

**How to Cite:**

Soibam, D., & Bansal, A. (2022). Impact of diet and physical activities in preventing type II diabetes mellitus in Asia: A systematic review. *International Journal of Health Sciences*, 6(S8), 4202–4218. <https://doi.org/10.53730/ijhs.v6nS8.13140>

## **Impact of diet and physical activities in preventing type II diabetes mellitus in Asia: A systematic review**

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**Abstract**---Diabetes is a major lifestyle disorder, the prevalence of which is increasing globally. Asian countries contribute to more than 60% of the world's diabetic population as the prevalence of diabetes is increasing in these countries. Asians have a strong ethnic and genetic predisposition for diabetes and have lower thresholds for the environmental risk factors. As a result, they develop diabetes at a younger age and at a lower body mass index and waist circumference when compared with the Western population. The review aims to explore impact of Diet and Physical activities in preventing Type II Diabetes Mellitus in Asia. The study involved a systematic review from internet databases such as Pubmed and CINHAL. Following that, databases were accessed to conduct a more detailed search of the literature using key phrases and Boolean operators to create articles pertinent to the issue. 1740 records identified. The duplicates and those not matching with the criteria were excluded. 8 articles were filtered using an inclusion/exclusion criterion. Dietary and physical activity components, and effects on T2D incidence, glycemic status and adiposity measures, were summarized in tabular format and evaluated narratively. Results showed that the interventions have positive impacts on the reduction of levels of parameters. However Intervention studies and guidelines did not reference evidence to support the effectiveness of components included in the intervention for South Asian populations in particular. The study concluded that Evaluation of current and emerging components among South Asian populations and subgroups seems necessary to formulate more specific recommendations in future intervention studies and guidelines.

**Keywords**--diabetes mellitus, diet, diet therapy, exercise, physical activity, Asia, southeast Asia.

## **Introduction**

Diabetes is a major lifestyle disorder, the prevalence of which is increasing globally. Asian countries contribute to more than 60% of the world's diabetic population as the prevalence of diabetes is increasing in these countries. Socio-economic growth and industrialization are rapidly occurring in many of these countries (Janus et al., 2000). The urban-rural divide in prevalence is narrowing as urbanization is spreading widely, adversely affecting the lifestyle of populations. Asians have a strong ethnic and genetic predisposition for diabetes and have lower thresholds for the environmental risk factors. As a result, they develop diabetes at a younger age and at a lower body mass index and waist circumference when compared with the Western population (Ramachandran et al., 2012). Populations of South Asian origin have a high risk for type 2 diabetes (T2D) and its complications, both in the country of origin and after migration. In comparison with populations of European origin, South Asians have been shown to develop T2D at a younger age and at lower levels of adiposity (Sattar & Gill, 2015). In the South Asian subcontinent, the diabetes epidemic has been fuelled by changes in the diet and patterns of physical activity due to economic transitions, especially in urban populations. As diet and physical activity are key modifiable risk factors for T2D, intervention studies and guidelines that aim to prevent or delay the onset of T2D include strategies to improve dietary intake and physical activity (Group, 2012)

## **Justification**

The prevalence of diabetes, constituted chiefly by type 2 diabetes (T2D), is a global public health threat. The prevalence among adults aged 20-70 years is expected to rise from 285 million in 2010 to 438 million by the year 2030. While T2D poses a huge economic burden to all nations, developing countries bear the highest burden since more than 80% of cases occur in these countries (Alberti et al., 2007). Prevalence estimates of diabetes and impaired glucose tolerance (IGT) are high for all Asian countries and are expected to increase further in the next two decades (Zheng et al., 2012). The present trend indicates that more than 60% of the world's diabetic population will be in Asia.

The adverse effect of physical inactivity and fatty food are manifested as the increasing rate of overweightness and obesity, even among children. The health care budgets for the disease management are meager and the health care outcome is far from the optimum. As a result, complications of diabetes are common and the economic burden is very high, especially among the poor strata of the society (Bhopal et al., 2014). National endeavours are urgently needed for early diagnosis, effective management and for primary prevention of diabetes.

