

SYSTEMATIC REVIEW: EFFECTIVENESS OF INTERVENTION STRATEGIES ON PRIMARY PREVENTION OF CARDIO VASCULAR DISEASES

Vaid Harvinder Kaur*
Gautam Sakshi**
Sarin Jyoti***

ABSTRACT

The increased incidence of cardiovascular (CVD) and lack of adherence, resources, health care infrastructure in highly populated country as India leads us to identify effectiveness of various intervention strategies on primary prevention of CVD, so that on community level only CVD can be prevented and off load the tertiary hospitals. There are no studies to support systematic reviews in evaluating various interventional strategies in terms of reducing CVD. This review summarizes evidences of various strategies for primary prevention on clinical, behavioural and psychosocial outcomes.

Design: We utilized as vigorous search MEDLINE, Pub med and data bases from seven international medicine webs, clinical trials were sought according to SIGN requirement (Scottish Intercollegiate Guideline Network) and reference list of identified studies and relevant reviews were checked from articles published in English language from past 7 years (Jan 2015-jan2022), due to lack of homogeneity in outcomes it was not possible to carry out meta analysis. Out 612 citations 26 RCT and 02 mixed method studies were identified according to SIGN, in majority mode of intervention were digital health interventions. The sample sizes of the studies ranged from 25 to 4672 adults except in one study which included blue collar workers. Study participants included adults with more than one CVD risk factor, including obesity, diabetes and hypertension. Maximum studies were conducted in community and primary health centres.

Results: Maximum number of included studies applied lifestyle intervention programs and digital health intervention which included physical exercise and nutritional modifications for reducing the risk of CVD. Regarding the mode of intervention, majority of them were digital health intervention. The intervention duration (treatment time) ranged from 4 to 24 months. The follow-up time 6-12 months and the longest follow-up duration were 6 years. Outcome Variables assessed in reviewed studies as clinical outcomes, Behavioral outcomes and psychological outcomes. Only one study reported regarding mental health well-being as outcome.

Conclusion: Review demonstrates interventions like life style modification, nutritional modification and digital health intervention in primary care seems to improve daily physical activity and dietary habits, cardiovascular risk factors and risk scores.

Keywords: Cardiovascular Diseases, Risk Factors, Blood Glucose, Body Weight, Primary Prevention.

Introduction

The Cardiovascular disease (CVD) and other non-communicable diseases threat has been recognized with the World Health Assembly's adoption of Global Action Plan for Prevention and control of non-communicable disease includes a global "25 by 25" goal: achieving 25% relative reduction in overall mortality from CVD, cancer, diabetes, and chronic respiratory diseases by 2025. Four of the nine targets within the global action plan directly relate to control and management of BP related disease –reducing population intake of salt/sodium, reducing or containing BP, essential drug availability, appropriate drug therapy to prevent heart attack and stroke. For achieving these goals on individual level strategies to identify and provide cost effective antihypertensive drugs must be incorporated.¹

* Ph D Scholar & Faculty, College of Nursing ABVIMS & Dr. R.M.L Hospital, New Delhi, India.

** Nursing Officer, ABVIMS & Dr. R.M.L Hospital, New Delhi, India.

*** Principal, College of Nursing, M.M.CON, Maharishi Markandeshwar University, Mullana, Haryana, India.

CVD is group of disorders of heart and blood vessels, it serves as canopy for a number of linked pathologies like coronary heart disease, cerebrovascular disease, peripheral arterial disease, rheumatic and congenital heart diseases and venous thrombo embolism and pulmonary embolism. CVDs are the leading cause of death globally. An estimated 17.9 million people died from CVDs in 2019, representing 32% of all global deaths out of which 85% were due to heart attack and stroke, over three quarters of CVD deaths take place in low- and middle-income countries, also out of the 17 million premature deaths (under the age of 70) due to non communicable diseases in 2019, 38% were caused by CVDs.ⁱⁱ

Worldwide India has one of the highest burdens of CVD. The annual number of deaths from CVD in India is estimated to rise from 2.26 million (1990) to 4.77 million (2020). Coronary heart disease prevalence rates in India have been projected over the past many decades ranged from 1.6% to 7.4% in rural populations and from 1% to 13.2% in urban populations. The inter heart study showed that CVD risk factors such as abdominal obesity, hypertension, and diabetes are higher among Indians, even at young ages, than among other ethnic groups.ⁱⁱⁱ According to community-based cohort study among 6026 adults aged 25–64 years in five villages in Tamilnadu, baseline (2005–2007) and two follow-up surveys in 2008–2009 and 2013–2015, risk factors identified were tobacco, alcohol, hypertension, self-reported diabetes and central obesity hence need to implement low-cost interventions as smoking cessation and treat hypertension in primary care settings.^{iv}

In the Indian context, poverty, maternal malnutrition, and early life changes enhance an individual's risk of CVDs also as the fastest-growing economy country rural to urban migration happens in distress leads to over-crowded and unclean environments in urban slums as problems of inadequate housing, indoor pollution, infectious diseases, inappropriate diet, stress and smoking.^v As well as epidemiological evidence suggests that CVD is associated with behavioural factors such as smoking, alcohol use, low physical activity, insufficient vegetable and fruit intake.

