



## Original Research

# A province-based surveillance system for the risk factors of non-communicable diseases: A prototype for integration of risk factor surveillance into primary healthcare systems of developing countries

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## SUMMARY

**Objectives:** To establish a surveillance system for risk factors of non-communicable diseases, develop a valid tool and methodology for surveillance surveys, and build capacity in 41 provincial surveillance sites to design and conduct the surveys and provide provincially interpretable baseline data.

**Study design:** Population-based national study.

**Methods:** The World Health Organization's STEPwise approach to non-communicable disease surveillance was adapted to design a national risk factor surveillance model. The first national population-based and cross-sectional study was conducted in 2005 in 41 universities of medical sciences in all 30 provinces of Iran. This involved multi-stage cluster sampling from 25–64 year-old Iranians and non-institutionalized populations. A national technical unit at the Ministry of Health and Medical Education supervised all study processes including data management and analysis.

**Results:** From the national results, the survey estimated that the prevalence of daily current smoking was 17.9%. Of the target population, 5% consumed at least five combined servings of fruit and vegetables per day. The median daily time spent undertaking transport-related physical activity (43.8 min) was significantly higher than the median time spent on work-related physical activity (27.5 min) or recreational physical activity (28.6 min). Overall, 54.7% of the target population were overweight or obese, and waist circumference was greater among women than men. The prevalence of hypertension was 23.8%, with a higher prevalence among women than men. In addition, 6% of the target population had a high fasting blood glucose ( $\geq 126$  mg/dl), and 45.1% had a total cholesterol level of at least 200 mg/dl.

**Conclusion:** Integration of province-based surveillance activities into the Iranian primary healthcare system is feasible. Provincial reports could provide a baseline picture of the most important risk factors for non-communicable diseases. There are several important risks with a prominent burden that may cause a progressive epidemic of major non-communicable diseases in the future in the absence of quality interventions.

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## Introduction

Worldwide, non-communicable diseases (NCDs) are increasingly recognized as a major cause of morbidity and mortality. They accounted for 35 million of 58 million global deaths from all causes in 2005, i.e. double the number of deaths from all infectious

diseases, maternal and perinatal conditions, and nutritional deficiencies combined.<sup>1</sup> NCDs represent the highest burden among all three major groups of non-infectious causes of disease including pre-transitional causes, NCDs, and accidents and injuries. Obesity and overweight, arterial hypertension, inadequate physical activity, hypercholesterolaemia and addiction comprise the five main risk factors, accounting for 68% of the risk factor burden, 11% of the total burden of disease, and 1.6 million disability-adjusted life years.<sup>2</sup>

To reduce the burden of NCDs, particularly in developing countries, the generation of data should be strengthened by

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establishing feasible and sound surveillance of these conditions and their risk factors. The surveillance of a more comprehensive list of NCD risk factors is a relatively new area; however, disease surveillance is already being undertaken in many parts of the world, and has been recognized as an important component of prevention and control programmes. Some NCD risk factors are well known, and have been subject to surveillance for a long time (e.g. tobacco), but the exact role that any specific risk factor plays in the causation of ill health in a specific community needs to be considered in depth. This is particularly true with regard to information concerning the cumulative effect of the combination and interaction of different risk factors in a given setting. Thus, surveillance of NCD risk factors is recommended in the first step of the World Health Organization (WHO)'s STEPwise approach to planning for prevention and control of NCDs.<sup>1</sup>

Knowledge about the major risk factors of NCDs in Iran was limited to small-scale studies in local communities that were not representative of the whole population. As such, this large population-based survey was undertaken with the following general objectives:

- to provide a standard method and tools to establish a well-tailored national NCD risk factor surveillance system;
- to build capacity in the Iranian universities of medical sciences and health services (i.e. the executive arms of Iran's national health system) to establish their own surveillance programme; and
- to determine baseline data on the existing situation of target NCD risk factors in each province and at national level. This information can provide baseline data for analysis of time trends, as well as for international comparisons.

This paper describes the approach taken to establish a national province-based surveillance system, and provides some selected results of the first survey conducted using this system.

