



# Isfahan healthy heart program: Evaluation of comprehensive, community-based interventions for non-communicable disease prevention

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## Summary

**Background:** Isfahan healthy heart program (IHHP), a six year, action-oriented, comprehensive and integrated community-based demonstration study, was launched late in 1999 to address the ongoing epidemic of non-communicable diseases (NCDs) and their major risk factors in Iran. It is a quasi-experimental trial that includes a reference area and several levels of evaluation including process, impact and outcome evaluations. IHHP involves individual, community and environmental changes to support health behavior modification.

**Objectives:** To describe the IHHP evaluation design and to assess the extent to which the program has attained its short-term impacts.

**Methods:** The IHHP evaluation includes four annual independent sample surveys in four specific sub-groups (adults, adolescents, health professionals and individuals at high risk for NCD) in both intervention and reference areas. In addition a six-year cohort study of persons aged  $\geq 35$  years in both areas measures impact on behaviors at the individual level and assesses the risk of myocardial infarction and stroke. The WHO STEPwise risk factor surveillance questionnaires were used to conduct the cross sectional surveys, which evaluate the impacts and outcomes

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of interventions evaluate the impacts and outcomes of interventions undertaken concurrently in 10 distinct component projects designed to improve behaviors, risk factors, and NCD-specific morbidity and mortality. Data collection on ischemic heart disease, stroke, and mortality is ongoing. The results of the first year of evaluation are reported here.

*Findings:* A significant increase in the consumption of oil was observed among males and females in the intervention community compared to the reference area ( $P < 0.05$ ). While daily smoking decreased and daily exercise increased among males in the intervention community, less favorable changes were observed among women. Daily exercise and oil consumption increased significantly, and attempts to smoke decreased among adolescents in the intervention community ( $P < 0.05$ ). Knowledge about healthy life style improved significantly in physicians, nurses and health trainees in the intervention compared to reference areas ( $P < 0.05$ ). Age, sex, level of education and urban or rural place of residence modified the response to intervention activities.

*Conclusion:* The implementation and evaluation of a comprehensive integrated community-based program for NCD prevention in a developing country is feasible and successful in obtaining short-term improvement in several lifestyle behaviors.

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## Introduction

The current and future burden of chronic diseases reflects cumulative exposure to a variety of risk factors [1]. The global prevalence of all leading chronic diseases is increasing, with the majority of non-communicable diseases (NCDs) occurring in developing countries. Further substantial increases are projected over the next two decades [2].

In 1995, circulatory diseases, mainly cardiovascular diseases (CVD), accounted for 47.3% of all Iranian deaths [3]. In Iran as in other countries, the prevalence of ischemic heart disease (IHD) is more common among people of lower socio-economic status [4]. NCDs mainly CVD including stroke, cancers, diabetes and some respiratory diseases share common risk factors which are amenable to intervention [5]. Previous studies in Iran showed that 32% of men and 41% of women had at least two major risk factors for CVD including, high blood pressure, smoking, hypercholesterolemia, diabetes mellitus and obesity [6], with a higher prevalence in urban than in rural areas [7]. In addition, the prevalence of hyperlipidemia and obesity has rapidly increased among Iranian children and adolescents in recent years [8,9].

Among primary prevention strategies developed to control the NCD epidemic, multifactorial integrated community-based interventions targeting the common risk factors and combining population and high-risk approaches are of particular interest [10]. The Isfahan healthy heart program (IHHP) was designed to study the feasibility and impact of a comprehensive, integrated, community-based pro-

gram, which consists of intervention strategies for health promotion and NCD prevention. The program is currently in a demonstration phase [11]. IHHP aims to reduce the occurrence of CVD including IHD and stroke, as well as related risk factors and to increase healthy behaviors including non smoking, healthy nutrition, and physically active lifestyles [11]. Because of common underlying risk factors, this approach is also likely to lead to a reduction in other NCDs including diabetes, cancers, hypertension and COPD. The main goals of the program are to improve population-wide behaviors, to prevent and control common risk factors for NCDs and to delay the onset, reduce disability, and postpone deaths due to NCDs. The program targets individual, community and environmental changes to support health behavior modification. The design of IHHP is described in full elsewhere [11,12].