Recently, interventions targeting diet and physical activity have been developed to reduce the risk of T2D among populations of South Asian origin. However, the trials evaluating these interventions only show small to moderate effects (Admiraal

et al., 2013). We speculate that this may be related to the lack of targeting of recommended dietary and physical activity intervention components (hereinafter referred to as components) to the needs of South Asian populations. While many interventions reported cultural adaptation of the mode of delivery, and inclusion or exclusion of components based on the prevalence of certain health behaviours in the target population it is uncertain whether the included components were sufficiently targeted to specific characteristics of South Asian populations (Iliodromiti et al., 2016)

There is some evidence to suggest that the effects of specific changes in physical activity or diet may be different in South Asian origin populations than in, for instance, those of European origin. For instance, a difference in the effect of a high-calorie, high-fat diet on insulin sensitivity was found between South Asian and White European origin men (Bakker et al., 2014). Other reports have suggested that the association between duration of physical activity and cardio-metabolic risk factors differs between South Asian and European origin men and women. While previous reviews have discussed the effects of interventions on the prevention of T2D, for instance by estimating the effects on weight loss, none have examined the specific components that were included in the interventions (Brown et al., 2015). Therefore, this systematic review set out to examine the dietary and physical activity components in intervention studies for the prevention of T2D in adult Asian populations worldwide

### **Aim**

This dissertation aims to critically review the best available evidence dietary and physical activity components for the prevention of T2D and make a suggestion for future interventions

### **Objectives**

1. To critically analyse current literature on dietary and physical activity components for the prevention of T2D in Asia
2. To extract the data from the eligible studies and produce a final list of studies to be included.
3. To draw conclusions from the findings of the eligible studies to enable meta-analysis;
4. To interpret the findings and conclude the suitable recommendations

### **Research Question**

The main aim of this review is to investigate how dietary and physical activity components are impacting on the prevention of T2D in Asia

### **Literature Review**

The review of literature is a summary of current knowledge about a particular practice, problem and includes what is known and what is unknown about the problem. Literature is reviewed to summarize knowledge for use in practice or to provide a basis for conducting a study.

## **Epidemiology of Diabetes in Asia**

Epidemiological studies have documented consistent increases in the prevalence of diabetes across different countries or areas in Asia. For example, the prevalence of diabetes in China has increased dramatically from around 1% in 1980 to the most recent estimate of 9.7% from a nationwide survey, with the disease trends strongly associated with urbanization (Yoon et al., 2006). In a systematic review of 22 studies on diabetes prevalence and associated factors in China from 2000 to 2010, diabetes prevalence increased from 2.6% to 9.7% during this decade, with increasing age, urban residence, positive family history, obesity, and hypertension being common associated risk factors (Li et al., 2012).

This pattern of increasing prevalence over the last 20 years is mirrored in many Asian countries, as shown by data on the prevalence of known and undiagnosed diabetes, as well as impaired glucose tolerance (IGT) in East Asia. In addition to ethnic differences within Asian populations, urbanization provides another source of variation in prevalence of diabetes in different areas. A comparison of 35 epidemiological studies from Mainland China, Hong Kong, and Taiwan, noted that Chinese patients living in Hong Kong and Taiwan have a higher prevalence of diabetes than Mainland Chinese (Wong & Wang, 2006).

Globally, there is a general decrease in the age of diagnosis for diabetes, (Chen et al., 2011) although the proportion of young- to middle-aged individuals with T2D remains higher in developing countries and Asia.<sup>1</sup> In the Diabetes Epidemiology: Collaborative Analysis of Diagnostic Criteria in Asia (DECODA) study, which evaluated 19,845 subjects from Asia, it was noted that the age-specific prevalence of diabetes in urban Chinese and Japanese patients was higher than that in Europeans at 30–69 years of age from the Diabetes Epidemiology: Collaborative Analysis of Diagnostic criteria in Europe (DECODE) study (Qing Qiao, 2003)

