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Original Article

Five-year Evaluation of Chronic Diseases in Hamadan, Iran: 2005-2009

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Abstract

Background: Now the increasing growth of chronic diseases is the major health challenge worldwide. This survey was conducted to assess noncommunicable diseases related risk factors.

Methods: A population-based cross sectional study was conducted in 2005 and repeated annually by 2009 in Hamadan province, the west of Iran using two-stage cluster sampling method. A total sample of 6500 subjects 15 to 64 years old were enrolled.

Results: The total prevalence of cigarette smoking was 18% [95% CI 17% to 19%], 35.1% in men versus 1.1% in women. The smokers consumed on average 15 cigarettes per day. Almost 26.3% [95% CI 24.8% to 27.7%] of the target population eat five or more servings of fruits and vegetables per day; 52.8% [95% CI 51.2% to 54.3%] had work related physical activity; 28.1% [95% CI 26.7% to 29.4%] had physical activity during leisure time; 80.3% [95% CI 79.0% to 81.5%] had transportation related physical activity; 47.2% [95% CI 46.0% to 48.4%] were either overweight or obese; 8.1% [95% CI 7.1% to 9.2%] had impaired fasting blood sugar or were confirmed diabetes; 33.7% [95% CI 31.9% to 35.5%] had hypercholesterolemia; and 15.6% [95% CI 13.0% to 18.3%] had hypertriglyceridemia. There was a statistically significant association of age and gender with body mass index, systolic and diastolic hypertension, hyperglycemia, hypercholesterolemia and hypertriglyceridemia.

Conclusions: The evidences of the present survey promise a silent progressive epidemic of chronic diseases among Iranian citizens that may lead to an increasing growth of noncommunicable diseases in the next decade.

Keywords: Noncommunicable diseases, Risk factor, Surveillance, Iran

Introduction

Today the increasing growth of noncommunicable diseases (NCDs) is a serious threat to health and hence is the major health challenges worldwide (1). In all but the poorest countries, the mortality and morbidity from noncommunicable diseases now exceeds that from communicable diseases comprising 49%, in comparison with about 40% respectively (2). The major NCDs, mainly cardiovascular diseases, cancers, diabetes and chronic respiratory diseases caused an estimated 35 million deaths in 2005. This figure represents 60% of all world deaths and 80% of deaths due to NCDs occurring in low and middle income countries (1). The rapidly increasing burden of these diseases affects all countries but with an increasing trend in developing countries particularly in poorer regions of

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the world. This trend contributes to widening health gaps between and within countries (1,3).
Although NCDs are among the most prevalent and costly health problems, they are also among the most preventable and modifiable common risk factors such as tobacco use, unhealthy diet, physical inactivity and alcohol abuse. These risk factors explain the vast majority of death due to NCDs at all ages worldwide including 4.9 million deaths as a result of tobacco use; 2.6 million deaths as a result of being overweight or obese; 4.4 million deaths as a result of hypercholesterolemia; and 7.1 million deaths as a result of hypertension (1, 4). On the other hand, up to 80% of heart diseases and strokes; 80% of type 2 diabetes; and 40% of cancers could be eliminated through preventing these major risk factors (1,5).
World Health Organization (WHO) suggested a tool for assessing the NCDs risk factors in low and middle income countries - the STEPwise approach to Surveillance (STEPS) (4). This tool was used in Iran as in many other countries worldwide to establish a survey on major NCDs risk factors. The present study which is part of this national survey was carried out in Hamadan Province, the west of Iran, in 2005 and continued to 2009 in order to determine the major risk factors of non-communicable diseases and to measure their impact on the chronic diseases.

Materials and Methods

Study design

In 2001, after comprehensive reviews by Iranian Ministry of Health and Medical Education (MOHME), the national NCDs risk factors surveillance was undertaken using the modified WHO STEPwise approach as the basic model. In this national survey, 41 medical universities affiliated the MOHME including Hamadan university of Medical Sciences participated. Four national workshops were held to enhance the capacity of the health care workers who were to undertake the survey. In addition, in order to assess different aspects of the survey, a comprehensive pilot study was conducted in three provinces including Tehran, Khorasan and Kurdistan.
After final evaluation of the pilot study, a national wide cross sectional study was conducted in 2005 to assess the prevalence of major risk factors related to NCDs. In Hamadan province, after minor revision, this survey was repeated in 2006, 2007, 2008, and 2009.

