Nutritional Interventions to Reduce Cardiovascular Risk Factors: An Iranian Perspective

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Abstract: Cardiovascular disease (CVD) is the most leading cause of morbidity and mortality worldwide. Despite efficacies of currently available clinical and pharmaceutical approaches for the control of CVD risk factors, it seems that designing and developing of population-based interventions reducing tobacco use, advocating of physical activity, reducing harmful alcohol use, and promoting healthy diet is a cost-effective, permanent way and could play a major role in reduction of the burden of CVD. In this study, we reviewed some population-wide interventional programs and some nutritional intervention studies designed to prevent cardiovascular disease among Iranian populations.

Keywords: Cardiovascular Disease, Dietary Intervention, Population-Based Study, Lifestyle Changes

1. Background

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality worldwide and there is global concern regarding the alarming increasing trend of cardiovascular risk factors especially among developing countries [1]. More than 7.3 million deaths and 58 million disability adjusted life years lost worldwide due to CVD were reported in 2001 [2]. Among Middle East countries, Iran probably has highest burden of heart disease [3]. In a population-based study, age-adjusted prevalence of coronary heart disease was 21.8% (22.3 and 18.8% in men and women, respectively) [4]. Despite the lack of accurate data, evidence shows that coronary artery disease (CAD) has an increasing trend in recent years with studies showing that age-adjusted mortality from CAD increased by 20-45% in an Iranian population [5].

Some important metabolic/physiological risk factors which contribute to the development of CVD, include overweight and obesity, hypertension, diabetes and dyslipidemia [6]. The age-adjusted prevalence of metabolic syndrome, a main risk factor for development of cardiovascular disease, among Iranian urban adults was 33.7% (95% CI: 32.8-34.6) and low-HDL-C was the most common metabolic abnormality in the population [5].

Low physical activity, use of tobacco and alcohol are also modifiable behavioral risk factors of cardiovascular disease; among these lifestyle factors, unhealthy diet, including low fruit and vegetable consumption, regular consumption of high-energy foods, processed foods, higher intake of salt, fats, saturated and trans fats, as well as dietary cholesterol play critical roles [6]. Consumption of imbalance diets with high energy and low nutrient density has been indicated as a main factor for developing of non-communicable diseases especially cardiovascular disease among Iranian populations [7]. Several studies report rapid ongoing nutrition transition in Iran, with a progressive shift to a westernized dietary pattern, in particular higher consumption of processed foods, sweetened beverages, out-of-home meals and fast foods, and energy-dense unhealthy snacks; this transition plays a critical role in the development of cardiometabolic risk factors among Iranian population [8-10].

Despite efficacies of clinical and pharmaceutical approaches available in the control of CVD risk factors, it

seems that designing and developing population-wide interventions through reducing tobacco use, promotion of physical activity, reducing harmful alcohol use, and promoting healthy diet is a cost-effective, permanent measure and may play a major role in reduction of the burden of CVD[6]. In fact, the ideal approach to promote cardiovascular health is prevention of cardiovascular risk factors via interventions within health systems, and community-based programs conducted in schools, worksites, and other community settings [11]. Several national and cost-effective nutritional interventions for cardiovascular health have been conducted worldwide; of which the main ones include population-wide sodium reduction, replacement of polyunsaturated margarines with butter, population-wide policies to promote healthy eating and adoption of the Dietary Approaches to Stop Hypertension (DASH) diet, population-wide policies to reduce dietary fat intake and increase fresh fruits and vegetables, reformulation and development of healthier food products to promote a healthy diet, and price-intervention policies including taxes, subsidies, price promotions and other economic incentives [12-14].

In this study, we reviewed main population-wide interventional programs and some nutritional intervention studies designed to prevent cardiovascular disease among Iranian populations. To identify relevant studies, we performed literature searches in Scopus, PubMed, Science Direct, Google Scholar and SID databases for articles published up to July 2014. Search terms included "cardiovascular disease", "risk factor", "Iran", "population-based intervention", "lifestyle" and "nutrition".