## Methods

### *Study setting*

A national NCD risk factor surveillance technical unit was established at the Centre for Disease Control, Iranian Ministry of Health and Medical Education (MOHME) in 2001. It immediately began to review the national, regional and international literature to design an appropriate model for Iran; WHO's STEPwise approach to NCD risk factor surveillance (STEPS) was a major model studied. In addition, a national consultative team consisting of experts of epidemiology and biostatistics, internal medicine, cardiology, endocrinology and microbiology contributed in preparing the national plan for the first survey. In an attempt to build necessary capacity in the peripheral surveillance sites, four national workshops were held to train NCD officers who worked in the disease control units at 41 medical universities affiliated to the MOHME. Training included introduction of the protocol and tools of the survey, training interviewers and supervisors, data entry and use of a specific tool prepared in Epi Info, version 6.04c, CDC, Atlanta, GA, USA, data cleaning, using the syntax to make analysis outputs, using Excel tables prepared for weighting provincial data, and report writing. According to the Iranian MOHME, health services, medical education and research are provided in an integrated model by medical universities. They serve as peripheral executive bodies of the Iranian health system at provincial level. In each medical university, the vice-chancellor for health was appointed as the supervisor of the team conducting the survey. Furthermore, in each university, an executive team was formed of medical officers responsible for NCD control, public health laboratory coordinators, health network officers and officers responsible for statistics to

handle guidelines developed by the national surveillance office. Members of the interview teams and district supervisors were selected from the medical university staff according to a set of criteria including previous experience in data collection, good knowledge of geographical area, good relationship skills, good knowledge of Farsi and local languages, good knowledge of local culture, and able to approach households outside office hours. They were trained by the NCD officer of the disease control unit through a provincial workshop. Data were collected during the afternoon to enhance the likelihood of interviewing employed members of the households, and to avoid any conflict with work for the university staff. This organizational structure and financial support from national level completed the capacity building efforts.

A comprehensive pilot study was conducted in three provinces (Tehran, Kurdistan and Khorasan) to assess different aspects of the content and processes of the study. After final revision of the study design according to the pilot study, the first Iranian survey of national NCD risk factor surveillance was a cross-sectional health survey conducted on a representative sample of Iranians aged 25–64 years. The survey was conducted in January and February 2005. A general overview of the survey has been published by the MOHME.<sup>3</sup>

### *Sampling*

A two-stage cluster sampling method was used to select the samples. A national data bank of post codes was used to identify the clusters at random. Each 10-digit post code represented an individual household in the country. According to the STEPS manual,<sup>4</sup> a basic NCD risk factor surveillance site should include at least 2000 participants aged 25–64 years (equal to 200 participants in eight age–sex groups). The sample size for each province was estimated to fulfill this recommendation. An additional youth age group (15–24 years) was also included in the survey (without blood sampling), but the youth results will not be reported in this paper because their data significantly dilute the burden of risk factors among older age groups with higher risk levels.

Data were collected from 20 inhabitants of each cluster; of these, four subjects were aged 15–24 years. This study analysed the results of the 16 subjects aged 25–64 years, with two male and two female participants from each of the four age groups (25–34, 35–44, 45–54, 55–64 years), through face-to-face interviews and physical measurements. Blood samples were taken via a local health facility or laboratory.

### *Ethical considerations*

A national committee, comprised of senior academic and administrative members, was established to steer the surveillance programme. Tools and guidelines of the surveys were reviewed by the committee to avoid any technical or ethical errors. Eligible individuals were recruited to the study after giving informed oral or written consent. Participants were given the results of their physical assessments and biochemical measurements. The whole programme was offered free of charge. Those participants with any unusual findings that required medical assessment were referred to a health facility for additional follow-up. The interviewers and staff taking the samples were the same sex as the subjects in order to respect the religious beliefs of the study population. They were trained to do their job with cultural sensitivity, e.g. collecting physical measurements according to Islamic rules.