This report summarizes the objectives, strategies, models of intervention and early field experiences of IHHP. It also describes the evaluation design and it presents early impact data.

## Background

### Objectives

The long-term objectives of IHHP are to decrease the incidence of NCDs including CVD (IHD and stroke), diabetes, hypertension, and cancers, as well as to decrease disability and mortality associated with NCDs. The short-term objectives are to improve knowledge and awareness in the general

population and among health professionals about the causes and consequences of NCDs, as well as to improve individual skills to control risk factors. Other objectives include: to reduce the prevalence of risk factors, to improve health professionals' knowledge and skills to achieve early identification, treatment, control and rehabilitation of individuals at high risk or with clinical manifestation of the disease, and to improve social and physical environments. Evaluation objectives include: to document the process, impact and outcomes of interventions at the individual, community and environmental levels. A final program objective is to facilitate maintenance of the program beyond the termination of external research funding.

### Target population

Two intervention counties (Isfahan and Najaf-Abad) and a reference area (Arak), all located in central Iran, are included in the study. According to the 2000 National Census, the population was 1,895,856 in Isfahan and 275,084 in Najaf-Abad, a county neighboring Isfahan. Arak, located 375 km northwest of Isfahan with a population of 668,531 was selected as a reference area because of socio-economic, demographic, health profile similarities to the intervention areas and good cooperation [11]. The intervention program targeted the general populations as well as specific target groups in urban and rural areas of the intervention communities (Table 2). Arak is monitored for evaluation purposes but does not receive interventions.

### Brief description of interventions

#### Key strategies and fields

The model of the IHHP program combines elements from the Precede-Proceed model [13], social learning theory [14], the Ottawa Charter for Health Promotion [15] and the innovation diffusion approach [16]. IHHP strategies have integrated activities targeted to different fields of the health sector (health promotion, disease prevention, and health-care treatment and rehabilitation). Key strategies for intervention activities include public education through mass media, intersectoral cooperation and collaboration, professional education and involvement, marketing and organizational development, legislation and coordination, policy development, as well as research and evaluation. Specific intervention activities are described elsewhere [11]. The main factors targeted by IHHP are healthy

nutrition, increased physical activity, tobacco control and stress management.

### Intervention projects

Interventions are targeted to individuals, populations and the environment and are based on results obtained from the baseline surveys, needs assessment, as well as existing health services. The program comprised 10 distinct projects each targeting different groups, including the Women's Healthy Heart Project, Heart Health Promotion in Children, the Health Professional Education Project, the Youth Healthy Heart Project, the Worksite Intervention Project, Healthy Lifestyles for High Risk Groups, Healthy Food for Healthy Communities, Isfahan Exercise Project, Non Governmental Organizations (NGOs) and Volunteer Intervention Project and Healthy Lifestyle for Cardiac Patients. Each project is supervised by a steering committee of directors that includes academics, health providers, stakeholders and policy makers. All directors are members of the High Council of IHHP [11] and are involved in planning, implementing and evaluating their projects. An underlying principle in all 10 projects is to develop and maintain close contact with representatives of relevant community organizations. The teams work intensively and closely with representatives of mass media (television, newspapers, radio, etc.), health professionals (administrators, physicians, nurses, health workers and volunteers, social workers, school staff, etc.), business and market leaders (food-industry, groceries, bakeries, fast food shops), key NGO staff, and local political decision makers (county, municipal and provincial leaders). The Mayor, Governor, and Governor General of Isfahan and Najaf-Abad are involved and the Governor General is the honorary president of the IHHP program. Details of the interventions as well as IHHP organization are described elsewhere [12].

### Evaluation

The intervention activities and evaluation are integrated components of IHHP. Generally, the functions of monitoring and evaluation are to assess the process of program development and performance and to assess the extent to which the program has attained its objectives. It was designed to address questions including the practicality, feasibility, reasons for success or failure of interventions, as well as the possibility of integration.

## Objectives

The main objectives of the IHHP evaluation are to gain insight to the program implementation, to improve the intervention projects, to determine whether impacts and effects are achieved and to give feedback to those who participated in the program.