2. Large Scale Community-Based Interventional Projects

Isfahan Healthy Heart Program

Table 1. Brief description of the main intervention projects of the Isfahan Healthy Heart Program [15].

Project name	Main intervention
Healthy Food for Healthy Community	Educating about healthy cooking methods and making high-fibre, low-salt bread; promoting the production of healthy food products by food industries; modifying food labels; educating the public on the concept of healthy nutrition; improving the formulations in confectioneries; introducing healthy brands and half-portions in restaurants and fast food eateries
Isfahan Exercise and Air Pollution Control Project	Providing training on exercise and physical activity through local television; distributing educational CDs about exercise at home and at the worksite; organizing public exercise rallies, automobile-free days and healthy heart exhibitions; educating about air pollution control methods through local television; advocating the development of bicycle lanes in the city
Women Healthy Heart Project	Providing healthy lifestyle training to young women attending pre-marriage classes and their family members, as well as instructors of the literacy campaign movement and their students, instructors of charities, women in the Basij Movement (coalitions within mosques), women in different organizations, women attending health centers and health houses, and female volunteer instructors of the Red Crescent Society; educating the public through television and cook books; distributing a CD about methods of physical activity requiring no special facilities
Heart Health Promotion from Childhood	Providing healthy lifestyle training to children, parents, health professionals and school and kindergarten staff about healthy lifestyles; promoting physical activity in schools and kindergartens; introducing healthy snacks in schools and kindergartens; establishing healthy buffets in schools; forming role model groups from volunteer students; providing practical training through television about healthy lifestyles; screening for cardiovascular disease risk factors in children of patients with premature cardiovascular disease and in children with at least one risk factor, such as obesity
Youth Intervention Project	Providing healthy lifestyle training to volunteers from the Red Crescent Society, garrison instructors, soldiers in their mandatory military service and university students, as well as kitchen staff of universities and garrisons; conducting an international anti-smoking Quit & Win campaign
Worksite Intervention Project	Providing healthy lifestyle training to occupational medicine physicians or health assistants; introducing dietary modifications into factory restaurants; enforcing no-smoking regulations at worksites; using the existing screening system to detect high-risk groups; promoting physical activity at worksites; providing health messages about cardiovascular disease prevention in official newsletters of different organizations
Non-Governmental Organizations and Volunteers Project	Training health workers in cities and villages; forming, training and empowering an assembly of health volunteers; training community members in performing physical activity in the absence of facilities, healthy nutrition and coping with stress via trained volunteers and health-related nongovernmental organizations
Health Professionals Education Project	Establishment of educational assemblies; training general practitioners by continual medical education courses; training physicians through periodical seminars; training nurses by forming educational assemblies; publishing and distributing books and newsletters among nurses and other health professionals in urban and rural areas; running information campaigns on various occasions
Healthy Lifestyle for High-Risk Groups	Providing healthy lifestyle training to health-system personnel, high-risk individuals and retired employees; activating clinics at hospitals; training the public; distributing educational brochures to people attending pharmacies; printing health messages on laboratory report sheets
Healthy Lifestyle for Cardiovascular Patients Project	Providing healthy lifestyle training to patients and their families at the time of hospital discharge; printing cards for patients to record all necessary information related to their disease; establishing rehabilitation units at all heart hospitals; improving nutritional and cooking procedures at hospital restaurants; distributing educational folders containing educational materials on cardiovascular-disease secondary prevention and rehabilitation