Sampling

A two-stage cluster sampling method was used for data collection. The national postal codes were used to establish random cluster sampling. Each 10-digit post code represented a subject household in the area. There were 20 inhabitants in each cluster. To obtain a sample of 2500 for the first year in 2005, 125 clusters were selected at random. A sample of 1000 was considered for each of the subsequent years from 2006 to 2009; hence 50 clusters were randomly selected in each year. Accordingly, a total sample of 6500 was selected in this five-year survey.
The study population aged 15 to 64 years. They were stratified into five 10-year age groups. They were stratified by gender as well. In the first year (2005), 250 subjects from each age-sex group were enrolled in the survey to achieve a sample of 2500. For the subsequent years, 100 subjects from each age-sex group were enrolled in the survey to achieve a sample of 1000.

Data collection and analysis

According WHO STEPwise approach to Surveillance (STEPS) (6), the data collection included three steps:

- Step 1: collecting questionnaire-based information about diet, physical activity, and tobacco use;
- Step 2: using standardized physical measurements to collect data on blood pressure, height and weight;

- Step 3: taking blood samples for biochemical measurement of lipids and glucose status.

The first and second steps were undertaken in all five years, but the third step was carried out in 2005 and 2007 for resource and logistic limitations. The data on high density lipoprotein (HDL) and triglyceride (TG) were collected exclusively in 2007.

Physical and laboratory measurement techniques

All measurements were conducted based on the WHO STEPwise guideline (6). Height and weight were measured in light clothing not wearing shoes. Blood pressure was measured using standardized mercury sphygmomanometers (Richter Aneroid, Germany) after five minutes resting in the sitting position.

Fasting blood sugar (FBS) and total cholesterol (TC) were measured by taking a venous blood sample after 12 hours overnight fasting. FBS was examined by the glucose oxidase/peroxidase-4-aminophenazone-phenol (GOD-PAP) method, and total cholesterol was examined by the cholesterol oxidase/p-aminophenazone (CHOD-PAP) method.

Physical activity included either vigorous or moderate intensity activities. 'Vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate for at least 10 minutes continuously, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate for at least 10 minutes continuously. A body mass index (BMI) between 25.0 and 29.9 kg/m^2 was considered as overweight, and that of 30 kg/m^2 or more as obese. Systolic blood pressure (SBP) of 140 to 159 mmHg considered as mild, that of 160 to 179 mmHg as moderate, and that of 180 mmHg or more as sever systolic hypertension. Diastolic blood pressure (DBP) of 90 to 99 mmHg considered as mild, that of 100 to 109 mmHg as moderate, and that of 110 mmHg or more as sever diastolic hypertension. FBS of 110 to 125 mg/dl was considered as impaired glucose and that of 126 mg/dl or more was considered as diabetes. Total cholesterol of 200 to 240 mg/dl was considered as borderline and that of above 240 mg/dl was considered as hypercholesterolemia. Triglyceride of 200 to 250 mg/dl was considered as borderline and that of above 250 mg/dl was considered as hypertriglyceridemia. HDL of 30 to 50 mg/dl was considered as borderline and that of below 30 mg/dl was considered as high risk.

The effect of age and gender as well as body mass index on SBP, DBP, FBS, TC, TG, and HDL levels were investigated using logistic regression at 95% confidence interval (CI). All statistical analysis was performed with the statistical software STATA version 10 (StataCorp, College Station, Texas).

Results

A total of 6500 subjects, including 3250 males and 3250 females, were enrolled voluntarily in this five-year survey. The participants aged between 15 to 64 years with mean age of 45.4 years. The overall response rate for step 1 (questionnaire-based information) and step 2 (physical measurements) was 81% but the response rate for step 3 (biochemical measurements) was 73%.

The results of descriptive analysis were summarized in Table 1, 2, and 3. The analytic results were shown in Table 4 and 5. Table 1 summarizes the results of the questionnaire-based information related to behavioral risks of the participants. Table 2 summarizes results of the standardized physical measurements of the participants. Table 3 summarizes the results of the biochemical measurements of the participants. Table 4 indicates the effect of age and gender on BMI, SBP, DBP, FBS, TC, TG, and HDL levels. Table 5 reveals the effect of BMI on SBP, DBP, FBS, TC, TG, and HDL levels.