### *Questionnaire administration*

The study instrument was mainly adopted from core and expanded questionnaires of WHO's STEPwise approach to NCD risk

factor surveillance<sup>4</sup> to meet Steps 1, 2 and 3, i.e. asking questions about demographic status and behavioural risks, and collecting data through physical and laboratory measurements. The questionnaire was translated into Farsi and then back translated into English in order to assess the validity of translation. Interviewers were trained to understand the importance of using correct words when interviewing the subjects in local languages.

A list of fruit and vegetables available in Iran was provided for questioning, and provincial surveillance sites were asked to add local products to the list in order to facilitate asking questions about dietary habits. Local examples were also added to the list of physical activities. Questions about alcohol use were excluded in order to avoid any unwanted friction, due to the predominant Islamic culture in Iran.

Questions were asked through face-to-face interviews. The variables investigated were:

- demographic: age, sex, urban/rural residence;
- socio-economic: education, occupation, marital status;
- past medical history: history of diabetes and hypertension; and
- behavioural: diet, physical activity, tobacco use.

Several optional questions on diet were adopted from national studies in order to investigate consumption of dairy products, fried food and fast food.

Two national workshops were held to train the provincial trainers before commencement of the data collection phase. In turn, the staff trained in these workshops provided necessary information to the local interviewers. The interviewers asked the questions in Farsi and in local languages, where applicable, without altering the meaning of the question or the true responses.

#### *Physical measurement techniques*

All measurements were conducted according to the STEPS manual. The survey team measured blood pressure, height, weight and waist circumference of all participants. All instruments were standardized before the examination and the scales were zero calibrated. Blood pressure was measured using mercury sphygmomanometers (Richter Aneroid, Germany) with appropriate-sized cuffs after 5 min of rest in the sitting position. The participants were seated with the heart, cuff and zero indicator on the manometer at the observer's eye level. All readings were taken in duplicate (with a 5-min interval) in the right arm. In the case of finding a difference of at least 10 mm Hg between the first and second measurements for systolic and/or diastolic blood pressure, a third measurement was taken and considered as the final measure; otherwise, the average of the two measurements was calculated and recorded as the subject's blood pressure.

Height and weight were measured in light clothing without shoes. Analogue portable scales were used, and these were calibrated daily with standard triple beam scales to 100 g for weights between 50 and 70 kg. Standard constant tension tapes and portable height measuring inflexible bars were used to measure waist circumference and height, respectively. Waist circumference was measured at the mid-point between the free head of the lower rib and the anterior superior iliac spine.

#### *Laboratory measurement and techniques*

A venous blood sample was taken to measure fasting blood glucose (FBG) and total cholesterol after a 12-h overnight fast. Participants were invited to health centres or laboratories close to their homes. The blood samples were centrifuged immediately

after clot formation to provide a serum sample. These were transferred to a referral laboratory in each province for testing. Approval of the national reference laboratory and its quality control procedures ensured the accuracy of laboratory measurements. Samples were kept frozen at  $-20^{\circ}\text{C}$  if there was a considerable distance between the centrifuging site and the referral laboratory.

FBG was determined by the glucose oxidase/peroxidase-4-aminophenazone-phenol (GOD-PAP) method, and total cholesterol was estimated using the cholesterol oxidase/p-aminophenazone (CHOD-PAP) method. Uniform testing kits from the same batch (Pars Azmun Co, Tehran, Iran) were used as standard. Internal quality controls were used to ensure the uniformity of operations in all of the provincial laboratories. Inter- and intra-assay coefficients of variation for each laboratory were less than 2.5% and 3.5% for FBG and cholesterol estimations, respectively. According to the laboratory examination guideline of the survey, 10% of the samples were selected at random for further quality assurance testing. These samples were sent to the national reference laboratory in Tehran (a WHO collaborating centre) for retesting.

Several measures are tracked to determine the trend of target risk factors over time according to the STEPS model.<sup>4</sup> Some can be interpreted as an abnormal ill-health condition according to defined cut-off points. Overweight was considered as a body mass index (BMI) between 25.0 and 29.9 kg/m<sup>2</sup>, and obesity was considered as a BMI of 30 kg/m<sup>2</sup> or more. Stage I hypertension was defined as systolic blood pressure of at least 140 mm Hg and/or diastolic blood pressure of at least 90 mm Hg among those who were not using antihypertensive medication.<sup>5</sup> An FBG level of at least 126 mg/dl was considered as the cut-off point to define diabetic patients,<sup>6</sup> and a total cholesterol of at least 200 mg/dl was used for the cut-off point for hypercholesterolaemia.