Preventive interventions to augment the population-level adoption of health lifestyle behaviours that reduce CVD risk are a priority, for improving health-related behaviours and outcomes face-to-face interventions impart individualization were effective, but are resource intensive & expensive. Electronic and mobile health (e- and m-Health) approaches aimed at modifying lifestyle risk factors may be an effective and scalable approach to reach many individuals while preserving individualisation. This systematic review aims to describe various aspects of Intervention Strategies on Primary Prevention of Cardio Vascular Diseases and their effect on clinical, behavioural, and psychosocial outcomes.

Method

The literature search was conducted in August 2021. We searched international electronic databases, including Pub Med, MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Scopus, Google Scholar, JAMA Network, Web of Science, Cochrane Public Health Group Specialised Register and CENTRAL electronic databases are searched between January 2015 and January 2022. Authors independently undertake data extraction and assess risk of bias. We scrutinized discretely at the current National Institute for Health and Care Excellence (NICE) guidelines. European Society of Cardiology (ESC) guideline, American Heart Association (AHA) guidelines and specifically for hypertension American College of Cardiologists (ACC), all areas was targeted by these guidelines and performed a review of current literature.

A literature search was performed using the search terms 'Primary prevention in Cardiovascular Disease', then a combination of 'diet', blood pressure, 'hypertension', 'lipids', 'exercise', 'smoking', 'alcohol', 'weight', BMI, waist to hip ratio, 'blood glucose', Cholesterol, LDL & HDL, Triglyceride, lipids, life style prevention, health behaviour, exercise, physical exercise health promotion, disease prevention, and the term 'cardiovascular disease prevention', workers and employees, stress and depression, food, diet and nutrition, weight loss, obesity, stress, psychological psychosocial. Data, guidelines and their scientific reinforce were extracted and compared. The search was limited to studies published in English between January 2015 and January 2022.

The study outcomes selected were blood pressure (systolic and diastolic), body mass index (BMI), waist-to-hip ratio, blood sugar levels, health indicators such as lipid levels, cholesterol, "triglyceride," "HDL," "LDL," exercise and health behaviours, such as lifestyle practices, and psychological disorders, such as stress and depression. References of the engaged studies were manually seek for additional eligible sources. As the data used in this systematic review were achieved from formerly published studies, ethical approval and consent were not required. Authors independently screened for titles and abstracts, followed by a full-text review of potentially eligible reports there after study reports were selected. Selection of study reports will involve two authors independently screening titles and

abstracts, followed by a full-text review of potentially eligible reports. Studies with Eligibility of adult population with risk of CVD underwent intervention/comparison: randomised controlled trials comparing e- or m Health CVD risk preventative interventions with usual care with outcomes: modifiable CVD risk factors.

Studies were considered to be eligible for inclusion based on the following criteria: 1. Studies about employees and community; 2. Studies that applied interventions to facilitate lifestyle behavioural modifications in diet, physical exercise, and behaviour; 3. Mixed –method, randomized controlled trials (RCTs) with a comparison group; 4. Web based and nurse –led intervention. Studies that solely focused on pharmacological therapy and complementary therapy were excluded.

Data Extraction

Data were extracted from the studies: name of the first author, publication year, country, study design, setting participants, setting, sample size, sample demographics, characteristics of the intervention (number of sessions, duration, length of intervention, and follow-up data points), and study outcomes. After data extraction, the interventions included in review were heterogeneous in terms of the duration of physical activities its type & frequency, BMI, dietary intake & physical fitness, of participants. Thus, meta-analyses or pooling of data across studies would be inappropriate so a qualitative synthesis of the evidence was performed instead.

Quality Assessment & Risk of Bias

Study quality of 28 selected studies was assessed by two reviewers independently using the methodology checklist of the Scottish Intercollegiate Guidelines Network (SIGN).^{vi} For assessing risk of bias based on the checklist consists of 10 criteria: appropriate research question; randomization, including blinding of treatment allocation; concealment method; similarity between the control group and treatment group; description of the intervention; relevant outcome measurement; dropout rate; intention-to-treat analysis; and confidence of multi-site studies. Table no.1 depicts based on these criteria, the overall quality of the 28 included studies were classified into three grades: few or none of the criteria were fulfilled, thus the conclusions of the study were likely or very likely to be altered (-); some of the criteria might have been fulfilled, and thus the conclusions were unlikely to be altered (+); and all or most of the criteria had been fulfilled, and the conclusion of the study would definitely not be altered (++)

Results

A total of 612 publications were retrieved from the electronic searches. Out of the 612 citations screened, only 28 RCTs were considered eligible for further analysis. Two reviewers independently analyzed the titles and abstracts of all retrieved articles to identify potential eligible articles. After screening the titles of the articles, 522 articles were excluded because of duplication (n = 300) or they were found to be unrelated to CVD risk reduction intervention. After abstract review, an additional 30 articles were excluded: narrative reviews (n = 48), and outside age range (n = 12). Full texts of the remaining 30 articles were retrieved and read in full to produce the final group of articles to be included. All references were screened by two reviewers, Disagreements were resolved through discussion and finally 2 articles were excluded as those articles were related to other aspects of CVD than the risk reduction interventions.