Table 1: Summary results of the questionnaire-based information related to behavioral risks of subjects aged 15-64 years

Behavioral risk	Percentage											
	2005		2006		2007		2008		2009		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Current tobacco use												
15-24	11.1	0.0	4.0	0.0	8.1	0.0	8.0	0.0	11.0	0.0	9.1	0.0
25-34	29.2	0.4	24.0	0.0	37.7	0.0	43.0	0.0	33.0	0.0	32.4	0.2
35-44	45.9	2.0	52.5	1.0	55.0	1.0	52.0	0.0	48.0	1.0	49.6	1.3
45-54	46.4	1.8	42.0	1.0	62.0	2.0	42.0	0.0	43.0	1.0	47.0	1.3
55-64	43.2	4.1	33.3	1.0	33.0	2.0	40.0	3.0	28.0	3.0	37.3	2.9
All ages	35.2	1.6	31.2	0.6	39.2	1.0	37.0	0.6	32.6	1.0	35.1	1.1
At least 5 servings of fruits and vegetables daily												
15-24	-	-	27.8	33.7	38.5	39.8	23.8	21.6	26.9	40.5	29.5	33.9
25-34	-	-	19.1	30.2	32.3	35.4	23.8	16.9	32.9	32.9	27.1	29.0
35-44	-	-	19.4	26.0	26.1	26.7	18.3	21.0	16.5	24.7	20.1	24.7
45-54	-	-	21.4	18.3	33.3	33.3	22.8	15.3	23.8	35.5	25.4	25.2
55-64	-	-	14.1	23.2	30.2	24.7	26.0	21.6	23.6	25.7	23.2	23.8
All ages	-	-	20.4	26.4	32.2	32.2	22.9	19.2	24.8	32.1	25.1	27.4
Work related physical activity												
15-24	50.4	38.8	52.0	32.0	64.7	38.0	50.0	40.0	48.0	42.0	60.3	47.4
25-34	58.0	50.6	57.0	41.0	80.2	55.0	63.0	48.0	60.0	40.0	68.7	56.6
35-44	54.6	55.0	69.3	38.4	71.0	55.0	68.0	56.0	65.0	47.0	68.7	59.4
45-54	53.2	52.8	65.0	41.0	73.0	56.0	55.0	47.0	53.0	47.0	65.2	56.8
55-64	44.8	35.8	59.6	29.7	67.0	52.0	63.0	46.0	42.0	34.0	58.6	47.3
All ages	52.2	46.7	60.6	36.4	71.2	51.2	59.8	47.4	53.6	42.0	64.3	53.5
Leisure time related physical activity												
15-24	51.0	32.3	71.0	45.0	76.8	22.0	80.0	45.0	62.0	19.0	59.3	32.5
25-34	33.1	21.0	52.0	21.0	39.6	20.0	43.0	21.0	41.0	17.0	37.2	20.5
35-44	25.8	17.2	36.7	18.2	29.0	14.0	36.0	17.0	25.0	11.0	28.1	16.4
45-54	22.0	14.2	33.0	17.0	17.0	10.0	23.0	14.0	22.0	16.0	22.7	14.2
55-64	21.9	12.9	22.2	9.9	18.0	6.0	18.0	10.0	19.0	5.0	20.9	10.9
All ages	30.8	19.5	43.0	22.2	36.0	14.4	40.0	21.4	33.8	13.6	33.6	18.9
Transport related physical activity												
15-24	92.3	86.0	83.0	84.0	89.9	89.0	90.0	79.0	85.0	81.0	89.1	84.3
25-34	95.6	88.3	75.0	72.0	80.2	85.0	72.0	82.0	71.0	76.0	82.5	82.4
35-44	94.7	90.2	73.3	77.8	81.0	91.0	79.0	84.0	76.0	79.0	84.0	85.8
45-54	91.5	91.4	80.0	84.0	85.0	87.0	81.0	81.0	70.0	78.0	83.8	86.0
55-64	94.0	85.0	79.8	67.3	87.0	82.0	84.0	76.0	78.0	75.0	86.7	78.9
All ages	93.6	88.3	78.2	77.0	94.6	86.8	81.2	80.4	76.0	77.8	85.2	83.5