#### *Data analysis*

A national workshop was held to train university staff in data management following guidelines prepared in Autumn 2005. Data entry was undertaken at university level using a tool developed in EPI-Info version 6. After primary cleaning by university staff, all data sets were transferred to the national technical unit to be recleaned by an epidemiologist. Statistical Package for the Social Sciences (SPSS)-compatible versions of the data sets were returned to the universities in association with a syntax prepared through SPSS version 11.5 (SPSS Inc., Chicago, IL, USA), a set of Excel tables for provincial estimation of risks in the total age range (25–64 years), and standard minimum blank tables to be used by universities for reporting. At national level, all of the data sets were merged and descriptive analyses were undertaken using the estimates for population density for each age group identified during the latest population census to provide national measures for 25–64-year-old Iranians.

#### **Results**

In total, 70,981 (35,833 females and 35,148 males) Iranian citizens aged 25–64 years were included in this study. The response rates differed between provinces; overall response rates of 81% were estimated for the questioning and physical measurement steps, but the response rate for laboratory examinations was approximately 73%. Tables 1–3 summarize the major findings of the survey in the target population. The indicators summarized in the tables represent the minimum output of the surveillance survey according to the STEPS approach.<sup>4</sup>

**Table 1**

Summary results of behavioural risks, physical measurements and biochemical measurements of 25–64-year-old Iranians.

Results for adults aged 25–64 years	Total n = 70,981	Males n = 35,148	Females n = 35,833
Current daily smokers	% (95% CI)	% (95% CI)	% (95% CI)
25–34	13.0 (12.8–13.3)	23.4 (23.1–28.6)	2.4 (2.1–2.5)
35–44	19.6 (19.4–20.7)	34.3 (34.0–34.5)	4.5 (4.2–4.7)
45–54	19.7 (19.4–20.3)	33.2 (32.9–33.5)	6.0 (5.9–6.4)
55–64	17.5 (17.3–17.9)	27.9 (27.5–28.2)	6.9 (6.5–7.2)
25–64	17.9 (17.6–18.2)	30.6 (30.3–31.0)	4.2 (3.9–4.6)
Consume at least five combined servings of fruit and vegetables per day (in a typical week)	% (95% CI)	% (95% CI)	% (95% CI)
25–34	5.2 (5.0–5.4)	4.6 (4.4–4.9)	5.8 (5.5–6.0)
35–44	5.2 (5.1–5.4)	5.1 (4.8–5.3)	5.4 (5.2–5.7)
45–54	4.7 (4.6–4.9)	4.5 (4.3–4.7)	4.9 (4.7–5.1)
55–64	4.6 (4.5–4.8)	4.6 (4.4–4.8)	4.7 (4.4–4.9)
25–64	5.0 (4.8–5.3)	4.7 (4.4–5.1)	5.4 (5.2–5.7)
Median time spent in work-related physical activity per day	min (95% CI)	min (95% CI)	min (95% CI)
25–34	27.3 (26.9–28.5)	21.3 (20.8–21.7)	30.3 (29.7–31.1)
35–44	33.3 (32.7–33.9)	28.1 (27.6–28.5)	35.3 (34.8–36.1)
45–54	30.1 (29.3–30.8)	25.4 (25.0–25.9)	33.6 (33.1–34.2)
55–64	23.4 (22.8–24.0)	19.7 (18.9–20.2)	26.8 (26.1–27.4)
25–64	27.5 (26.3–28.8)	23.9 (22.3–25.5)	31.6 (29.4–33.2)
Median time spent in transport-related physical activity per day	min (95% CI)	min (95% CI)	min (95% CI)
25–34	39.8 (38.7–40.2)	49.3 (48.8–49.9)	29.4 (28.8–29.9)
35–44	45.9 (45.2–46.7)	55.9 (55.2–60.5)	38.5 (38.1–38.8)
45–54	42.1 (41.6–42.4)	56.1 (55.7–56.7)	35.4 (34.8–36.1)
55–64	35.6 (35.1–36.0)	38.6 (38.1–39.3)	27.3 (26.8–27.9)
25–64	43.8 (42.3–45.4)	53.9 (52.1–55.8)	33.5 (31.3–35.7)
Median time spent in recreational physical activity per day	min (95% CI)	min (95% CI)	min (95% CI)
25–34	34.1 (33.6–34.8)	32.2 (31.8–32.8)	35.1 (34.7–36.5)
35–44	31.4 (31.0–31.9)	24.1 (23.6–24.6)	36.6 (36.1–37.0)
45–54	27.6 (27.1–28.2)	20.1 (19.81–20.4)	30.1 (29.6–30.8)
55–64	19.3 (18.7–20.1)	18.2 (17.7–18.5)	20.1 (19.6–20.7)
25–64	28.6 (27.3–30.0)	22.17 (20.6–23.8)	35.3 (33.4–37.1)