## Evaluation design

IHHP was developed as an action-oriented, quasi-experimental demonstration program with ongoing evaluation as well as other secondary research studies (Fig. 1). IHHP includes three phases: pre, during and post intervention, all of which have been described previously [11]. The first surveys of the first phase were completed among 12,600 individuals aged  $\geq 19$  years, 6300 in each of the intervention and reference areas, as well as 2000 adolescents aged 11–18 years, 2000 health professionals and 2000 high risk and CVD patients selected in equal number from intervention and reference areas. IHHP is evaluated in two study designs: a repeat cross-sectional study design with four annual independent sample surveys, and a 10-year longitudinal cohort sample survey, both of which compare levels of modifiable risk factors for NCDs in the intervention and reference areas before, during and after the implementation of

the interventions. During the first two years (2001–2002), the program developed a close collaboration with the national authorities in the Ministry of Health in Iran, and with the WHO regional office and headquarters as a major demonstration study. To our knowledge, there is no evidence of the effectiveness of similar comprehensive integrated community-based intervention programs for NCD prevention in a developing country, using a quasi-experimental design, and with different levels of evaluation.

Our approach to evaluate changes in risk factors as short term impacts, and NCD-specific morbidity and mortality as long term outcomes was based on the WHO STEPwise surveillance design (Table 1) [17]. NCD risk factor surveillance was performed at all steps in the baseline survey in 2000. Data on behaviors, physical measurements, and biochemical variables were collected in the intervention and reference areas. The same studies are being done on independent samples and the cohort sample in the post interventional phase in 2006. IHHP impacts on lifestyle behaviors of all groups in the first phase were evaluated using the behavioral questionnaire-based model (Step 1) with additional questions on an annual basis beginning in late 2001; data collection continued until 2005 (Fig. 1). Data on heart attacks and stroke are collected on a continuous basis using the WHO STEPwise approach.

Data on age, gender and cause of death from the National Registration of Deaths are collected for

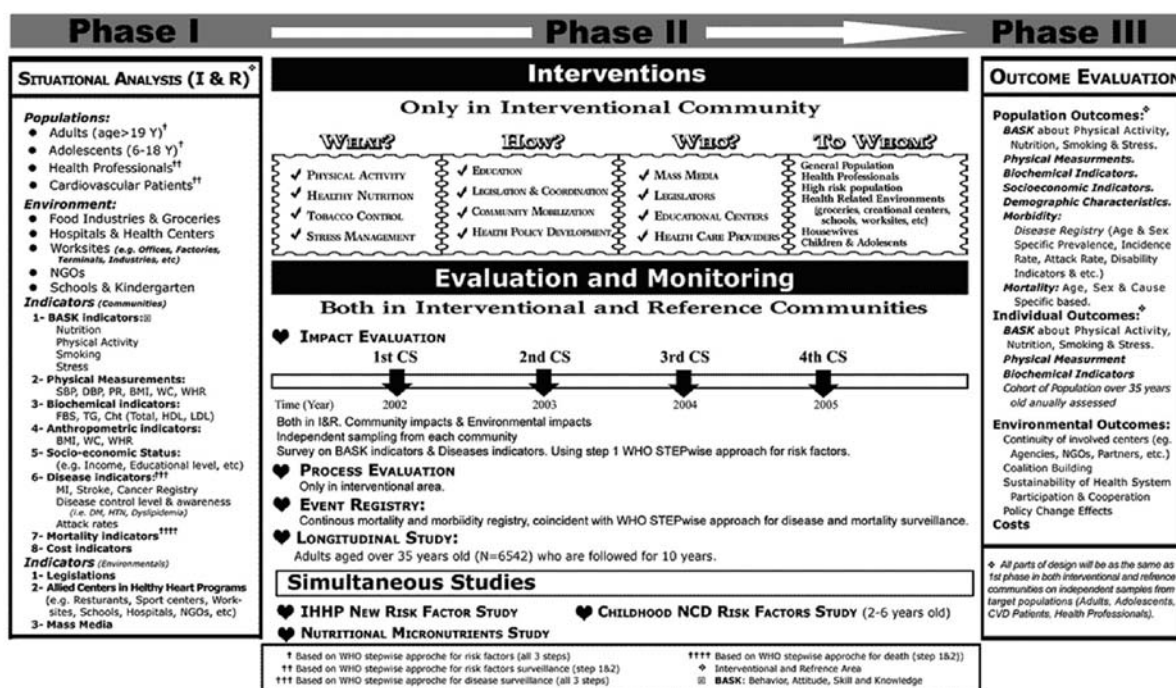


Figure 1 Evaluation design in Isfahan Healthy Heart Program.

