab.2 Main themes related to ‘success’ and ‘challenges’ in the implementation of interventions as emerged from the analysis of the interviews

Key factors of success	
Approaching the community in the "right way"	<ul style="list-style-type: none"> • Build relation of trust • Overcome fear • Identify 'door opener' • Involve the community • Use team workers from the same community • Capitalise on the desire for change
Intervention as a space for social relations	<ul style="list-style-type: none"> • Create opportunities for building networks • Mobilise existing resources • Make participants feel at ease
Support from public authorities	<ul style="list-style-type: none"> • Build alliances with local institution • "Bend" Some rules • Build capacity • • Find creative solutions
Being reflexive and flexible	<ul style="list-style-type: none"> • Acknowledge different values and practices • Adapt to the participants' pace
Main Challenges	
Struggling with time	<ul style="list-style-type: none"> • Recruitment • Language and communication • • Cultural adaptation • Lack of long-time investment and commitment
Overemphasising cultural differences	<ul style="list-style-type: none"> • Limitations of using ethnicity to define groups • Differences in acculturations • Differences in social class • Paternalism