**Behavioural risks**

The self-reported prevalence of daily current tobacco use in the study population was 17.9 [95% confidence interval (CI) 17.6–18.2], with a significantly higher prevalence among men than women.

Overall, 5% (95% CI 4.8–5.3) of participants ate at least five servings of fruits and vegetables each day, with a higher prevalence among women than men [5.4% (95% CI 5.1–5.7) vs 4.7% (95% CI 4.4–5.0), respectively] (Table 1). The median time spent by 25–64-year-old Iranian citizens on physical activity related to transportation is

**Table 2**

Summary results of physical measurements of 25–64-year-old Iranians.

Results for adults aged 25–64 years	Total n = 70,765	Males n = 35,067	Females n = 35,698
Overweight or obese (BMI $\geq 25$ kg/m <sup>2</sup> )	% (95% CI)	% (95% CI)	% (95% CI)
25–34	46.2 (45.8–46.6)	40.0 (39.5–40.5)	52.5 (52.0–53.0)
35–44	59.3 (59.0–59.7)	50.3 (49.7–50.8)	68.6 (68.1–69.0)
45–54	62.7 (62.3–63.0)	54.0 (53.5–54.6)	71.3 (70.8–71.8)
55–64	58.9 (58.5–59.3)	50.9 (50.4–51.5)	67.0 (66.5–67.5)
25–64	54.7 (54.2–55.3)	47.3 (46.6–48.0)	62.8 (62.1–63.4)
Obese (BMI $\geq 30$ kg/m <sup>2</sup> )	% (95% CI)	% (95% CI)	% (95% CI)
35–44	13.9 (13.6–14.1)	9.0 (8.7–9.3)	18.8 (18.4–19.3)
45–54	22.1 (21.8–22.4)	12.9 (12.6–13.3)	31.5 (31.0–32.0)
55–64	24.8 (24.4–25.1)	14.7 (14.3–15.0)	34.8 (34.3–35.4)
25–64	22.3 (22.0–22.6)	13.8 (13.4–14.1)	31.0 (30.5–31.3)
25–64	19.3 (18.9–19.7)	11.9 (11.6–12.4)	27.2 (26.7–27.8)
Average waist circumference	cm (95% CI)	cm (95% CI)	cm (95% CI)
25–34	85.66 (85.47–85.86)	84.85 (84.60–85.10)	86.51 (86.22–86.81)
35–44	90.36 (90.16–90.55)	88.31 (88.05–88.57)	92.44 (92.15–92.73)
45–54	93.04 (92.84–93.25)	90.88 (90.62–91.15)	95.21 (94.91–95.51)
55–64	93.47 (93.26–93.69)	91.18 (90.89–91.46)	95.82 (95.51–96.13)
25–64	89.48 (89.31–89.65)	87.95 (87.77–88.14)	91.17 (90.94–91.40)
Raised blood pressure and not taking antihypertensive medication (systolic blood pressure $\geq 140$ mm Hg and/or diastolic blood pressure $\geq 90$ mm Hg)	% (95% CI)	% (95% CI)	% (95% CI)
25–34	11.6 (11.4–11.9)	14.3 (13.9–14.7)	8.9 (8.6–9.2)
35–44	19.3 (19.0–19.6)	20.5 (20.0–20.9)	18.2 (17.8–18.6)
45–54	31.4 (31.0–31.7)	31.5 (31.0–32.0)	31.3 (30.8–31.8)
55–64	43.8 (43.4–44.2)	42.9 (42.4–43.5)	44.8 (44.3–45.4)
25–64	23.8 (23.4–24.3)	24.7 (24.1–25.3)	22.9 (22.4–23.4)

BMI, body mass index.