## **Diagnosis of Type II DM in Asians**

Traditionally, the American Diabetes Association (ADA) does not recommend the primary use of the 75 g oral glucose tolerance test (OGTT) to diagnose diabetes in routine clinical practice, although the OGTT remains the gold standard for diagnosis according to the World Health Organization (WHO) (“Diagnosis and Classification of Diabetes Mellitus,” 2012). Compared with Europeans in the DECODE study, a higher proportion of Chinese and Japanese men and women display IGT, relative to isolated impaired fasting glucose, across most age groups (Qing Qiao, 2003). In several epidemiological surveys it was noted that omitting the OGTT and postprandial plasma glucose criteria for diagnosis of T2D would have led to significant underreporting of the prevalence of diabetes in Asian populations. For example, significant decreases in the prevalence of diabetes have resulted from the application of the 1997 ADA criteria compared with the WHO criteria in Hong Kong Chinese (Ko et al., 1998). Out of 1,513 individuals in a Hong Kong Chinese working population, 27 had a known history of diabetes. Out of the remaining 1486, 29 (1.95%), with a fasting glucose <7 mmol/L, had a 2-h plasma glucose  $\geq$  11.1 mmol/L, whereas 8 individuals (0.53%), without a prior diagnosis of diabetes according to the WHO criteria, had a fasting glucose between 7.0 and 7.8 mmol/L and were classified to have diabetes according to the 1997 ADA

criteria. In the DECODA study, which involved 11 population-based studies from Asia, only 37% of subjects diagnosed with diabetes using either elevated fasting glucose or abnormal OGTT fulfilled both diagnostic criteria (Q. Qiao et al., 2000). As many as 44% of men and 50.1% of women diagnosed with diabetes in a recent epidemiological study in China had normal fasting, but isolated increased 2-h, plasma glucose.<sup>6</sup> This highlights the importance of using OGTT, despite its inconvenience, to diagnose diabetes in Asian populations.

The ADA and WHO have both included levels of hemoglobin A1c (HbA<sub>1c</sub>)  $\geq$  6.5% as one of the diagnostic criteria for diabetes. This recommendation has negated the problem of day-to-day variability of plasma glucose values and the need for fasting and dietary preparations. However, HbA<sub>1c</sub> may be affected by a variety of genetic, hematological, or illness-related factors. For example, iron or vitamin B<sub>12</sub> deficiency may lead to a falsely high HbA<sub>1c</sub>. Hemoglobinopathies may also affect HbA<sub>1c</sub> measurements, for example, due to altered amino acids on binding sites of immunoassays for HbA<sub>1c</sub>, or by causing variable interference in assays that utilize ion exchange chromatography. (Weltgesundheits organisation, 2011) Importantly, there are significant ethnic disparities in the correlation between HbA<sub>1c</sub> and ambient blood glucose levels. This may be related to genetic differences in the concentration of hemoglobin, the rates of glycation, and either the life span or the number of red blood cells (Dagogo-Jack, 2010)

### **Diet and exercise in Type II DM**

Evidence from observational studies and randomized trials suggests that prediabetes and type 2 diabetes mellitus (T2DM) can develop in genetically susceptible individuals in parallel with weight (that is, fat) gain. Accordingly, studies show that weight loss can produce remission of T2DM in a dose-dependent manner. A weight loss of ~15 kg, achieved by calorie restriction as part of an intensive management programme, can lead to remission of T2DM in ~80% of patients with obesity and T2DM. However, long-term weight loss maintenance is challenging. Obesity and T2DM are associated with diminished glucose uptake in the brain that impairs the satiating effect of dietary carbohydrate; therefore, carbohydrate restriction might help maintain weight loss and maximize metabolic benefits. Likewise, increases in physical activity and fitness are an important contributor to T2DM remission when combined with calorie restriction and weight loss (Magkos et al., 2020).

Diet and exercise are considered important components of the treatment strategy for adults with type 2 diabetes. Appropriate use of diet and exercise can improve insulin sensitivity and glycemic control and decrease the need for oral medications or insulin (Chandalia et al., 2000). Although there is some controversy over the optimal diet for adults with type 2 diabetes (high fiber, glycemic index approaches, low versus moderate fat), there is a consensus to increase consumption of fruits and vegetables and decrease daily consumption of saturated fats. Regular, moderate-intensity physical activity for 30 min at least 5 times per week is recommended for most Americans (Franz et al., 2002).