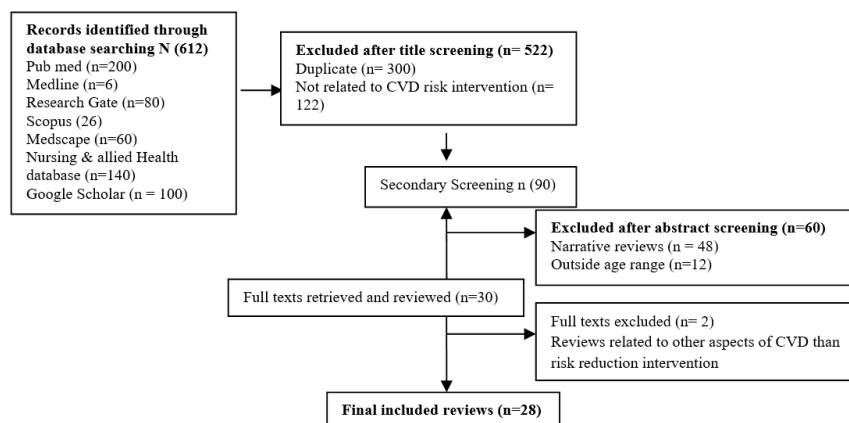


Figure 1: Flow Diagram of Study Selection

Study Characteristics

Table 2 provides detailed characteristics of the studies included in this study. Of the 28 included studies, 26 studies were randomized controlled trials (RCTs) and two study were Mixed - Method. The studies were published between January 2015 and January 2022.

The sample sizes of the studies ranged from 25 to 4672. The locations of studies (n) were the United States (7), Korea (1), Australia(1), Srilanka(2), Canada (1), Spain (4), U.K (4), India (4), Tanzania (1), Hong Kong and the Netherlands (1), Carolina(1), South Asian Country(1). The mean age of subjects was similar across studies (36 –66 years), except for the study by Wijesurya.M et al. in which the mean age was 22.5. The studies 10 were conducted in community settings [Ursha, Jeddih, Gomez, , Foley, Eagle, Joshi, Khetan, , Wong EML, Jafar, Zou], 6 Primary health centre (Arija, Hardestle, Vangbussel, Alonso, Ducan, Rahul) 1 workplace settings [Hwang], 1 University (Solbrig. L.), 3 Online (Block .G & Saslow, Wang), 2 at clinic [Correy, Juraschek], 3 at Diabetic Centers (Guess, Salisberi, Wijesurya), 1 Medical Institute (subramanium), 1 Tertiary care hospital (Panniyammakal Jeemon). The proportion of male participants were more than female in 5, The proportion of female participants were more than male in 5. Out of all 5 studies included only male participants, 5 were only female and in 9 studies there were equal proportions of male and female. Two studies did not report the gender distribution [Salisbury and Gomez]. Study participants included adults with more than one CVD risk factor, including obesity, diabetes, hypertension, type 2 diabetes, etc., except for two [Ursua, & Subramanian H } which focused on only one risk factor of hypertension.

Characteristics of the Interventions

Maximum number of included studies applied lifestyle intervention programs and digital health intervention which included physical exercise and nutritional modifications for reducing the risk of CVD. One study examined a telephone-based intervention, one study applied both telephone- and internet-based interventions and one study involved motivational interviewing. Other studies applied nurse led intervention, educational workshops, multifactorial interventions, behavioural change and functional imaginary training.

The intervention duration (treatment time) ranged from 4 to 24 months. Four studies had an intervention duration of less than six months [Jeddiah, Khuja J, Wong EML, Juraschek, Subramanian & Zou] and three studies had an intervention duration of more than 2 years [Vanbussel, Guess & Gomez]. The follow-up time in most of the studies was 6-12 months and the longest follow-up duration was 6 years [Van Bussel]. Regarding the mode of intervention, majority of them were Life Style Intervention (Guess N, Jeddah, Gomez-Huelgas R, Eaglehouse, Joshi R, Wijesuriya M, Block G, Wong EML), digital health intervention (Coorey, Foley P, Saslow LR, Wang, Wong EML), Nurse led intervention (Van Bussel), Tele Health (Salisbury C), Multifactorial interventions (Alonso, Dominguez R, Tazeen H), educational workshop was conducted (Ursua), and 1 health management journal (Hwang WJ), change in dietary habits (Saslow SR, Juaschek S P, Zou P), Functional Imaginary (Solbrig), Behavioural changes (Foley P, Wang, Rahul Arya, Khetan A), Physical Activity (Arija V, Hardcastle, Duncan S, Subramanium), were used as the other mode of interventions.