**Table 3**  
Summary results of biochemical measurements of 25–64-year-old Iranians.

Results for adults aged 25–64 years	Total n = 65,781	Males n = 32,842	Females n = 32,932
Mean fasting blood glucose	mg/dl (95% CI)	mg/dl (95% CI)	mg/dl (95% CI)
25–34	89.2 (88.8–89.5)	90.1 (89.6–90.6)	88.3 (87.9–88.8)
35–44	94.1 (93.6–94.6)	93.9 (93.2–94.6)	94.2 (93.5–94.9)
45–54	100.4 (99.8–101.0)	98.9 (98.0–99.7)	101.8 (100.9–102.7)
55–64	104.9 (104.2–105.7)	101.7 (100.8–102.6)	108.2 (107.0–109.3)
25–64	95.1 (94.7–95.4)	94.9 (94.4–95.3)	95.3 (94.8–95.7)
Raised blood glucose ( $\geq 126$ mg/dl)	% (95% CI)	% (95% CI)	% (95% CI)
25–34	2.2 (2.1–2.3)	2.4 (2.2–2.6)	2.0 (1.8–2.1)
35–44	4.9 (4.7–5.1)	4.8 (4.5–5.0)	5.0 (4.8–5.3)
45–54	9.7 (9.5–9.9)	8.7 (8.4–9.0)	10.6 (10.3–10.9)
55–64	12.8 (12.6–13.1)	11.1 (10.7–11.4)	14.6 (14.2–14.9)
25–64	6.0 (5.8–6.2)	5.8 (5.5–6.1)	6.2 (5.9–6.5)
Mean total blood cholesterol	mg/dl (95% CI)	mg/dl (95% CI)	mg/dl (95% CI)
25–34	186.2 (185.5–187.0)	185.3 (184.3–186.4)	187.0 (186.1–188.0)
35–44	198.1 (197.4–198.8)	197.8 (196.8–198.9)	198.3 (197.4–199.3)
45–54	208.3 (207.6–209.0)	201.9 (200.8–202.9)	214.1 (213.1–215.2)
55–64	213.6 (212.8–214.3)	202.3 (201.4–203.3)	224.8 (223.7–225.9)
25–64	197.8 (197.3–198.4)	195.1 (194.4–195.7)	200.5 (199.9–201.2)
Raised total cholesterol ( $\geq 200$ mg/dl)	% (95% CI)	% (95% CI)	% (95% CI)
25–34	33.4 (33.1–33.8)	32.9 (32.4–33.4)	33.8 (33.3–34.3)
35–44	45.5 (45.2–45.9)	45.1 (44.6–45.6)	45.9 (45.4–46.4)
45–54	55.8 (55.4–56.2)	49.8 (49.3–50.3)	61.3 (60.8–61.8)
55–64	60.6 (60.2–61.0)	50.7 (50.2–51.3)	70.4 (69.9–70.9)
25–64	45.1 (44.6–45.7)	42.7 (42.0–43.5)	47.5 (46.8–48.2)

greater than that spent on work-related or recreational physical activity per day. The median time spent on work-related physical activity and recreational activity is higher among women than men.

#### Physical measurements

Mean BMI was higher among women than men [27.13 kg/m<sup>2</sup> (95% CI 27.05–27.21) vs 25.08 kg/m<sup>2</sup> (95% CI 25.01–25.15), respectively]. The prevalence of overweight and obesity, as well as abdominal obesity, was higher among women than men. The highest rates for overweight and obesity were found in participants aged 45–54 years.