Behavioral risks (Table 1)

Cigarette smoking

The prevalence of cigarette smoking on average was 18% [95% CI 17% to 19%] for all participants. However there was a considerable difference between prevalence rates of cigarette smoking in males compared to females (35.1% versus 1.1% respectively). The smokers used on average 15 [95% CI 14 to 16] cigarettes per day. The prevalence of cigarette smoking increased with age up to 35 to 44 years and decreased thereafter. Age of starting smoking is shown in Figure 1. These findings indicated that most of the smokers experienced smoking for the first time during the second and third decades of life.

Fruits and vegetables consumption

Almost 26.3% [95% CI 24.8% to 27.7%] of the target population eat five or more servings of fruits and vegetables per day. The rate was nearly the same in males and females (25.1%

versus 27.4% respectively). It was nearly the same for all age groups as well.

Physical activity

The data on physical activity indicated that 52.8% [95% CI 51.2% to 54.3%] of the target population had work related physical activity, 28.1% [95% CI 26.7% to 29.4%] had physical activity during leisure time, and 80.3% [95% CI 79.0% to 81.5%] had transportation related physical activity. There were significant differences in physical activity during daily work and leisure time between males and females (71.9% versus 57.8% and 38.2% versus 17.9% respectively). However the transport related physical activity for both sexes was nearly the same (80.0% versus 80.5% respectively). On the other hand, there was a decreasing trend in leisure time physical activity from younger ages to older ages. Such trend was seen neither in physical activity during daily work not in transport related physical activity.

Table 2: Summary results of the standardized physical measurements of subjects aged 15-64 years

Physical measurement	Percentage											
	2005		2006		2007		2008		2009		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Overweight (BMI 25-29.9 kg/m^2)												
15-24	11.7	18.6	11.1	24.0	15.2	18.0	13.0	10.0	14.0	22.0	12.7	18.6
25-34	24.9	35.3	27.0	41.0	22.8	37.0	32.0	37.0	24.0	34.0	25.9	36.5
35-44	35.3	38.3	36.6	44.4	31.0	39.0	37.0	35.4	34.0	45.0	34.9	39.9
45-54	34.5	39.8	44.0	43.0	37.0	35.0	24.0	47.0	31.0	35.0	34.2	39.9
55-64	36.0	43.5	35.4	43.6	33.0	42.0	34.0	43.0	35.0	47.0	35.0	43.7
All ages	28.5	35.1	30.9	39.2	27.8	34.2	28.0	34.5	27.6	36.6	28.6	35.7
Obese (BMI ≥30 kg/m^2)												
15-24	2.8	6.5	2.0	5.0	3.0	3.0	0.0	5.0	3.0	8.0	2.3	5.7
25-34	3.7	9.5	12.0	19.0	7.9	23.0	6.0	15.0	11.0	18.0	7.1	15.2
35-44	9.1	26.7	8.9	29.3	9.0	28.0	10.0	31.3	12.0	26.0	9.7	27.9
45-54	9.1	30.7	10.0	40.0	10.0	37.0	10.0	31.0	14.0	35.0	10.3	33.8
55-64	6.0	29.7	9.1	25.7	16.0	26.0	13.0	30.0	14.0	30.0	10.3	28.6
All ages	6.2	20.6	8.4	23.8	9.2	23.4	7.8	22.4	10.8	23.4	8.0	22.3
Systolic blood pressure (≥140 mmHg)												
15-24	2.0	1.6	2.0	0.0	4.0	1.0	3.0	0.0	2.0	1.0	2.5	0.9
25-34	1.2	1.2	0.0	1.0	4.0	4.0	4.0	1.0	5.0	3.0	2.5	1.8
35-44	5.9	4.0	3.0	4.0	5.0	6.0	5.0	14.0	9.0	5.0	5.7	6.0
45-54	13.1	20.9	8.0	13.0	18.0	26.0	18.0	20.0	20.0	21.0	14.9	20.3
55-64	22.4	35.4	16.1	22.8	48.0	46.0	37.0	50.0	34.0	45.0	29.4	38.8
All ages	9.0	12.6	5.8	8.2	15.8	16.6	13.4	17.0	14.0	15.0	11.0	13.6
Diastolic blood pressure (≥90 mmHg)												
15-24	1.2	2.0	2.0	1.0	2.0	6.0	3.0	1.0	4.0	6.0	2.2	2.9
25-34	1.6	1.2	3.0	0.0	7.9	12.0	5.0	6.0	6.0	15.0	4.0	5.5
35-44	3.6	5.2	5.0	3.0	10.0	18.0	13.0	22.0	14.0	20.0	7.8	11.7
45-54	4.8	12.6	4.0	6.0	28.0	40.0	24.0	28.0	16.0	27.0	12.9	20.3
55-64	9.2	19.5	8.1	11.9	39.0	45.0	32.0	46.0	28.0	41.0	20.0	29.7
All ages	4.1	8.1	4.4	4.4	17.4	24.2	15.4	20.6	13.6	21.8	9.4	14.0