Many studies underscore these and other benefits from exercise. Exercise lowered HbA<sub>1c</sub> values by 0.7 percentage point in people of different ethnic groups with

diabetes who were taking different medications and following a variety of diets—and this improvement occurred even though they didn't lose any weight. All forms of exercise—aerobic, resistance, or doing both (combined training)—were equally good at lowering HbA1c values in people with diabetes. Resistance training and aerobic exercise both helped to lower insulin resistance in previously sedentary older adults with abdominal obesity at risk for diabetes. Combining the two types of exercise proved more beneficial than doing either one alone (Harvard Health, 2020).

Nutrition is a key factor for prevention of diabetes and helping to maintain blood glucose levels in the blood with healthier diets. Along with, weight management is a cornerstone of metabolic health and thus physical exercise. Evidence supports that avoiding processed foods, refined grains, processed red meats, and sugar sweetened drinks, but increasing to consume fiber, vegetables, and yoghurt, are beneficial to prevent diabetes, strokes, heart disease, kidney failure, avoidance of blurred vision and influence of weight loss or gain (Asif, 2014). In a meta-analysis of a Randomized Controlled Trial (RCT) with interventions >4 weeks among people with diabetes, participants on a low-GI diet (GI, glycemic Index) had a significant reduction in HbA1C than those on a high-GI diet (Danaei et al., 2014).

Mono and polyunsaturated fats (e.g., olive oil, canola oil, nuts/seeds, avocado), fatty fish (particularly those are high in omega-3 fatty acids e.g., salmon, herring, trout, Sardines, fresh tuna), skinless poultry, nonfat or low-fat dairy, and legumes while considered good to consume; sugary beverages, trans fats, dried fruits are not recommended for diabetic people (Asif, 2014). Beef, pork, lamb and high-fat dairy products (e.g., cream cheese, whole milk or yogurt), as they contain high saturated fat and may be associated with increased cardiovascular risk are also not recommended either.

Soluble fiber interventions have been shown to reduce HbA1C and plasma fasting glucose in people with diabetes . Overconsumption of high fructose-sweetened beverages has adverse effects on selective deposition of visceral fat, lipid metabolism, blood pressure, insulin sensitivity, and de novo lipogenesis in overweight and obese individuals . However, naturally occurring fructose from whole fruits is unlikely to be deleterious because of its relatively slow digestion and absorption unless consumed in an excess amount (>10% of energy) [20]. Nonnutritive sweeteners may have potential to reduce overall calorie and carbohydrate intake (Evert et al., 2014).

There is no such report on restriction of protein consumption for Diabetic people [20]. Rather, it is important to maintain or increase protein intake for people on energy-reduced diets for weight-loss because using a fixed percentage of total calories to estimate a protein requirement may result in inadequate protein intake and lean muscle loss (Dworatzek, 2022). Several dietary patterns consisting of combinations of different foods or food groups are beneficial for diabetes management. The DASH (Dietary Approaches to Stop Hypertension) diet has been shown to lower blood pressure among people without (or controlled) diabetes (Appel et al., 1997). However, in an experiment with a small 8-week RCT among people with diabetes, the DASH diet, including the 2,400mg/d sodium restriction, had favorable effects on glycemic control, high-density lipoprotein and Low-

Density Lipoprotein (LDL) cholesterol, blood pressure, and inflammatory biomarkers (Azadbakht et al., 2011).

Aerobic exercise is useful for increasing the body's use of oxygen and stimulating cardiovascular health, while stretching and resistance training are good for cardio-respiratory and musculoskeletal fitness, as well as improves flexibility and body composition [36]. Therefore, it appears that nutrition and physical activity as they depend on each other, goes simultaneously and works synergistically . Many diseases are instigated by poor diet and lack of exercise (Colberg et al., 2016).