**Table 1** WHO STEPwise approach for NCD surveillance in Isfahan Healthy Heart Program

NCD	Step 1	Step 2	Step 3	Data collection intervals
Deaths (past)	Death rates by age and sex	Death rates by age, sex and cause of death (verbal autopsy)	Death rates by age, sex and cause of death (death certification)	Continuous data collection
Diseases (present)	Hospital or clinic admission by age and sex <i>plus</i> reason for admission	Rates and principal condition NCDs	Cause specific disease incidence or prevalence, case fatality	Continuous data collection
Risk factors (future)	Questionnaire-based report on key risk factors	Questionnaires <i>plus</i> physical measurements	Questionnaires <i>plus</i> physical measurements <i>plus</i> biochemical measurements	Step 1: annually <sup>a</sup> Step 2: every 5 years <sup>b</sup> Step 3: every 5 years <sup>c</sup>

(With permission of the Surveillance Unit for NCD in WHO).

<sup>a</sup> Step 1 is performed in adult populations, adolescents, high risk populations and health professionals.

<sup>b</sup> Probably is performed at 3rd year of study on adult and adolescent populations.

<sup>c</sup> Will be continued even after the study termination.

both intervention and reference areas. In addition to annual cross-sectional surveys, which measure behaviors, all eligible individuals aged  $\geq 35$  years from the original sample studied in the baseline phase are followed-up from 2001 for 10 years in biannual longitudinal studies for the occurrence of CVD events, sudden death, hospitalizations, physician visits, etc. This cohort of 6542 adults from the intervention and reference areas will allow determination of an Iranian risk assessment algorithm based on major and some novel risk factors.

All data collected in the baseline surveys of the first phase are being reassessed in 2006 on independent samples. The target populations, sample size, impacts and outcomes, as well as simultaneous studies done on smaller sub samples are described in Fig. 1.

### Process, impact and outcome evaluation

The process evaluation is undertaken in the intervention area only, while the impact and outcome evaluations are undertaken in both intervention and reference areas.

#### Process evaluation

Data on implementation of the IHHP, exposure to interventions, diffusion of intervention activities, as well as the process of changing health behavior and risk factors are obtained from the annual behavioral survey, annual process notes collected by the related health center units as part of their routine monitoring of worksites, schools, etc., as

well as from site visits. Data are collected in questionnaires, individual interviews, focus groups and group discussions. Several questions concerning community awareness and participation levels in IHHP were added to the annual WHO STEPwise behavioral impact evaluation questionnaire in intervention areas. While some process evaluation questions addressed IHHP partners, leaders, volunteers, health professionals and coalitions trying to monitor their role activities and contributions, other questions addressed environmental changes in worksites, schools and communities. All interventional activities in Isfahan and Najaf-Abad are monitored to determine why and how some are successful and sustainable. Identification of mechanisms as well as barriers and facilitators to implementation are also an integral part in the process evaluation of IHHP.

#### Impact evaluation

Short term impacts of IHHP interventions on knowledge, awareness, attitudes, practices and skills, assess whether and to what extent the short term program objectives are achieved. Where indicators of these impacts were not already available in the WHO STEPwise approach to behavioral risk factors (Step 1), we added them into the questionnaire.