Physical measurements (Table 2)

Body mass index

Almost 47.2% [95% CI 46.0% to 48.4%] of the target population were either overweight or obese. However the prevalence of overweight and obesity was considerably much more among females than among males (35.7% versus 28.6% and 22.3% versus 8.0% respectively). Overweight and obesity had an increasing trend with age in both males and females.

Systolic and diastolic hypertension

The prevalence of systolic and diastolic hypertension among the target population was 12.3% [95% CI 11.5% to 13.1%] and 11.7 [95% CI 10.9% to 12.5%] respectively. Both systolic and diastolic hypertension was more common in females than in males (13.6% versus 11.0% and 14.0% versus 9.4% respectively). There was a considerably increasing growth in systolic and diastolic hypertension with age among both genders.

Table 3: Summary results of the biochemical measurements of subjects aged 25-64 years

Biochemical measurement	Percentage 2005 Male	2005 Female	2007 Male	2007 Female	Biochemical measurement	Percentage 2005 Male	2005 Female	2007 Male	2007 Female
Fasting blood sugar (110-125 mg/dl)					**Fasting blood sugar (>125 mg/dl)**				
25-34	1.5	1.7	0.0	1.1	25-34	0.0	1.3	0.0	1.1
35-44	3.1	2.5	3.5	2.2	35-44	2.2	2.1	1.2	0.0
45-54	5.3	7.5	2.4	3.1	45-54	6.2	7.5	1.2	5.2
55-64	5.5	7.8	4.4	3.2	55-64	7.2	11.3	3.3	10.6
All ages	**3.9**	**4.9**	**2.7**	**2.4**	All ages	**4.0**	**5.5**	**1.5**	**4.2**
Total cholesterol (200-240 mg/dl)					**Total cholesterol (>240 mg/dl)**				
25-34	10.2	16.0	13.9	11.6	25-34	5.6	7.2	5.1	4.2
35-44	26.1	27.2	12.8	18.5	35-44	7.8	7.7	9.3	3.3
45-54	26.0	32.2	15.5	29.2	45-54	9.5	15.1	4.8	10.4
55-64	24.4	39.3	24.4	36.2	55-64	10.5	20.5	4.4	17.0
All ages	**21.9**	**28.7**	**16.8**	**23.9**	All ages	**8.4**	**12.6**	**5.9**	**8.8**
Triglyceride (200-250 mg/dl)					**Triglyceride (>250 mg/dl)**				
25-34	-	-	6.3	1.1	25-34	-	-	11.4	4.2
35-44	-	-	3.5	6.5	35-44	-	-	11.6	5.4
45-54	-	-	9.5	5.2	45-54	-	-	3.6	7.3
55-64	-	-	5.6	10.6	55-64	-	-	13.3	20.2
All ages	**-**	**-**	**6.2**	**5.8**	All ages	**-**	**-**	**10.0**	**9.3**
HDL (30-50 mg/dl)					**HDL (<30 mg/dl)**				
25-34	-	-	72.2	54.7	25-34	-	-	2.5	2.1
35-44	-	-	73.3	66.3	35-44	-	-	3.5	2.2
45-54	-	-	56.0	55.2	45-54	-	-	6.0	3.1
55-64	-	-	66.7	51.1	55-64	-	-	2.2	1.1
All ages	**-**	**-**	**67.0**	**56.8**	All ages	**-**	**-**	**3.5**	**2.1**