Synthesis by Outcomes

Outcome Variables assessed in reviewed studies were illustrate in Table no.3 clinical outcome (systolic and diastolic blood pressure, glycemic control) improved, lipid profile decreased, BMI and body circumference reduced. Behavioural outcomes and psychological outcomes

Discussion

Cardiovascular disease (CVD) is the leading cause of mortality in India. Social and behavioural factors are strongly interrelated in the prevention and control of CVD. The ability to make lifestyle changes to control hypertension and diabetes (major risk factors for CVD) is determined by factors such as education, gender, caste, poverty, and urban city. An integration of social and health services may be required to achieve interventions to improve the management of risk factors for CVD need to address social risk factors and be sensitive to the needs of population sub-groups that may require additional support to access health services. Currently, there are limited high-quality published studies concerning the application and integration of interventional strategies to prevent CVD risk in workplace settings/ community/ clinics etc.

This review article is to examine the effectiveness of Various Intervention Strategies on Primary Prevention of Cardio Vascular Diseases among adults to our knowledge. While the interventions for adults varied, evidence generally suggests that lifestyle interventions and behavioural interventions particularly

interventions with longer durations, have a beneficial effect on some CVD risk factors. Affected risk factors include systolic blood pressure, diastolic blood pressure, and BMI. Weight and LDL level did show a significant improvement following lifestyle interventions. These findings are consistent with previous studies, which reported that lifestyle interventions reduce the risk for CVD among adults with diabetes. Our study findings provide evidence for the promotion of CHW models in minority communities as a means of increasing BP control and reducing CVD disparities. Given that there has been significant policy and research discussion regarding the integration of CHWs into healthcare, future analysis of CHW interventions should include an evaluation of cost-effectiveness and assessment of implementation factors that influence sustainability across different settings. A substantial proportion of rural Indian population is at elevated risk of CVD, many low-risk individuals currently receive BP lowering therapy, while treatment gaps among intermediate- and high-risk populations remain. With widespread implementation of Indian guidelines that encourage an absolute risk approach to BP lowering treatment is highly cost-effective and in the specific case of treating all at high risk, cost-saving¹ The effect of pragmatic lifestyle modification as compared to control lifestyle modification on the incidence of the primary cardio-metabolic composite endpoint and its individual components in 3539 healthy participants and 1814 healthy participants aged above 18 and 1725 below 18 years of age were found to be significant.^{vii}

Significant reduction in BP is persistence in the 3 intervention groups after (cross-over) confirmed the non-pharmacological intervention's biological plausibility. A study reconfirmed that physical exercise was more effective than Salt Reduction or Yoga. Salt Reduction and Yoga were equally effective.^{viii} Effects of integrated management of risk factors led by community health workers to improved blood pressure in hypertension patient, has inconclusive effect on fasting level of blood glucose in diabetes and no demonstrable effect on smoking.^{ix}

Studies of interventions revealed that, compared to interventions lasting less than 12 months, the effect size of long-term intervention (≥ 12 months) was smaller, although it remained positive. This is because interventions lasting less than 12 months may increase the likelihood of remembering and applying the skills learned to achieve the outcome. The effects of behavioural interventions were reduced over time. According to previous studies of interventions for behavioural change, within a year, individuals may return to their old behaviours. Thus, to maintain changes in health behaviours, it is important to develop strategies. To examine the critical time-points for intervention and follow-up further research is needed.^{x xi xii} The most important components of helping respond well to an intervention program are education and skill training. Testing a particular program multiple times would improve the ability to recommend specific, effective, programs. Although there are many studies concerning the prevalence and effectiveness of non-pharmacological intervention programs, there is a lack of research into this specific area.

Continuous integrated risk reduction of CVD programs if checked & tested multiple time in multiple settings can lead advised recommendation to revised, improved, effective & specific, cost effective health programs. Although there are many studies concerning the prevalence and effectiveness of non-pharmacological intervention programs, there is a lack of research into this specific area. Exercise, nutrition and other components included in lifestyle and integrated interventions may reduce the risk of CVD among adult workers. In addition, the development of standardized interventions for objectively monitoring the risk of CVD among workers is identified as a potential benefit of researching lifestyle interventions for adult workers with CVD risk factor BMI BP.^{xiii} Lastly, the studies in this review were conducted in developed and developing countries and were in English publications only. The studies lacked information about the participants' backgrounds, including education level and work-related characteristics such as white-collar job or sedentary work or any other professionals. Out of all 28 studies, 10 were conducted in community settings, 6 in primary health centres, one in work place and others were in clinics, university campus, diabetic clinics, online, medical institutes and in tertiary care hospital. Although the participants in the reviewed studies were adults only, it was not possible to obtain a sufficient number of relevant articles for this review, despite conducting an extensive systematic computerized search applying MeSH keywords & terms.

Moreover, "lifestyle interventions" generally refers to active interventions such as allocation of a specific meal type or diet plan, caloric restriction or exercise training. The studies in this analysis are not of these characteristics but are mostly of lifestyle education or counselling programs. According to previous studies, the level of work organization or work environment has a more sustainable effect on the health of employs than individual-based interventions. Future studies (RCTs) at different organization-level interventions in multiple settings & workplaces could be included.^{xiv xv xvi} The family-based intervention was effective in reducing cardiovascular risk in all participants irrespective of their baseline

risk factors, sex, or age, suggesting that interventions targeting family processes and barriers to adoption of healthier choices influence all family members equally. A so-called ripple effect of the intervention on other family members, who were not part of the intervention, including children and immediate relatives of the family, might also occur, as noted in other cardiovascular intervention studies.²⁰ Spouses in intensive lifestyle intervention showed a significant greater reduction in weight loss and calorie intake also decrease in high fat food in home.^{xvii}