The Isfahan Healthy Heart Program is one of the comprehensive integrated community-based interventional programs aimed at modifying coronary heart disease and stroke risk factors and improving the Knowledge, Attitude and Practice (KAP) of both the general community and health professionals regarding these factors and their prevention. This study was an intervention consisting of three stages performed by Kelishadi et al. over a period of 6 years. In the first stage in 1379several cross-sectional studies were conducted on adults, children, health workers and patients with heart disease and stroke to determine existing level of KAP among people (adults and children), health workers and patients, the prevalence of risk factors, coronary artery disease and stroke and mortality and morbidity resulting from these diseases in Esfahan and Najafabad (intervention counties) and Arak (control area). The20800 subjects included 12600 healthy subjects aged over 19 years, 2000 children aged 6-18 years and their parents, 500 school teachers and principals, 1700 health workers and 2000 cardiovascular patients. In the second stage, based on the results of surveys conducted in the first phase, the interventions including 10 projects (women, children, youth, individuals in worksite, health workers, non-governmental organizations and volunteers, high risk individuals, cardiovascular patients and nutrition and exercise project)was begun in1380 in the total population. These intervention projects are described in table1 [15]. Interventions were performed in three groups including health workers, the general public (children and adults) and high risk individuals. Among health professionals, the purpose was teaching algorithms to control risk factors, simple methods for rehabilitation and secondary prevention of heart disease and cardiopulmonary resuscitation via seminars, workshops, lectures, distribution of pamphlets and posters and preparation of algorithms for control of cardiovascular and stroke risk factors. In the general public, the target was lifestyle modification in the field of cardiovascular disease and stroke and their risk factors as well as their prevention and control. This training was done through face to face education, holding competitions and lectures in different communities, workplaces, the usage of mass media such as radio, television, magazines and newspapers, allocation of exercise hours in worksites and collaboration with non-governmental organizations. Among individuals of the high risk group, interventions were carried out in patients with heart disease and stroke, their children, and families and for people having at least one cardiovascular risk factor. The goal was to teach subjects how to control risk factors, and to introduce them to the symptoms of these diseases, medications and their side effects, highlighting the importance of prevention since childhood and increasing awareness of the importance of rehabilitation and secondary prevention. This training took place by educating individuals regarding appropriate dietary pattern, not smoking and doing regular exercise, using simple pamphlets about the disease, its symptoms,

medications and treatment and a prevention guide in the intensive care sections of the hospitals and holding training courses in cooperation with various organizations. After 3-4 years, in third stage, in the last year of the program in 1384, all surveys that were performed in the first stage were repeated in a random population of the intervention and control areas. The interventional program were assessed by determination of the changes in the prevalence of risk factors, mortality and morbidity of heart and stroke patients, KAP changes and related costs in intervention areas compared with the control area [16].

Several studies were conducted during this program; in one, a semi-experimental study, 12345 residents from a central area of Iran who had participated in the Isfahan Healthy Heart Project, were divided in two groups (an intervention group from Isfahan province and a control group from Arak) and were investigated and intervened in three stages. The first step included surveys before interventions, the second stage consisted of executive and educational interventions and provision of healthy nutrition programs in food catering in specifically for the intervention group andthe third phase included surveys after interventions. The results showed that after one year following initiation of the study, the average score of knowledge and performance related to proper nutrition increased in all age groups and both sexes, the rate of increase being higher in the intervention group in comparison to controls [17].

Another study, in order to design community-based interventions for prevention and control of cardiovascular risk factors, was conducted on 2000, 11-18 year old students selected by multi-stage simple random sampling, their parents and 500 school officials in Isfahan province as the intervention area and Arak as the control region. In this study the status of serum lipids in adolescents and its association with diet and Behavior, Attitudes, Skills and Knowledge (BASK) of students, parents and school officials were evaluated. The results showed that most of the students, parents and school officials had sufficient knowledge of healthy nutrition, but they lacked compliance. More families despite being aware of the fact that liquid oil is healthier than solid oil, used more solid oil, which could have been due to the lower price and easier access to solid oil. Although the average fat intake in adolescents ($21.2 \pm 0.4\%$) was in the recommended range ($\leq 30\%$), in many cases there were blood lipid disorders. This study showed a significant direct correlation between total cholesterol and consumption frequency of red meat, fatty snacks, fried foods and fast foods (sandwiches and pizza) and also a significant relationship between TG and intake frequencies of red meat, fatty snacks, fried foods, fast foods and rice intake. Findings demonstrating a significant association between serum LDL-C level and the intake frequency of fried foods as well as an inverse relationship between serum HDL-C level and frequency of red meat, fatty snacks and fast foods (sandwiches and pizza) consumption [18].