The IHHP impact was evaluated in a series of independent sample surveys in 2002, 2003, 2004 and 2005 beginning in October every year. Modifiable behavioral risk factors are compared in intervention and reference areas. Multistage random

sampling and age-based CINDI protocol sampling methods [18] were used for the baseline and subsequent annual impact evaluations to study 2400 adults aged  $\geq 19$  years in each of intervention and reference areas. Additional independent cross-sectional studies were done on 1000 school children aged 11–18 years, 500 of their parents and schools staff, as well as 500 health professionals each in the interventional and reference areas. The sampling design and size, procedures and questionnaires were described earlier [8,11,19]. These studies were designed to test the hypotheses whether short term comprehensive approach of interventions for healthy lifestyle is effective in creating a significant change in the behaviors of adults, adolescents, health professionals and a high risk group. Qualitative and quantitative questions on sociodemographic characteristics, smoking behaviors, physical activity, dietary habits and psychosocial variables were asked in addition to those used in the WHO STEPwise behavioral questionnaire. The target population, and frequency of cross-sectional studies are outlined in Fig. 1.

### Outcome evaluation

Long-term outcomes are being evaluated in 2006 using the WHO STEPwise approach to risk factors at three steps and modules for behavioral, physical and biochemical measures. Outcomes are evaluated as changes in the mean levels and prevalence of core risk factors defined by the WHO STEPwise approach. Levels of morbidity, disability and mortality among the high risk and patients groups are also assessed as are the continued involvement of community partners, coalitions, NGO's and the public health system in IHHP interventional actions at the environmental level, and the effects of policy changes [20]. Study participants, outcome measures, target sites and research instruments are described elsewhere [11] and summarized in Fig. 1.

### Data analysis

Data from the 2000 baseline survey and the 2001–2002 independent sample surveys were used to evaluate program impacts after one year of intervention. We compared the unadjusted prevalence of selected risk behaviors in the four groups of interest (adults, adolescents, health professionals, high risk groups) in the intervention and control areas over time. The impact of the program on smoking, physical activity and type of cooking fat

used, was then examined in multivariate logistic regression models which tested community  $\times$  time interaction terms in each target group for each gender separately. Results of the adjusted main effects models are presented as odds-ratios (OR) and 95% confidence intervals (CI) of the community  $\times$  time interaction terms adjusted for potential confounders. Data were analyzed using the SPSS statistical package version 12 for Windows (SPSS Inc., Chicago, USA) [21]. All hypotheses were tested with 80% power ( $\beta$ -error = 20%) and 95% confidence ( $\alpha$ -error = 5%).

### Results

Only behavioral indicators from the independent sample surveys in both areas are presented in this report, while the results of process evaluation and qualitative research will be reported separately. Table 2 describes selected characteristics of the survey participants. The response proportions in the 2001–2002 surveys were lower than those obtained in 2000, particularly among health professionals and high risk individuals. Selected health characteristics of intervention and reference subjects at baseline were similar in both genders (Table 3).

There was a significant increase among intervention subjects in the consumption of oil after the first year of IHHP interventions ( $P < 0.05$ ). Among men in the intervention community, oil consumption and daily physical activity increased while smoking decreased after one year of intervention (Table 3). Although smoking among women showed less favorable results (Table 3), the use of oil increased significantly ( $P < 0.05$ ).

Table 4 presents the ORs for community  $\times$  time interaction terms after adjustment for potential confounders. The prevalence of smoking was higher among younger, less educated men living in urban areas in both the intervention and reference areas. No statistically significant differences between communities in the odds ratios were detected.

Daily smoking increased significantly among women in both intervention and reference areas in the first year of evaluation. It was more prevalent among older, higher educated women living in urban areas. The difference between urban and rural smoking levels was lower among men than women (Table 4).

Both in urban and rural areas, oil consumption was higher among older, higher educated men and women living in urban areas. Table 4 also

**Table 2** Comparison of selected characteristics of respondents in the intervention and reference areas at baselines

≥ 19 years	General adult population survey		Adolescent survey (11–18 years)		Health professional survey <sup>a</sup>		Survey of high risk population and CVD patients	
	Intervention area	Reference area	Intervention area	Reference area	Intervention area	Reference area	Intervention area	Reference area
<i>Year</i>								
2000	6300	6300	1000	1000	1000	1000	1000	1000
2001–2002	3000	3000	1000	1000	500	500	500	500
<i>Response rate</i>								
2000 (%)	96.4	99.2	96.9	98.1	95.6	94.1	81.2	92.5
2001–2002 (%)	99.0	96.0	96.4	96.1	74	61.8	80.6	79.6
<i>Gender</i>								
Male (%)	50.9	50.8	50	50	41.8	47.7	56	48
Female (%)	49.1	49.2	45.6	48.3	58.2	52.3	44	52
<i>Place of residence</i>								
Urban (%)	79.7	66.6	68	62	81.2	76.3	78	67
Rural (%)	20.3	34.4	32	38	19.8	23.7	22	33

<sup>a</sup> Health professionals: physicians, nurses and primary health care providers.