During the last 2 decades, resistance training has gained considerable recognition as a viable exercise training option for patients with type-2 diabetes. Synonymous with strength training, resistance exercise involves movements utilizing free weights, weight machines, body weight exercises, or elastic resistance bands. Primary outcomes in studies evaluating the effects of resistance training in type-2 diabetes have found improvements that range from 10% to 15% in strength, bone mineral density, blood pressure, lipid profiles, cardiovascular health, insulin sensitivity, and muscle mass.

## Methodology

To investigate details, this chapter will expand on the literature review and emphasise the dissertation's research topic. It will shed light on the significance of a systematic review by outlining the advantages over a literature review. Literature review qualitatively summarizes evidence on a topic using informal or subjective methods to collect and interpret studies whereas Systematic review is a High-level overview of primary research on a focused question that identifies, selects, synthesizes, and appraises all high quality research evidence relevant to that question. The goal of literature review is to provide a summary about the topic whereas systematic review Clearly defines and answerable clinical question. (Phillips, n.d.)Its purpose is to investigate and define the systematic review process through the use of the P.I.C.O. (population, intervention, comparison, and outcome) approach (Booth et al., 2019).

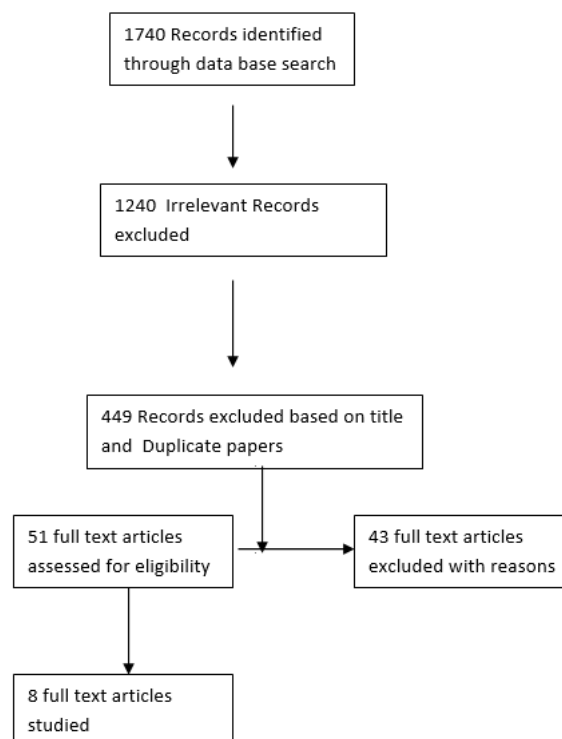
|                    |   |
|--------------------|---|
| Participants       | Patients with Type II DM                              |
| Intervention       | Interventions related to diet and physical activities |
| Comparison/Control | Any control against intervention                      |
| Outcome            | Impact of diet and physical exercise on Type II DM    |

The data gathered for a SR should employ specific relevant search terms along with the use of a methodical, reliable and precise search process to unite existing information and research literature. This SR analyses eight studies which used a variety of research designs, and which were searched for using particular keywords from specific databases. These selected studies should then be assessed for quality. From this, the findings should be synthesised making sure that there is no bias. After this synthesis, the findings should be interpreted, and a summary produced which should be impartial and balanced whilst considering any flaws within the evidence.

## Data Collection Strategies

(T et al., 2015) highlight that data collection is a key step in systematic reviews as this data then forms the basis of conclusions which are to be made. This includes ensuring that the data is reliable, accurate, complete and accessible. Relevant literature reporting the interventions for controlling excess weight in children and adolescents was identified through electronic search of papers published from 2012 to 2022 in MEDLINE, PubMed, Web of Science, and Scopus. Keywords such as “Diabetes Mellitus”, “Diet,” “Diet Therapy,” “Exercise”, “Physical activity”, “Asia,” “Southeast asia,” were used. The searches yielded 1740 articles.(Pati& Lorusso, 2018)suggest that intentional or accidental bias can be apparent depending on how a search is conducted. This is why it is important to be able to demonstrate that a complete, thorough and broad search was conducted.