Another community-based trial was conducted within the

framework of the Isfahan healthy heart program to evaluate the effects of the Isfahan healthy heart project on diet, physical activity and smoking in two intervention areas compared to the control area; results indicated that after 4 years, a significant increase occurred in percentage of subjects who consumed healthy diets among the intervention group; leisure time physical activities increased in all areas and daily smoking decreased by 0.9% in the intervention areas and by 2.6% in the control area [15].

Results of 5-year interventions of the Worksite Intervention Project of the Isfahan healthy Heart Program on cardiovascular risk factors, showed that the prevalence of hypertriglyceridemia and central obesity decreased in both office staff and factory workers, but that of low HDL increased. Moreover a decline in the mean values of waist circumference, HDL and total cholesterol and an increase in diastolic BP and fasting BS were reported in both worksites of the intervention group [19].

Finally, another study conducted for evaluation of Healthy Lifestyle for Cardiovascular Patients Project implementation (HLCP). In HLCP, developed five main strategies to achieve goals such as a reduction in cardiovascular events, its risk factors and morbidity and mortality in heart patients. Interventions were designed on the basis of education, legislation and facilitating cooperation between different sectors and individuals. The contents of training programs in all interventions included the introduction of CVD, causes of its development or reversal, its risk factors, and control and prevention methods, appropriate pharmacological treatments, medications related to secondary prevention in particular, and non pharmacological treatments such as lifestyle modification including proper nutrition, quitting smoking, increasing physical activity and dealing with stress; this study also reviewed the effects of the project on taking medications for secondary prevention in patients with cardiovascular disease and the findings specified that among implemented interventions, training patients at the time of hospitalized, hospital discharge and after that, were successful interventions. In addition, motivating and mobilizing people for collaboration with a non-governmental organization, in the field of integration of secondary prevention programs in the community, was one of the successes of this project. Besides taking aspirin, beta blockers, angiotensin converting enzyme inhibitor (ACE-1) and statins significantly increased during the study in patients with CVD [20].

Tehran Lipid and Glucose Study

The Tehran Lipid and Glucose Study (TLGS) is the other integrated community-based program conducted by Azizi et al. in Iran to determine the risk factors for non-communicable disorders (NCD) among Tehran's urban population and perform population-based measures to modify the lifestyle and prevent incidence of diabetes mellitus and dyslipidemia, cardiovascular risk factors; 17000 men and women 3-69 years old were randomly selected to assess conventional and emerging cardiovascular risk factors [21].This ongoing study began in 1999 and it will continue

for at least 20 years. It has several phases, of which phase II, lifestyle interventions were implemented in 5630 people as the intervention group and 9375 individuals as the controls. The aim of the interventions were lifestyle modification by improving dietary pattern, increasing physical activity levels, and smoking cessation and as a result, primary, secondary and tertiary preventions for NCD. Dietary interventions were designed according to the KAP study, implemented earlier. The KAP study included several questions related to factors of weight change, fat sources, fibers, snacks and food groups. Interventional strategies were based on changes in school programs, educating health care volunteers and treating patients with NCD risk factors. The specific target groups were schoolchildren, housewives and high-risk people and the intervention group received the interventions through face to face education, leaflets and brochures [22].

In one study done on a sub-sample of participants in TLGS to assess the diet and conduct some nutritional interventions.316 subjects aged ≥20 were selected and divided into 2 groups, case group (133 subjects) and control group (183 subjects). Mean energy and macronutrients intakes were measured and compared within the two groups, and results indicated a significant decline in mean energy, carbohydrate and fat intake and a significant increase in cholesterol intake in both groups. Moreover the prevalence of low HDL and central obesity increased in the controls, while hypercholesterolemia and high LDL cholesterol decreased in cases [23].