As presented in Table 2, among those participants who were not taking antihypertensive medication, stage I hypertension was more prevalent among men than women. In both genders, hypertension rates increased with age; the maximum increase was 7.7% and this was observed between 24–34 years and 35–44 years.

#### Biochemical measurements

Mean levels of FBG and cholesterol increased with age. Mean FBG did not differ between males and females. After exclusion of those taking medication for diabetes, 6.0% (95% CI 5.8–6.2) of the study population had an FBG level of at least 126 mg/dl, and were considered as new diabetic patients.

Mean serum cholesterol was higher among women than men. Raised total cholesterol level was more prevalent among women than men (Table 3). In both genders, the rate of raised serum cholesterol increased with age.

#### Discussion

As the baseline data for a surveillance system, the first provincial and national estimates for some major risk factors of NCDs became available in 2005; some of these have been published previously,<sup>7–12</sup> and several others have been presented at national or international scientific events to investigate provincial or national profiles

of NCD risk factors in Iran. This paper presents some new information from the 2005 survey that represents the first national estimates from Iran.

As there have only been a few recent small-scale studies on NCD risk factors, the MOHME decided to gather valid, up-to-date information on the risk factors to set appropriate policies and plans to face NCDs through this nationwide survey; however, the ultimate goal was to increase the country's capacity to develop a sustainable infrastructure for NCD surveillance according to the STEPS initiative.<sup>13</sup> When designing this surveillance system, the Iranian health system had to be considered, in which universities of medical sciences and health services are responsible for the provision of provincially appropriate health policies and programmes according to national directions. Thus, the focus was on building capacity to develop a surveillance system with capability to respond to both provincial and national needs. This could be achieved through integration of the surveillance activities into the primary healthcare system of Iran by establishing provincial surveillance sites in disease control units at the medical universities. Several mechanisms have been elaborated to ensure validity of data and information. A systematic supervision approach, formation of central and provincial scientific and executive committees, use of simple and user-friendly software for basic data analysis, provincial weighting of data and reporting, introduction of a set of regulations for security of data management and dissemination, and encouragement for more involvement from academic members have been taken into account.

The sample was questioned about smoking as a risk behaviour. Smokers have markedly increased the risk of multiple cancers, particularly lung cancer, and are at far greater risk of heart disease, stroke, chronic obstructive pulmonary disease, diabetes, and other fatal and non-fatal diseases. People who chew tobacco risk cancer of the lip, tongue and mouth.<sup>14</sup> The prevalence of daily current tobacco use in Iran (17.9%) has increased since 2000 (12.5%; 25% men vs 2.5% women).<sup>15</sup> Men are more likely to smoke than women and represent the priority target group for tobacco prevention and control programmes in Iran. Evidence from an Isfahan city in 2004 showed that the prevalence of smoking in men and women aged at

least 19 years was 18.7% and 1.3%, respectively.<sup>16</sup> The present finding is also similar to the findings of the Iraqi STEPS survey using the same method and target population; 21.6% in 2006.<sup>17</sup> Smoking prevalence was 18% in the Egyptian STEPS survey in 2005<sup>18</sup>; however, their target population was 15–64-year-old citizens.

Low intake of fruit and vegetables is estimated to cause approximately 19% of gastrointestinal cancers, 31% of ischaemic heart disease and 11% of strokes worldwide.<sup>19</sup> The consumption of at least 400 g of fruit and vegetables, or at least five combined servings per day, is recommended to prevent diet-related chronic diseases.<sup>20</sup> The first reported prevalence rate for this dietary behaviour is very low in Iranians (5%). Unexpectedly, the percentage of participants from an urban population of Isfahan city consuming at least five servings of fruit and vegetables per day was 46.7% and 30% for 30–44-year-old men and women, respectively, and 58% and 46.7% for 45–60-year-old citizens; these results are very different from those of the present study.<sup>21</sup> Rates provided by a World Health Survey conducted in Brazil in 2003 with almost the same questions regarding consumption of fruit and vegetables ranged from 11.4% in 18–24 year olds to 20.6% in participants aged 65 years or more.<sup>22</sup> Using the STEPS survey, the reported rate from Iraq is almost as low as that for Iran (7%), and the rates reported by a Syrian study were 4.2% for men and 4.4% for women aged 15–64 years in 2003.<sup>23</sup> This conflict of information provided by different tools may challenge the validity of the dietary questions of the STEPS model.