## Prisma Flowchart



## Inclusion /exclusion criteria

For this review, a clear strategy was produced in order to identify the relevant inclusion and exclusion criteria (see table below). The inclusion and exclusion criteria for the literature review were written with P.I.C.O. in mind. This ensured that the research question was followed and that appropriately designed research articles were found as suggested by (Torgerson & Torgerson, 2003) (Pati & Lorusso, 2018)highlight that the inclusion and exclusion criteria within a

literature search is a source of potential bias therefore higher trust and credibility can be gained by the clear documentation of such exclusion and inclusion criteria.

| Inclusion Criteria                        | Exclusion Criteria                        |
|---|---|
| full-text articles                        | Articles published more than 10 years ago |
| RCT, Quasi experiment , Pre and Post test | Other than Asian Popultaion               |
| Articles Free to access                   |   |
| Articles written in English               |   |

Based on Prisma data extraction and abstraction 1740 records identified (484 from PubMed, 430 from Medline and 501 Web of science and 325 SCOPUS) .1240 records excluded with justification. 449 records excluded based on title. This SR analyses eight papers of that employed a range of research designs and were identified through the use of certain keywords in various databases accessed. The quality of these selected studies should next be determined. The findings should then be synthesized to ensure there is no bias. Following this synthesis, the findings should be evaluated and a summary created that is objective and balanced while taking into account any weaknesses in the evidence.

## Results

All of the above studies are relevant as they fulfil all the guidelines prescribed in the inclusion criteria. Each study is recent, being published 2012 onwards which means that the information is up to date. The table below is used to display an overview of each article.

| Author and year                                    | Population        | Design                                | Sample | Key findings   |
|--|-------------------|---------------------------------------|--------|--|
| Padmini Balagopal, Indian (Balagopal et al., 2012) | Balagopal, Indian | BAS, Community based health promotion | 1638   | The intervention significantly reduced blood glucose levels by 5.7 and 14.9 mg/dL  |
| Dutta et al , Indian (Dutta et al., 2014)          | Indian            | RCT                                   | 170    | Vitamin-D supplementation in vitamin-D insufficient/deficient individuals is associated with significantly lower progression to diabetes |
| Hegde et al 2013, Indian (Hegde et al., 2013)      | Indian            | RCT                                   | 29     | Yoga intervention resulted in a significant decline in malondialdehyde   |
| Islam et al 2016, Bangladeshi (Islam et al., 2016) | Bangladeshi       | RCT                                   | 28     | Beta cell function, insulin sensitivity and insulin resistance all showed a statistically significant improvement                        |
| Madsen et al 2015 Indian (Madsen et                | Indian            | Comparative study                     | 117    | fasting plasma insulin levels, homoeostasis model assessments  |

|   |     |     |  |
|---|-----|-----|--|
| al., 2015)  |     |     | (HOMA) of insulin resistance (HOMA-IR) and insulin secretion (HOMA-IS), improved to the same extent in both the groups   |
| Anderson et al 2013 , Pakistani (Andersen et al., 2013)             | RCT | 150 | Insulin values taken 2 h after an OGTT were reduced in the intervention group  |
| Patel et al 2017 Indian (Patel et al., 2017)                        | RCT | 36  | The intervention group lowered their HbA1c and waist circumference   |
| Thirunavukkarasu et al. 2017 Indian (Thirunavukkarasu et al., n.d.) | RCT | 75  | There was a significant difference across the 3 time points and significant differences between control and study groups by lowered FPG, fasting insulin, insulin-resistance, diastolic blood pressure |

## Results

Padmini Balgopal et al (2012) tested the effectiveness of a 6-month community-based diabetes prevention and management program in rural Gujarat, India. The intervention significantly reduced blood glucose levels by 5.7 and 14.9 mg/dL for individuals with prediabetes and diabetes, respectively, and systolic and diastolic blood pressure by 8 mm Hg and 4 mm Hg, respectively, in the overall population. Knowledge of diabetes and cardiovascular disease improved by 50% in the high SES group and doubled in the low SES group; general and abdominal obesity also decreased by  $\leq 1\%$ . High rates of undiagnosed hypertension (26.1%) were surprising. Among individuals with diabetes, metabolic complications such as diabetic nephropathy and chronic kidney disease were noted. Through collective engagement of the community, participatory programs can serve as a prototype for future prevention and management efforts, which are rare and underutilized in India.