3. Other Studies

Other studies have also been conducted among Iranian populations regarding nutritional and lifestyle interventions; one of these is a semi-experimental study performed on 118 married women, to design and evaluate the precede planning model for improving nutritional behavior in a rural community. The precede method, a successful model, which is widely used for planning health promotion interventions, is based on this fact that a proper educational diagnosis can help design appropriate interventional programs. The 7 steps of this model include social, epidemiological, behavioral, educational (predisposing, enabling and reinforcing factors) and managerial diagnosis and evaluation. The aim is to enable health training professionals in the systematic planning, implementation and evaluation of educational programs. In this survey, based on the steps of the precede model, the mortality of CVD as the most important social problem, improper food habits as the most important health problem, and nutritional behaviors as the most important behavioral problem were selected. The educational programs included training sessions, providing posters, booklets and pamphlets in order to introduce people to cardiovascular disease, its complications and symptoms, the types of food groups and nutrients and dietary habits contributing to the development or reduction of the disease. In the evaluation step, the effects of the program on the predisposing, enabling and

reinforcing factors were measured at immediately and 3 months after intervention. The findings indicated a significant increase in the structures of the precede model and an improvement in the predisposing, enabling and reinforcing factors. Moreover the relationship between knowledge and favorable behavior was significant [24].

The other study of this category is a randomized controlled trial implemented in postmenopausal Iranian women to discover the effect of a 6-month diet intervention on reducing cardiovascular risk factors. As documented, menopause is one of the CVD risk factors because estrogen withdrawal can be harmful for cardiovascular system. In this study 64 healthy postmenopausal women were chosen and were divided in to the intervention group (n=35) and controls (n=29). Intervention strategies included two face to face education sessions, three lecture discussion sessions about menopause, CVD and healthy diet. Subjects were educated on adequate consumption fruits and vegetables, whole grain, fibers and fish and also limited intakes of fat and salt. Results after 6 months indicated that weight, body mass index and fasting blood sugar were significantly lower whereas there were a significant increase in intakes of fiber, a significant decline in consumption of sodium in the intervention group, in comparison with the control group. Besides participants in the diet group consumed fruits and vegetables more than 5 servings a day [25]. Some other nutritional clinical trials conducted in small population are shown in table 2.

Table 2. *Characteristics of some interventional studies focusing cardiovascular disease in Iran.*

Reference	Author	Population	Intervention	Results
[27]	Mahmoodi M, et al	75postmenopausal women with type 2 diabetes	-Three groups: group 1: 1.8 g omega-3 fatty acids plus 400 mg vitamin E, group 2: 5 mg zinc plus 300 mg vitamin C, group 3: placebo -For 12 weeks	At baseline, there were no significant differences in glycemic parameters among the three groups. Changes in HOMA-IR in group 1 were significantly higher than those in group 2 and the placebo group After intervention, the change in fasting plasma insulin was higher in group 1, while it was lower in the other 2 groups. The supplementation caused a significant decrease in the mean changes in fasting plasma glucose in group 1 and a significant increase in group 2 (-11.1±14.1 vs. 27.9±10.9 mg/dl, respectively), (p= 0.039)
[28]	Haghighat N, et al	69 diabetic patients	-Two groups: the intervention group (n=32): 25 gr dark chocolate (containing 450 mg polyphenols) the control (n=28) group: similar amount of white chocolate -For 8 weeks	The intervention brought about statistically significant reductions in the blood levels of TG, apo-lipoprotein A-1, apo-lipoprotein B and hs-CRP. There were no significant differences in either group with regard to serum total cholesterol, LDL-c or HDL-c levels at the end of the period; neither were observed any intergroup differences
[29]	Yavari P, et al	A randomized, controlled, double-blind clinical trial on 125 patients with type 2 diabetes	-Five groups: 1)10 mg of B12, 10 mg of B6, 200 micrograms of B12 And 1,000 micrograms of folate 2)Vitamin B complex, and 100 milligrams of vitamin E 3)Vitamin B complex, 200 mg of vitamin C 4) Vitamin B complex, 100 milligrams of vitamin E, 200 mg of vitamin C 5)Placebo -For 2 months	After 2 months, no significant changes in mean serum apolipoproteins were seen But Significant positive correlation between the changes vitamin E and apo A1 and apo B changes were reported
[30]	Sadeghifa J, et al	A descriptive and interventional study on 96 patients of CCU and Post CCU of Mustafa Khomeini hospital of Ilam	After educational intervention on knowledge and attitude of patients in field of cardiovascular risk factors	Knowledge of patients in field of cardiovascular disease before (25.93) and after (36.19) education, had a significant difference. Moreover there was a significant difference between before (23.5) and after (35.7) education in attitude mean score
[31]	Paziraei M.et al	36 men non-athletes aged 57 years	-4 groups: 1: exercise with 2000 mg omega-3 supplement, 2: exercise with placebo, 3: 2000 mg omega-3 supplement 4: placebo -For 8weeks	A decline by 3.6% inthe exercise + supplement group, by 12.4% in the exercise + placebogroup andby 2.8% in the omega-3 supplement group were reported
[32]	ArablouT, et al	A randomized controlled double-blind clinical trial on 63 type 2 diabetic Patients	-2 groups: 1: the intervention group (n=33): 1600 mg ginger powder 2: the control group (n=30): 1600 mg placebo containing wheat flour -For 12 weeks	Ginger could reduce fasting plasma glucose, triglyceride, total cholesterol and C-reactive protein, significantly in intervention group compared to placebo group