Biochemical measurements (Table 3)

Fasting blood sugar

Almost 8.1% [95% CI 7.1% to 9.2%] of the target population had impaired fasting blood sugar or were confirmed diabetes. Impaired fasting blood sugar was more common among females than among male in 2005 (4.9% versus 3.9% respectively). A reverse relationship was seen in 2007 (2.4% versus 2.7% respectively). On the other hand, prevalence of diabetes was much higher in females than in males in the both years (5.5% versus 4.0% in 2005 and 4.2% versus 1.5% in 2007 respectively). There was a remarkably increasing trend with age in impaired fasting blood sugar as well as diabetes among both males and females.

Cholesterol and triglyceride

The total prevalence of hypercholesterolemia and hypertriglyceridemia among the target population was estimated to be 33.7% [95% CI 31.9 to 35.5%] and 15.6% [95% CI 13.0% to 18.3%] respectively. However these both estimates were much higher among females than among males in both 2005 and 2007 examinations. There was an increasing growth in both measurements with age in both sexes in 2004 and 2007 as well.

Triglyceride and HDL were measured exclusively in 2007. Prevalence of borderline triglyceridemia and hypertriglyceridemia was more common in males than in females in both years. There was a fluctuating growth in the prevalence of hypertriglyceridemia across age groups. The prevalence of HDL under 50 mg/dl was much more common among males than among females.

Table 4: The effect of age and gender on important risk factors of non-communicable diseases

Variable	Absent	Present	OR	95% CI	*P*-value
Body mass index ≥30 kg/m²					
15-24	627	667	1	-	-
25-34	590	708	1.13	0.97, 1.32	0.126
35-44	477	825	1.63	1.39, 1.90	< 0.001
45-54	431	875	1.91	1.63, 2.24	< 0.001
55-64	444	852	1.80	1.54, 2.10	< 0.001
Male	1,519	1,728	1	-	-
Female	1,050	2,199	1.84	1.66, 2.04	< 0.001
Systolic hypertension ≥140 mmHg					
15-24	1,273	22	1	-	-
25-34	1,271	28	1.27	0.73, 2.24	0.399
35-44	1,228	76	3.58	2.21, 5.79	< 0.001
45-54	1,076	230	12.37	7.93, 19.3	< 0.001
55-64	854	442	29.95	19.3, 46.4	< 0.001
Male	2,893	357	1	-	-
Female	2,809	441	1.27	1.10, 1.48	0.002
Diastolic hypertension ≥90 mmHg					
15-24	1,262	33	1	-	-
25-34	1,237	62	1.92	1.25, 2.95	0.003
35-44	1,177	127	4.13	2.79, 6.10	< 0.001
45-54	1,089	217	7.62	5.24, 11.0	< 0.001
55-64	974	322	12.64	8.75, 18.3	< 0.001
Male	2,945	305	1	-	-
Female	2,794	456	1.58	1.35, 1.83	< 0.001
Hyperglycemia ≥110 (mg/dl)					
25-34	601	12	1	-	-
35-44	617	29	2.35	1.15, 5.11	0.011
45-54	575	73	6.35	3.38, 13.0	< 0.001
55-64	557	94	8.45	4.55, 17.1	< 0.001
Male	1,148	85	1	-	-
Female	1,202	123	1.38	1.03, 1.87	0.027
Hypercholesterolemia ≥200 mg/dl					
25-34	508	119	1	-	-
35-44	451	203	1.92	1.48, 2.49	< 0.001
45-54	403	253	2.68	2.08, 3.46	< 0.001
55-64	357	299	3.58	2.78, 4.60	< 0.001
Male	900	345	1	-	-
Female	819	520	1.61	1.36, 1.91	< 0.001
Hypertriglyceridemia ≥200 mg/dl)					
25-34	155	19	1	-	-
35-44	154	24	1.27	0.64, 2.56	0.463
45-54	157	23	1.20	0.60, 2.42	0.588
55-64	138	46	2.72	1.47, 5.15	<0.001
Male	284	55	1	-	-
Female	320	57	0.92	0.60, 1.41	0.672
High density lipoprotein <50 mg/dl					
25-34	61	113	1	-	-
35-44	49	129	1.42	0.88, 2.30	0.128
45-54	72	108	0.81	0.51, 1.27	0.337
55-64	73	111	0.82	0.52, 1.29	0.367
Male	100	239	1	-	-
Female	155	222	0.60	0.43, 0.82	0.001