Educational workshop¹ life style modification^{2,4,6,8} supervised walking programe⁵,health management journal, e health interventional and telephonic ,group discussions, semi structured interventions, feedback survey²,pragmatic dietary intervention⁴ behavioural management about diet, smoking cessation, mediterrian diet, heart health walk^{7,8}.counselling about physical activity, yoga, brisk walk, 120min walk /week and diet by activist and dietician, algorithm generated behavioural change goal^{13,15} diabetes prevention program¹⁴,risk reduction advice¹⁵ communication multicomponent intervention, lifestyle education programme^{17,18}.plate method for food portions²⁰ all tailored and comprehensive health educational interventional programme addressed about physical activities , DASH diet (more intake of food and vegetables)²³ reduction in cholesterol and saturated fats, includes grains, fish nuts, take smaller amount of red meat, sweets and beverages, salt reduction, self monitoring of weight and waist circumference, cessation of smoking, compliance and adherence to drugs^{26,27} helps in preventing CVD.

Findings

The study is similar with another study in which the LDL cholesterol and hypertension significantly reduced in intervention group of wives with men who changed their health status, also significant reduction in smoking also noted^{xviii} in our study 803 intervention group and 819 usual care group, 66.5% female, 33.5% male with predominant cardiovascular risk factor with hypertension (37%) and diabetes (19.9%) was able to achieve a significant reduction in BP from baseline (67%) to 1st year (73%) & 2nd year (74%), fasting glucose (< 110mg/dl) baseline (62%) to 1st year (70%) & 2nd year (72%) in LDL Cholesterol (<100mg/dl) baseline to (14%) to 1st year (20%) & 2nd (23%), tobacco abstinence base line (94%) 1st year (97%) & 2nd year (96%), study shows that family based cardiovascular risk reduction intervention delivery by non physician health worker is effective in reducing cardiovascular risk in individuals with family history of premature CHD. Family support aids to adopt healthier lifestyle choices, diet exercise, play major role in creating conducive environment for the patient, also it was found to be associated with adherence to self-care activities. Regular visits by health care worker results in improved compliance to healthy life choices and reduced B.P & mortality^{xix} the moderate reduction in multiple risk factors as result of the family-based intervention cumulatively yields significant reductions in cardiovascular risk and might prevent future cardiovascular events at the population level.^{xx} The comprehensive intervention package, designed to be replicable, was feasible, and implemented as planned by routine health staff. Additional measures, such as more intensive training of doctors, innovative patient education and improved health insurance cover for outpatients are needed^{xxi}.

Strength of study includes collection of risk factors for CVD in many studies it is likely to generalize much in India. We identified that family-based approaches could have substantial public health benefits, if applied in primary prevention level. Limitation of studies includes that we only took studies in English language, we also unable to locate post intervention status of CVD in prolonged period of their life. Consequently there are no reviews with which we can compare the result of this primary prevention review. We utilized in depth systematic design and execution of our search strategy, including a number of relevant databases and in selecting our final papers and extracting and reviewing the relevant data. Due to low number of trail that fitted the inclusion criteria and the lack of homogeneity in risk score used, we are unable to conduct a meta analysis and limited our ability to make quantitative comparisons of effect sizes relating to change in clinical outcomes.

Conclusion

The objective of CVD prevention is to reduce the occurrence of major cardiovascular events thereby reducing premature disability and morbidity also prolonging survival and quality of life. The American, British, European guidelines exhibits various methods to diminish CVD risk profile with strong accord with respect to smoking and exercise, although the specific details can differ for other factors. Pharmaceutical options have developed over the years while non pharmacological advice remains largely unchanged. For further analysis there is need to identify and formulate CVD risk assessment tool according to Indian context and other validated tools, also address need to formulate educational programs and camps for mass education about CVD risk factors and methods to regulate modifiable risk Factors.

Primary prevention continues to evolve and with greater availability of long-term data comes improved understanding of the means by which we can reduce CVD risk, which must be continued if we are to reduce the burden of cardiovascular disease, a preventable disease. Behavioural counselling interventions to improve diet and increase physical activity for people with elevated blood pressure and lipid levels were effective in reducing cardiovascular events, blood pressure, low-density lipoproteins, etc.

Table 1: Study Quality Rating

Controlled Trial	URSUA	HWANG W.J.	COOREY, G	GUESS,	ARIJA,	JEDDAH	SALISBURY	GOMEZ	HARDCASTLE,	VAN BUSSEL,	ALONSO	SOLBRIG	FOLEY P	EAGLEHOUSE YL
1.1 The study addresses an appropriate and clearly focused question.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.2 The assignment of subjects to treatment groups is randomised.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.3 An adequate concealment method is used	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.4 The design keeps subjects and investigators 'blind' about treatment allocation.	No	Yes	Yes	Yes	N	N	Yes	N	Yes	Yes	No	Yes	Yes	Yes
1.5 The treatment and control groups are similar at the start of the trial.	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.6 The only difference between groups is the treatment under investigation.	Yes	No	Yes	Yes	Yes	Yes	Yes	N	Yes	Yes	Yes	Yes	Yes	Yes
1.7 All relevant outcomes are measured in a standard, valid and reliable way.	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.8 What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?	8.6%	.09%	11%	40%	13%	.01%	2%	32.4%	36%	36%	10%	-	20%	22%
1.9 All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis).	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.10 Where the study is carried out at more than one site, results are comparable for all sites.	Y	DNA	DNA	DNA	yes	DNA	DNA	yes	yes	yes	DNA	DNA	Yes	DNA
Overall assessment of the study	+	+	++	++	+	+	++	+	++	++	+	++	++	++