Dutta et al (2014) Vitamin-D supplementation in vitamin-D insufficient/deficient individuals is associated with significantly lower progression to diabetes and higher reversal to normoglycemia, associated with decreased insulin resistance and systemic inflammation (TNF $\alpha$  and IL6). Baseline vitamin-D and 2 h blood glucose independently predicted progression to diabetes. Hegde et al (2013) studied the effectiveness of yoga intervention on oxidative stress, glycemic status, blood pressure and anthropometry diabetes patients. oga intervention resulted in a significant decline in malondialdehyde ( $p < 0.001$ ), relative to the control group. In comparison with the control, there was a significant improvement in BMI, waist circumference, systolic blood pressure and fasting glucose levels at follow-up. No significant improvement in glycated haemoglobin, waist-to-hip ratio or any of the antioxidants was observed. Yoga intervention may be helpful in control of oxidative stress in prediabetes subjects. Yoga can also be beneficial in reduction in BMI, waist circumference, systolic blood pressure and fasting glucose. Effect of yoga on antioxidant parameters was not evident in this study. The findings of this study need to be confirmed in larger trials involving active control groups.

Islam et al (2016) determined participants' fasting blood glucose levels, (FBG) and Homeostasis Model Assessment (HOMA) parameters (beta cell function, insulin sensitivity and insulin resistance) at baseline and after 6 months of zinc supplementation. After six months, the intervention group significantly improved their FBG concentration compared to the placebo group as well as compared to their own baseline. Beta cell function, insulin sensitivity and insulin resistance all showed a statistically significant improvement as well. To our knowledge this is the first trial to show an improvement in glucose handling using HOMA parameters in participants with prediabetes. Larger randomized controlled trials are warranted to confirm these findings and to explore clinical endpoints.

Madsen et al (2015) assessed the impact of an outdoor exercise intervention on body composition, insulin secretion and action in young men born with LBW and NBW in rural India. Physical activity was measured using combined accelerometry and heart rate monitoring during the first and the last week of the intervention. Following the exercise intervention, the LBW group displayed an increase in physical fitness and total fat-free mass. In contrast, an increase in total fat percentage as well as total fat mass was observed in the NBW group. After intervention, fasting plasma insulin levels, homeostasis model assessments (HOMA) of insulin resistance (HOMA-IR) and insulin secretion (HOMA-IS), improved to the same extent in both the groups. In summary, young men born with LBW in rural India benefit metabolically from exercise training to an extent comparable with NBW controls.

Anderson et al (2013) aimed to increase the physical activity (PA) level in a group of Pakistani immigrant men, and to see whether any increase was associated with reduced serum glucose and insulin concentrations. Risk of diabetes was assessed by serum glucose and insulin concentrations determined in a fasted state, and after an oral glucose tolerance test (OGTT). There was a mean difference in PA between the two groups of 49 counts per minute per day, representing a 15 % higher increase in total PA level in the intervention group than in the control group. Insulin values taken 2 h after an OGTT were reduced in the intervention group by 27 % more than those in the control group. There were no differences in fasting or postprandial glucose values between the groups at the follow-up test. This type of intervention can increase PA and reduce serum insulin in Pakistani immigrant men, thereby presumably reducing their risk of T2D.