**Table 3** Comparison of the prevalence of selected health behaviors in adults aged  $\geq 19$  years in 2000 and 2001–2002

	Male		Female	
	Intervention area % (95% CI)	Reference area % (95% CI)	Intervention area % (95% CI)	Reference area % (95% CI)
<i>Daily smoking</i>				
2000	26.1 (24.9–27.3)	26.8 (25.7–27.9)	1.3 (0.8–1.7)	0.8 (0.65–0.96)
2001–2002	21.8 (20.2–23.4)	28.3 (26.7–29.9)	2.5 (1.8–3.3)	1.6 (0.95–2.1)
<i>Use of oil in cooking</i>				
2000	52.4 (46.2–56.6)	40.3 (39.6–46.1)	56.1 (51.3–59.2)	49.2 (42.5–55.9)
2001–2002	57.6 (49.3–65.9)	39.8 (33.1–46.5)	63.3 (59.1–67.5)	45.8 (40.4–51.2)
<i>Daily physical activity</i>				
2000	20.5 (18.3–22.7)	20.9 (18.1–23.7)	10 (8.3–11.7)	8.3 (6.9–9.7)
2001–2002	23.3 (21.8–24.8)	19.8 (16.9–21.7)	12 (10.7–13.3)	9.2 (7.9–10.3)

$\Delta P_i$  versus  $\Delta P_r$  is significant only about "use of oil in cooking" in both genders ( $P < 0.05$ ).

$\Delta P$ : Difference between prevalence in baseline (2000) and first evaluation (2001).

shows that the prevalence of daily physical activity was higher in the 50–64 year age group except for the women in the reference area. It was more prevalent among higher-educated men and women, but less prevalent in subjects living in rural areas.

Data shown in Table 5 suggest that physical activity and use of oil in food increased significantly among adolescents after one year of intervention. In addition, attempts to smoke significantly decreased. Although the addition of salt to food decreased in the reference area, the difference between intervention and reference areas was not significant ( $P > 0.05$ ) (Table 5).

The levels of risk factors in an independent sample of health professionals are compared to their baseline data in Table 6. The data suggest similar trends in the intervention and reference areas. While the percentage of health professionals who participated in daily exercise increased significantly in both communities, daily smoking decreased after one year. Knowledge about healthy lifestyle and medical advice increased significantly among physicians and nurses after one year of intervention ( $P < 0.05$ ).

## Discussion

Since the 1970s, many community-based studies have evaluated the impact of NCD prevention efforts in developed countries [22,23]. These experiences are useful in planning and implementing NCD prevention activities in developing countries because lessons learned can be adapted in other jurisdictions. One successful demonstration project was conducted in Finland from 1972 to 1977. The North

Karelia Project began as a demonstration project in a rural area in Finland, where the socioeconomic setting was similar to that in many developing countries today [24]. IHHP, similar to the North Karelia model was a quasi-experimental study with a reference community that evaluated comprehensive community participation and organization to CVD prevention using an integrated, bottom-up approach that combined many different activities to produce synergistic effects.

The evaluation of comprehensive integrated programs is important, although because of cost and complexity, the effect of each component of the intervention is usually not assessed. In many evaluations to date, the study designs and methods are not sufficient to draw valid conclusions on the impact or effectiveness of the interventions. A true experimental design would have a number of communities allocated randomly into intervention and control communities. This is seldom possible as it may not comply with the basic idea of comprehensive community interventions. Instead, quasi-experimental designs have been often used with a reference community or with the national change as the comparator. Swedish [25], American and British [23,26] studies that reviewed study designs and evaluations in community-based trials, suggested that only eight met the criteria for appropriate study design and evaluation. These projects showed only modest or no effects on the target risk factors or disease rates, because of the varying nature and dose of interventions, because the investigators defined impacts or outcomes expectations that were not realistic, because diffusion of successful interventions to other areas was not undertaken, and because sec-