Controlled Trial	JOSHI	KHETAN A	JAFAR TH	WIJESURIYA M,	BLOCK G,	SASLOW LR,	WANG,	WONG	JURASCHEK SP	DUNCAN S,	SUBRAMANIAN H	RAHUL ARYA	PANNIAMMAK	ZOU, P
1.1 The study addresses an appropriate and clearly focused question.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.2 The assignment of subjects to treatment groups is randomised.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.3 An adequate concealment method is used.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.4 The design keeps subjects and investigators 'blind' about treatment allocation.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.5 The treatment and control groups are similar at the start of the trial.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.6 The only difference between groups is the treatment under investigation.	No	Yes	Yes	N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.7 All relevant outcomes are measured in a standard, valid and reliable way.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.8 What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?	44%	30%	9%	24%	13.9%	24%	2.86%	11.69%	Nil	.4%	4.08%	.01%	5%	5%
1.9 All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis).	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.10 Where the study is carried out at more than one site, results are comparable for all sites	Yes	DNA	DNA	DNA	DNA	No	Yes	DNA	DNA	No	DNA	DNA	DNA	DNA
Overall assessment of the study	+	+	++	+	++	++	++	++	++	++	++	++	++	++

Table 2: General Characteristics of the Studies

S. No:	1 st Author (Publication year); Country	Study Design	Setting	No of Participants	Age (yr) Mean & Gender %	Characteristic of Intervention	Duration (Months) Follow up data points	Outcome
1	Ursua RA, (2018), New York	Mixed, Individual & group activities	Community	240 Filipino Americans with Hypertension	54 F>M	Educational workshop Topic: Heart disease & heart attack, control of cholesterol, BS, Physical activity, wt mnt, BP control, Nutrition & smoking	4 & 8 months	DBP & SBP