Analytic results (Table 4 and 5)

Age and gender association with body mass index

There was a relatively strong association between BMI and female gender. The odds ratio (OR) estimate of obesity and overweight was 1.84 [95% CI 1.66 to 2.04] for females in comparison with males**.** There was a strong positive association between BMI and age as well.

Table 5: The effect of body mass index on hypertension, diabetes, and hyperlipidemia

Variable	Absent	Present	OR	95% CI	*P*-value
Systolic blood pressure ≥140 mm Hg					
Normal	3,178	249	1	-	-
Overweight	1,779	309	2.22	1.86,2.65	<0.001
Obese	742	239	4.11	3.38,4.99	<0.001
Diastolic blood pressure ≥90 mm/Hg					
Normal	3,192	235	1	-	-
Overweight	1,800	288	2.17	1.81,2.61	<0.001
Obese	744	237	4.33	3.55, .27	<0.001
Fasting blood sugar >110 mg/dl					
Normal	1,134	56	1	-	-
Overweight	831	89	2.17	1.53,3.07	<0.001
Obese	383	63	3.33	2.28,4.86	<0.001
Total cholesterol ≥200 mg/dl					
Normal	906	308	1	-	-
Overweight	576	351	1.79	1.49,2.16	<0.001
Obese	236	214	2.67	2.13,3.34	<0.001
Triglyceride ≥200 mg/dl					
Normal	294	25	1	-	-
Overweight	191	57	3.51	2.12,5.81	<0.001
Obese	119	30	2.96	1.67,5.25	<0.001
High density lipoprotein <50 mg/dl					
Normal	119	200	1	-	-
Overweight	83	165	1.18	0.84,1.68	0.344
Obese	53	96	1.08	0.72,1.62	0.717

Normal weight: BMI 20-24.9 kg/m²
Overweight: BMI 25-2.9 kg/m²
Obese: BMI ≥30 kg/m²

Age and gender association with systolic and diastolic hypertension

Systolic and diastolic hypertension had very strong positive associations with age and a weak association with gender. The OR estimate of systolic and diastolic hypertension for females compared to males was 1.27 [95% CI 1.10 to 1.48] and 1.58 [95% CI 1.35 to 1.83] respectively.

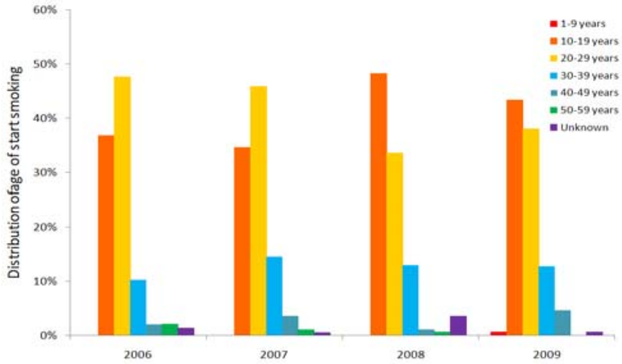

Fig. 1: Prevalence of age of start smoking by year

Age and gender association with fasting blood sugar

There was a weak association between diabetes and/or impaired fasting glucose and age as well as gender. The OR estimate of diabetes and/or impaired fasting glucose for women compare to men was 1.38 [95 CI 1.04 to 1.84].

Age and gender association with cholesterol and triglyceride

Based on these results, there was a positive association between hypercholesterolemia as well as hypertriglyceridemia and age. Hypercholesterolemia had a significant association with female gender as well. The OR estimate for hypercholesterolemia in women compared to men was 1.61 [95% CI 1.36 to 1.91]. However, no association was observed between hyp-ertriglyceridemia and gender.