**Table 5** Comparison of the prevalence of selected health behaviors in adolescents in 2000 and 2001–2002

Habit	Baseline survey		1st Annual evaluation	
	Intervention area % (95% CI)	Reference area % (95% CI)	Intervention area % (95% CI)	Reference area % (95% CI)
Daily regular exercise <sup>a</sup>				
2000	14.6 (13.1–16.1)	13.1 (11.7–14.5)	21.7 (17.9–24.5)	14.3 (11.1–17.5)
2001–2002				
Frequent fruits and vegetables <sup>b</sup>				
2000	26.2 (25.1–27.3)	27.6 (26.3–28.9)	25.7 (23.0–28.4)	24.3 (21.2–27.4)
2001–2002				
Added salt to food <sup>c</sup>				
2000	27.2 (26.0–28.4)	32.7 (31.4–33.9)	26.8 (24.5–29.1)	26.6 (23.7–29.5)
2001–2002				
Oil in food <sup>a</sup>	49.6 (47.9–51.3)	44.7 (43.1–46.3)	53.7 <sup>a</sup> (49.9–57.5)	45.1 (40–50.2)
Attempt to smoking <sup>a</sup>	6.3 (5.1–7.8)	7.1 (6.5–7.8)	10.1 (8.9–11.8)	9.1 (8.2–10.9)
Passive smoking	43 (40.2–45.8)	38 (35.3–40.7)	42.4 (38.2–46.6)	39.5 (35.8–44.2)

<sup>a</sup>  $\Delta P$  is significant between interventional versus reference area ( $P < 0.05$ ).

<sup>b</sup> More than four times in a week.

<sup>c</sup>  $\Delta P$  is significant between interventional versus reference area ( $P < 0.05$ ).

**Table 6** Prevalence of health knowledge and activity among health professionals

Variable	Baseline survey		1st Annual evaluation	
	Interventional area % (95% CI)	Reference area % (95% CI)	Interventional area % (95% CI)	Reference area % (95% CI)
Regular daily exercise	22.3 (19.8–23.5)	19.8 (17.5–20.1)	26.2 (23.5–28.9)	21.2 (18.4–24.1)
Current smoking	7.8 (6.6–9.1)	8.3 (7.2–8.4)	6.3 (4.1–8.4)	8.1 (5.9–10.3)
Acceptable knowledge about healthy life style <sup>a</sup>				
Physician	74.3 (70.1–78.8)	68.6 (62.7–74.5)	78.2 (71.1–85.3)	69.2 (62.5–75.9)
Nurse	59.5 (55.1–63.9)	51.8 (46.1–57.6)	67.5 (60.3–74.7)	53.4 (45.5–61.3)
Other health care providers	34.6 (31.8–37.4)	36.3 (33.4–39.2)	37.8 (32.9–42.6)	38.9 (33.6–44.1)
Health advises to cardiovascular patients				
Physician	36.3 (33.6–39.1)	37.8 (35.1–40.3)	43.2 (38.3–48.1)	38.6 (34.9–42.3)
Nurse	59.4 (55.6–63.2)	56.8 (52.5–61.1)	64.2 (58.3–70.1)	55.2 (50.6–60.5)
Other health care providers	24.6 (21.3–27.9)	31.2 (27.8–34.6)	28.9 (24.1–32.7)	30.8 (25.7–35.9)

<sup>a</sup> Score above 70% of total score is defined as acceptable knowledge.

ular trends were so pronounced that demonstrating impact was not possible.

IHHP uses both a repeat cross-sectional and a cohort design to assess impact and outcomes. The independent sample surveys assess the magnitude of change in the population as a whole, while the cohort approach provides information on changes at the individual level.

In addition, frequent process evaluations in Isfahan and Najaf-Abad increase understanding of mechanisms underlying any change. Furthermore, results are used to improve the ongoing interventional activities.

The strategy to evaluate IHHP impacts and outcomes was based on the WHO STEPwise approach for surveillance of NCD risk factors, morbidity and mortality. This approach was originally developed

based on the concept that NCD surveillance systems require standardized data collection to ensure comparability over time and across communities.