2	Hwang W.J. (2019); Korea	3times / 4mths/year	Workplace	32 blue collar workers.	45 Only male	Health management Journal; Observing, Reflecting, Acting, Observing and promoting health behaviour. Topics: Life style modification	12 months	BP, BMI, LDL, FBS
3	Coorey, G. (2019) Australia	Mixed Method RCT follow-up period	Clinic	397 patients with moderate-high risk of cardiovascular disease.	66 M=F	E-Health Intervention and Telephone calls Focus group discussions, semi structured interview, feedback survey and web dytic data	12 months	BP, BMI, LDL, FBS
4	Guess, N. (2016) Srilanka	RCT	Diabetic Centre	4672, aged 5–40 years with two or more of the following risk factors for cardio-metabolic disease	5–40 years M=F	Lifestyle advice was based on the Indian Diabetes Prevention Program. Pragmatic dietary intervention. (Individual advice to balance food intake and physical activity and to achieve or maintain appropriate body weight). Pragmatic dietary intervention Peer to peer education	4 Years	BP, BMI, FBS, WC
5	Arija, V., (2017), Spain	RCT	PHC	364 patients in primary health centres		Supervised walking program consisted of 120 min/week walking (396 METs / min /week) and socio cultural gathering once a month	24 months	BP, BMI, FBS, WC, Wt
6	Jeddah, Khouja J (2020) Saudi Arabia	RCT	Community	59, women ≥30 years having a moderate to high risk of CVD	49 + 6.5 M=F	Lifestyle intervention program regarding Health education, exercise training, and diet counselling as individuals and in groups according to the participant's risk	3 months	BP, BMI, FBS, WC, Wt.Tch
7	Salisbury C, (2016) England	RCT	Diabetic centre	641, adults aged 40 to 74	67 M=F	Telehealth in chronic disease (TECH) model comprised of computerised behavioural management program. Motivational interviews on drug adherence, diet and smoking cessation	12 months	HT, BMI & SM
8	Gomez-Huelgas R, (2015) Spain	RCT	Community CHC	601 subjects with metabolic syndrome.	53.8 M=F	Lifestyle intervention (LSI) program comprised of risk factors, Mediterranean diet,	36 months	HT, BMI, FBS,
9	Hardcastle, , (2015) UK	RCT	primary-care setting	350 participants aged 18–65 years with at least one CVD risk factors;	51 M=F	Counselling by physical activity specialist and registered dietician regarding physical activity and diet	6 months	HT, BMI, FBS, CHOL
10	van Bussel, (2018) Netherland	RCT	Healthcare centre	2254 Community-dwelling older adults aged 70–78 years, free from cardiovascular disease	74 M<F	Nurse-led intensive vascular care every 4 months by motivational interview technique	6 years	HT, BMI, FBS, CHOL, SM, obesity
11	Alonso-Dominguez R, (2019) Spain	RCT	Healthcare centre	204 subjects between 25–70 years with T2DM.	60.6 only female	A multi factorial intervention involving a food workshop and a smart phone application produced improved for heart-healthy walks and adherence to the Mediterranean diet	12 Months	HT, BMI, FBS, CHOL, SM, obesity
12	Solbrig, (2019) England	RCT	University campus	141 adults with BMI (kg/m ²) ≥25		Functional Imagery Training (FIT) by, face-to-face and telephonic motivational sessions	6 and 12 months	obesity
13	Foley P, (2016) Caroline	RCT	community	351 men and women, aged 21 to 65 years, with a BMI of 30.0-44.9 kg/m ² and a weight ≤ 330 pounds and a current diagnosis of hypertension, type 2 diabetes, and/or hyperlipidemia.	men and women aged 21 to 65years F>M	Intervention consists of algorithm-generated tailored behaviour change goals, self-monitoring via mobile technologies, daily self-weighing using a network-connected scale, skills training materials, 18 counselling phone calls with a Track coach, and primary care provider counselling.	12 months	HT, BMI, FBS, CHOL, SM, obesity
14	Eaglehouse YL, (2016) USA	RCT	community	223 overweight adults at-risk for type 2 diabetes and/or cardiovascular disease	58.4 Only female	12-month Diabetes Prevention Program (DPP).-based lifestyle intervention. physical activity (PA)	12 months	Obesity, BMI
15	Joshi R, , (2019) India	RCT	community	2312 households with individuals of age ≥35 years living in the area of the study villages 52 years for men and 50 yrs for women	52 years for men and 50 yrs for women M=F	In the intervention group, trained CHWs delivered risk-reduction advice and monitored risk factors during 6 household visits over 12 months.	12 months	SBP<DBP <BMI< Waist hip ratio, waist circumference
16	Khetan A, (2016)\ India	RCT	community	3556 adults (35 to 70 years of age)	Adults (35 to 70 years of age) M>F	Intervention comprised of behavioural change communication through regular home visits from community health workers	24 months	SBP, Blood glucose
17	Tazeen H. Jafar, (2017) South Asian Country	RCT	community	2645 individuals aged ≥40 years with hypertension	58.8 years M=F	Multicomponent Intervention: The intervention involved home visits by trained government community health workers for blood-pressure monitoring and counselling, training of physicians, and care coordination in the public sector.	24 months	SBP, DBP, obesity, blood pressure
18	Wijesuriya M, (2017) SriLanka	RCT	Diabetic national centre	3539 participants at risk of T2DM	22.5 F>M	Intervention and goals All participants received an identical lifestyle education	1 2 months	SBP, DBP, obesity,

						programme, with the only difference being the frequency of the delivery of this advice (3 monthly or 12 monthly). In the P-LSM group, advice was given every 3 months, on a one-to-one basis, on the importance of a healthy diet and lifestyle with the aim of reducing weight, encouraging regular exercise and managing psychological stress.		smoking, alcohol, unhealthy diet, physical activity, cholesterol, HDL, LDL
19	Block G, (2015) USA		ambulatory care health care delivery system,	339 persons aged between 30 and 69 years with a BMI of at least 27	55 M>F	Alive-PD provided tailored behavioural support for improvements in physical activity, eating habits, and factors such as weight loss, stress, and sleep. Weekly emails suggested small-step goals and linked to an individual Web page with tools for tracking, coaching, social support through virtual teams, competition, and health information. A mobile phone app and automated phone calls provided further support.	6 months	FBS, weight, BMI, Triglycerides, HDL
20	Saslow LR, (2017) USA		Online	25 participants who are overweight adults	53.0 years M=F	32-week online intervention based on our previous recommendations or an online diet program based around a plate method diet	32 weeks or 8 months	HbA1C, weight, Triglycerides, HDL, LDL
21	Wang, (2018) USA (Texas)		online	26 participants who were Overweight or obese patients with type 2 diabetes mellitus.	56.4 years Only female	(1) Behaviour intervention with smart phone-based self-monitoring, (2) behaviour intervention with paper diary-based self-monitoring, and (3) usual care group. Both the mobile and paper groups received a total of 11 face-to-face group sessions in a 6-month intervention. The mobile group received an Android-based smart phone with 2 apps loaded to help them record their diet, physical activity, weight, and blood glucose, along with a connected glucometer, whereas the paper group used paper diaries for these recordings	6 months	HbA1C, weight,
22	Wong EML, (2021) Hongkong,	RCT	Community Health Centre	77 Chinese > 50 years age with MetS	57.4 F>m	A mobile application (app) and booklet for adults with metabolic syndrome (MetS). Topics: risk factors and advice on lifestyle management, a healthy diet for MetS patients, regular exercise, stress management, medication, and self-monitoring of health.	3 months	body weight, total amount of exercise, blood pressure, and lipid concentrations.
23	Juraschek SP, (2017) USA	RCT	Clinical centres	412 hypertensive adults	48.2 F>M	Participants were fed either the DASH diet (intervention) or a control diet. The DASH diet (intervention), emphasized fruits, vegetables, and low-fat dairy foods with reduced intake of saturated fat, total fat, and cholesterol. In addition, the DASH diet emphasized whole grains, poultry, fish, and nuts with smaller amounts of red meat, sweets, and sugar-containing beverages.	4 weeks	SBP, DBP, BMI
24	Duncan S, Goodyear-Smith F, (2016) Auckland (UK)	RCT	primary health care clinics	320 primary health care patients with an elevated 5-year cardiovascular disease (CVD) risk.	54.8 M>F	Two treatment conditions: a CVD risk assessment and one-time consultation ("usual care" control) and a CVD risk assessment and up to five home sessions that aimed to reduce obesity by encouraging physical activity and healthy eating (intervention). In addition to usual care, the intervention group received a maximum of five home-based sessions with a trained health professional to improve physical activity and dietary patterns.	12 months	BMI, waist circumference, weight, Triglycerides, HDL, LDL, SBP, DBP
25	Subramanian H, (2022), India	RCT	Medical Institute	94 young adults	23.5 M>F	Health education & counselling Topics: Physical Exercise (NG II)-brisk walking for 50 to 60 minutes, three to four days/week, Salt Intake Reduction (NG III) to at least half of their previous intake, Yoga (NG IV) for 30 to 45 minutes/day, five days/week.	8 weeks	SBP & DBP
26	Rahul Arya (2021) India	RCT	Non Communicable disease (NCD) clinics of primary care	132 adult patients with Diabetes Mellitus attending Non Communicable disease (NCD) clinics of primary care settings of South Kerala, India	60.9 male	Module consisted of a 1-day training to be conducted in three sessions Topics: Healthy diet, adequate exercise, compliance to treatment and follow-up, cessation of smoking, and alcohol intake.	6 months	Glycemic control, drug adherence, change in dietary habits
27	Panniyammakal Jeemon, (2021)	RCT	tertiary care speciality	1671, Individuals with the family history of coronary	40.8 F>m	2.5-day training session for all selected non-physician health workers involved in the study.	2 years	FBS, BP, LDL, BMI Smoking