Reference	Author	Population	Intervention	Results
[33]	Raufi A, et al	58 patients with elevated LDL cholesterol levels	-Two groups: 1) controlgroup: lovastatin, 2) case group:lovastatin + Rhuscoriria -For 3 months	After intervention, the mean level of LDLdecreased in both groups. The decline of LDL level was 17% in the casegroup while was 18% in thecontrols
[34]	BagheriN, et al	A randomized clinical trial on 60 hypertensive patients	-Two groups: 1: placebo group 2: experimental group: a capsule containing 100 mg coenzyme Q10 -For 3 months	In experimental group, the median Systolic Blood Pressure (SBP) before and after the intervention were 150 and 130 mmHgrespectively.In addition, there was no significant difference in the median SBP between two groups before the intervention, but it was significant atthe end of the intervention
[35]	JavadiSh,et al	6 normal adult dogs	Each of the dogs were administered normal saline (control) and hydro-alcoholic extract of walnut (intervention)	Normal Saline had no effect on blood pressure and serum aldosterone and renin, whereas blood pressure reduced 15 minutes after the last administration of the extract and renin increased 15 minutes after administration of the extract so, the ratio of aldosterone to renin significantly reduced
[36]	Baljany A, et al	A semi-experimental study on 86 patients with cardiovascular disease	-Two Groups: 1) intervention group: self-management interventions related to healthy lifestyle and long-term adherence to medication treatment 2) control group: routine interventions -For 6 months	Self-management interventions could help patients with cardiovascular disease control themselves

4. Conclusion

Community-based intervention programs are considered as the best and most cost-effective strategies in the management of cardiovascular disease risk factors to decrease CVD mortality and morbidity [16]. In Iran, currently two ongoing large scale community-based intervention programs including the Isfahan Healthy Heart Program (IHHP) and the Tehran Lipid and Glucose Study (TLGS) being conducted. Both studies emphasize the effectiveness of such programs on cardiovascular disease prevention and control. Due to the high prevalence of CVD and its risk factors in Iran, more large community-based educational interventional studies are necessary in order to find proper solutions for the control of the disease and its risk factors. Moreover it must be emphasized that at the time of the implementation of such programs, the ways of encouraging public involvement should be carefully reviewed, implementer must use the advantages of effective interventions like improving the attitude and motivation of individuals and finally the implementation of these programs ought to be supported by the necessary legislation and accurate monitoring [26].

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