To our knowledge, this is the first time that the WHO surveillance approach for NCD has been used as a model to evaluate preventive interventions. The data will eventually be used to influence health policies in a comprehensive integrated program for NCD prevention and health promotion, not only in healthy adult populations, but among children, health professionals and high risk groups. We believe that this approach is sufficiently flexible to be appropriate in a variety of country situations.

One year of intervention is a relatively short time period over which to assess lifestyle changes at a population level, although there is evidence that risk

behaviors can be changed in a short time [27]. Our results showed that in both genders, use of oil increased significantly. Before IHHP, most people used hydrogenated vegetable fat for cooking, baking and frying, likely because the government subsidized this kind of fat. However following IHHP educational programs, several meetings were organized with the Provincial Chief of Commercial Office to discuss replacing subsidized hydrogenated fat with oil in Isfahan and Najaf-Abad. Based on these policy changes, the percent of hydrogenated fat and oil distribution changed from 82% and 18% in 2000, to 68% and 32% in 2002, respectively while in the reference area this change was from 97% and 3% in 2000 to 95% and 5% in 2002, respectively. Hydrogenated fat has been analyzed from eight domestic industries in Iran. The level of *trans* fatty acids was 34% [28] while saturated and *trans* fatty acids together comprised 60% of hydrogenated fats [29]. Following these reports, IHHP officials developed a health policy statement for the Provincial government, to identify *trans* fatty acids on food product labels.

Among men, smoking declined significantly in the intervention areas while among women, it increased in both the intervention and reference areas. Explanations include insufficient sample size, sampling bias as the sample size was reduced in the one year follow up, bias in the intervention design which targeted multiple risk factors in women rather than focus on smoking, which was less than 2% at baseline. Another explanation is the role of antismoking activities in Iran including Quit and Win Campaigns that targeted men more than women. Also, it may be related to the pronounced secular increases in smoking among Iranian women and youth [30], which will require interventions targeted specifically to these susceptible groups.

Smoking initiation decreased significantly in adolescents in the intervention areas compared to the reference area, while exposure to passive smoking did not change. A law was passed by the Iranian government in 1998 prohibiting indoor smoking, although its enforcement remains problematic.

Although there was a decline in salt added to food among adolescents in the reference area, the overall difference between the intervention and reference areas was not significant.

While physical activity increased significantly among men and adolescents in the interventional areas, no differences were observed among women. The increase observed among adult men, adolescents and health professionals, possibly related to the many physical activity health promotion programs implemented in Isfahan and Najaf-Abad schools, worksites, etc. Interventions to increase physical activity specifically designed for and tar-

geted to Iranian women will likely need to be redesigned before similar changes will be observed.

The IHHP implemented regular educational sessions, seminars, and workshops for health professionals on the role of diet, antismoking activities, regular exercise and stress management for NCD prevention. In addition, continuous medical education programs addressed guidelines on screening for cholesterol and fasting blood sugar (FBS). These activities likely had a significant impact on knowledge and behavior of health professionals.

Examining the influence of socioeconomic status on health behaviors, we found that smoking was more common in higher educated women and less educated men; oil consumption was higher among highly educated men and women. It is well known that better educated groups generally have better health [22], however that was not the case for smoking among Iranian women. The effect of place of residence was inconsistent, as well. Contrary to previous studies [7], regular physical activity was less prevalent among men and women in rural areas, both in intervention and reference areas. One explanation is that media campaigns and group education programs might have less impact in rural communities, suggesting that these kinds of interventions might need to be better adapted to rural populations.

## Limitations of the study

In the present study, multiple interventions targeting many risk behaviors make the evaluation of each intervention effect or the change in each risk factor more difficult, however a comprehensive community-based approach usually combines many activities to produce a synergistic effect. Another limitation is the different sample sizes used in the baseline and one year follow up study.

## Conclusion

Our experience with the integration of intervention and evaluation demonstrates that, conducting a comprehensive integrated approach for NCD prevention in developing countries and integrating research with practice is feasible and can improve population lifestyle behaviors.

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