	India		hospital	heart disease diagnosed before the age of 55 years		Intervention package consisting of screening and detection of cardiovascular risk factors at baseline and annual follow-up visits, description of lifestyle options, and tailored 28 recommendations based on baseline risk profile and existing family practices to improve cardiovascular health.		cessation
28	Zou, P. (2017) China	RCT	Community	618 Chinese canadian	56.5 M=F	The DASH Na-CC intervention consisted of a written manual, two classroom sessions, and one telephone booster call to provide healthy dietary and sodium reduction advice, integrated with Traditional Chinese Medicine food therapy recommendations for hypertension control.	8 weeks	SBP, Physical health score

Table 3: Synthesis of Outcomes

Clinical Outcome Variable	First Author	Conclusion
SBP	Ursua R.A, Hwang W.J, Khouja, J. H, Salisbury C, Gomez-Huelgas R, Van Bussel, Joshi R, Khetan A, Jafar TH, Juraschek SP, Subramanian H, Rahul Arya, Panniyammakal Jeemon, Zou, P.,	Improved
DBP	Ursua R.A, Hwang W.J, Gomez-Huelgas R, Van Bussel, Jafar TH, Juraschek SP, Subramanian H, Rahul Arya, Panniyammakal Jeemon,	Improved
BMI	Khouja, J. H, Salisbury C, Hardcastle, Wang, Wong EML, Duncan S,	Reduced
T Chol.	Hwang W.J, Guess N, Saslow LR,	Decreased
HDL	Hwang W.J, Guess N, Khouja, J. H, Gomez-Huelgas R, Block G, Duncan S, Panniyammakal Jeemon,	Decreased
LDL	Hwang W.J, Guess N, Panniyammakal Jeemon,	Decreased
TG	Hwang W.J, Block G, Saslow LR,	Decreased
Glycemic control	Guess N, Khouja, J. H, Alonso-Domínguez R, Eaglehouse YL, Wijesuriya M, Block G, Wang, Rahul Arya, Panniyammakal Jeemon,	Improved
Waist Circumference	Guess N, Solbrig, Block G,	Reduced
Abd. Circumference	Gomez-Huelgas R	Reduced
Body Weight	Salisbury C, Solbrig, Foley P, Eaglehouse YL, Block G, Wong EML,	Reduced
Behavioural Outcome Variable	First Author	Conclusion
Quality of Life	Zou, P.,	Improved
Smoking	Van Bussel, Panniyammakal Jeemon,	Ceased
Physical activity	Coorey, G, Arija, Salisbury C, Eaglehouse YL, Hardcastle, Rahul Arya,	Improved
Medication adherence	Coorey, G, Salisbury C, Hardcastle, Joshi R, Jafar TH, Rahul Arya,	Improved
Healthy eating	Coorey, G, Guess N, Arija, Salisbury C, Hardcastle, Rahul Arya,	Improved
Risk factor self monitoring	Coorey, G	Improved
Psychosocial Outcome Variable	First Author	Conclusion
Mental health well being	Coorey, G	Improved

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