Patel et al (2017) conducted an experimental, pretest-posttest control group repeated measures design to evaluate the effectiveness of a community-based culturally appropriate lifestyle intervention program to reduce the risk for type 2 diabetes (T2DM) among *Gujarati* Asian Indians. The primary outcomes were reduction in weight and hemoglobin A1c (HbA1c) and improvement in physical activity. No significant baseline differences were noted between groups. While a significant decline in weight and increase in physical activity was observed in all participants, the intervention group lowered their HbA1c ( $p < 0.0005$ ) and waist circumference ( $p = 0.04$ ) significantly as compared to the control group. Findings demonstrated that participation in a culturally tailored, lifestyle intervention program in a community setting can effectively reduce weight, waist circumference, and HbA1c among Asians

Deviga Thirunavukkarasu et al (2017) assessed and compared the effect of soy flour diet with different quantity on glycemic control and systemic blood pressure. Before, 6 weeks and 12 weeks of the intervention, serum fasting glucose, fasting insulin, insulin resistance and systolic and diastolic blood pressure, were measured in the subjects. Insulin-resistance was calculated by using HOMA-IR formula. There was a significant difference across the 3 time points and significant differences between control and study groups by lowered FPG, fasting insulin, insulin-resistance, diastolic blood pressure, but not had any significant different in time within group & between the three groups in reducing systolic blood pressure. Moreover, the study groups I & II is more effective in controlling diastolic blood pressure and glycemic changes.

## **Discussion**

This review found that most intervention studies and guidelines to prevent T2D in South Asians recommended a wide variety of dietary and physical activity components that were underpinned by evidence from studies in non-South Asian populations and that were largely in line with guidelines not specifically developed for a South Asian origin population, such as the NICE guideline. We could not identify clear patterns in components across subgroups according to study or population characteristics. The included studies and guidelines often did not provide specific evidence that recommended components were effective in reducing T2D risk among South Asian populations or subgroups. Although the overall directionality of the results was towards an improvement of outcome measures, we were not able to assess patterns to determine the contribution of specific components to these effects. It is noteworthy that potentially relevant evidence that has only emerged in recent years was lacking from the intervention studies and guidelines for South Asians. These components may also be relevant to the general population, but were shown effective for South Asians. The results revealed that intake of soy flour diet is placing a role in controlling the diastolic blood pressure, fasting glucose, fasting insulin and HOMA insulin resistance. But, it did not have a significant effect on systolic blood pressure (Thirunavukkarasu et al., n.d.) It has been observed that intervention group reduced their insulin-2 h levels, which most likely means an important reduced constraint on the insulin-secreting cells of the pancreas. However, there were no changes in the HOMA-IR score (Andersen et al., 2013). But it does not, however, elucidate the mechanisms behind the observed changes in insulin-2 h values. Pakistani immigrant men increased their total PA level and reduced their waist circumference, as well as obtaining an appreciable reduction in insulin concentration following glucose ingestion. Presumably, these changes would imply a reduced risk of T2D, and it is conceivable that an increase in the amount of PA governed the beneficial changes in serum insulin.

## **Limitations**

The purpose of this dissertation was to determine the impact of diet and physical activities on prevention of Type II DM. The search process involved searching the databases for relevant literature. This was carried out by using keywords with Boolean operators. This review is limited to few countries in Asia and only focused on domains mentioned in most guidelines. Future studies should include other

Asian countries such as Indonesia, China, and other Association of South East Asian Nations for a more representative overview. Some of the dietary and physical activity components may have been missed which should be considered in the interpretations of the findings. Last, based on the estimated end date of yet unpublished trials, we found evidence to suggest possible publication bias. We found two studies that ended prior to 2014 that have not yet updated their registrations or published their results in the international scientific literature.

### **Conclusion and Recommendations**

The study shows that, as was expected, dietary and physical activity components in intervention studies to prevent T2D in South Asians are based upon those developed for the European white population. Intervention studies and guidelines did not reference evidence that shows included components to be effective for South Asian populations in particular. It remains uncertain whether dietary and/or physical activity components in interventions and guidelines should be adapted to fit the metabolic characteristics of South Asians, or whether other aspects must be adapted to increase the effectiveness of interventions. Research into the effects of current and emerging components among South Asian populations and subgroups in their specific contexts is needed for further clarification, or for instance by more high quality trials in South Asians that test a specific dietary or physical activity component.

### **Conflict of Interest**

The authors certify that they have no involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this paper.

### **Funding Source**

There is no funding Source for this study

### **Acknowledgement**

I most sincerely convey my deep sense of gratitude to my Organisation for their remarkable guidance and academic support during this study.

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