This study found that more than half (54.7%) of the target population were overweight or obese. The prevalence of overweight and obesity in the same age group in Iraq is 66.9%. In comparison with men, women are more likely to be overweight or obese, and have a larger waist circumference (abdominal obesity) in both Iran and Iraq. Regardless of the obvious negative impact of this finding on womens' health, women should be the focus of health programmes because of their key role in the nutritional state of their households.<sup>11</sup>

Men are more likely to be hypertensive than women (24.7% vs 22.94%), which concurs with the results of an Iraqi survey. The reverse pattern was reported by the Iranian Centre for Disease Control and Management through registers produced by Iran's national hypertension programme.<sup>24,25</sup> This may indicate that women may receive more care through the national programme.

The first estimate of the national prevalence of diabetes is 6%, with raised FBG defined as at least 126 mg/dl and regardless of medication used. The prevalence of raised FBG is greater among females than males, and greater among urban residents than rural residents. A recent study in an urban population ( $\geq 20$  years old) of Tehran, the capital of Iran, reported that 8.1% of the population had been diagnosed with diabetes and 5.1% had undiagnosed diabetics.<sup>25</sup> The prevalence of high total cholesterol levels was estimated through the 2005 national survey to be 45.1%. This is close to that estimated by an Iraqi survey (37.5%). The higher rates of hyperlipidaemia, diabetes and obesity among women may indicate a greater burden of NCDs among females in the near future.

Although it was not possible to estimate the overall level of physical activity, the existing information regarding the median time spent on physical activity for work, transportation and leisure is still informative. The results suggest that transportation represents much more of the physical activity of Iranians compared with work or recreation. Men are most likely to spend time in transportation-related physical activity than women, probably because they are more likely to commute. In contrast, women spend more time undertaking physical activity during leisure time. This may be due to fewer recreational activities of men or more sedentary recreation activities. The authors could not find any comparable information in this area, despite the importance of the issue.

The evidence provided by the surveillance system is crucial for setting targets and assessing important national programmes such as the national hypertension control programme, the national diabetes type II control programme and the national cancer control programme. These programmes use diverse strategies, such as a community approach and a high-risk-group approach, to confront their target diseases. Other major users of the surveillance system include community nutrition, family health, youth health, tobacco control, health promotion and primary healthcare network development programmes of the MOHME, the Parliament Research Centre and the Office of the Deputy President for Management and Planning.

## Conclusion

The Iranian model for NCD risk factor surveillance has been established on the basis of provincial surveillance sites working under a national technical unit at the Centre for Disease Control and Management, MOHME. The provincial sites are able to design and conduct repetitive surveys, so that locally interpretable data can be produced through a similar methodology and under a single national policy to inform provincial and national health policies and programmes, and to track the trend of risks over time. However, it is suggested that national surveys should be separated from provincial surveys in order to ensure sustainability of national surveys, which may be affected by provincial decisions. This will allow provinces to arrange appropriate intervals between their own surveys according to their resources, without interfering with national surveys that can be conducted every year on subsamples to collect data on behavioural risks, and larger studies conducted every 3–5 years to estimate physical and biochemical measures.

Results of the 2005 survey indicate low consumption of fruit and vegetables according to the international recommended cut-off point (at least five combined servings per day). This problem, in association with the high burden of overweight and obesity, may lead to increased risk of NCDs in future, and needs an urgent response. In the absence of sufficient evidence regarding physical activity in Iranians, NCD risk factor data are the only way to obtain detailed information regarding different aspects of this behaviour. Utilization of the best available questionnaires assessing dietary habits can help to quantify this subject more accurately.

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## Ethical approval

A national committee, comprised of senior academic and administrative members, was established to steer the surveillance programme. The tools and guidelines of the surveys were reviewed by the committee to avoid technical and ethical errors.

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## Competing interests

None declared.

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