No significant association between HDL and age was found. But the OR estimate for the ratio of HDL lower than 50 mg/dl in women compared to men was 0.60 [95% CI 0.43 to 0.82]. In other words, the risk of HDL reduction was 40% less in women compared to men**.**

The association of BMI with biochemical measurements was evaluated. A notable significant association of overweight and obesity with systolic and diastolic hypertension was evident A positive association of overweight and obesity with diabetes, hypercholesterolemia, and hypertriglyceridemia was found as well. However no association between BMI and low level of HDL was observed.

The prevalence of risk factors of non-communicable diseases among subjects aged 25-64 years were shown in Table 6 by age groups and years of study. Based on these findings, the prevalence of NCDs risk factors in target population was remarkably high. Almost 92.4% of the subjects exposed to at least two or more risk factors.

Table 6: The prevalence of risk factors of noncommunicable diseases among subjects aged 25-64 years by age groups and year

Year of study	2006			2007			2008			Total		
Number of risk factors	0	1-2	3	0	1-2	3	0	1-2	3	0	1-2	3
Age groups (yr)	**Percentage**			**Percentage**			**Percentage**			**Percentage**		
15-24	14.5	85.5	0.0	5.5	94.5	0.0	7.5	91.5	1.0	9.2	90.5	0.3
25-34	13.0	84.5	2.5	5.0	92.5	2.5	9.0	86.9	4.1	9.0	88.0	3.0
35-44	9.5	84.9	5.6	5.5	90.0	4.6	6.0	91.5	2.5	7.0	88.8	4.2
45-54	10.0	83.9	6.1	5.0	90.0	5.1	7.5	85.9	6.6	7.5	86.6	5.9
55-64	9.0	88.5	2.5	4.5	89.6	5.9	2.5	93.6	3.9	5.3	90.6	4.1
All ages	11.2	85.5	3.3	5.1	91.3	3.6	6.5	89.9	3.6	7.6	88.9	3.5

Discussion

The present study represents the first comprehensive provincial-based estimates of NCDs risk factors in Iran including both descriptive and analytic findings resulted from a five-year sequential survey in Hamadan province, the west of Iran, from 2005 to 2009. Although the results of Iranian first national survey for major risk factors of NCDs in 2005 was published previously (7).

Cigarette smoking is among the most preventable and modifiable common risk factors that explains the vast majority of death due to NCDs particularly chronic obstructive pulmonary diseases (COPD) and lung cancer (1). The total prevalence of tobacco use in target population was estimated 18% (35.1% in men) with 15 cigarettes per day on average. On the other hand, 40.6% and 41.4% of the smokers experienced smoking in the second and third decades of life respectively. These evidences revealed the fact that male adolescents and youths represent the priority target group for health education and prevention programs. This finding is similar to the results of national survey in 2005 (7) as well as the results of Iraqi STEPS survey in 2006 (8) with the same method and target population which reported the prevalence of tobacco use 17.9% and 21.6% respectively.

Fruit and vegetables are essential components of a healthy diet that can help prevent major chronic diseases such as cardiovascular diseases (9) and certain cancers principally of the gastrointestinal system (10). At least 400 g per day of total fresh fruit and vegetables is recommended to reduce the risk of cardiovascular diseases, stroke and hypertension (11). On the other hand, low intake of fruit and vegetables as part of daily diet is responsible for almost three million deaths a year from these diseases (12). Based on presenting findings, nearly 26.3% of the citizens aged 15 to 64 years eat five or more servings of fruits and vegetables per day. This reveals the fact that average intake of fruits and vegetables is very low in vast majority (73.7%) of the population. Nonetheless, this finding is different from what reported by the national survey in 2005 which reported the rate of this behavior about 5% (7) for Iranian citizens. A survey which was conducted in 2002 in USA reported similar results and indicated that 75.5% of the adults eat fewer than five servings of fruits and vegetables per day (13). Another survey which was conducted in Iraq indicated that 91.4% of the Iraqi people eat low fruit and vegetables (8).

Reduced physical activity is likely to be one of the major well-known leading causes of overweight and obesity (11). Although the exact estimation of the daily physical activity is not straight forward, our findings indicated that transportation related physical activity comprises the major physical activity of the both men and women compared to work or leisure time related physical activity. This finding is similar to the result of national survey in 2005 (7). Nonetheless, men spent much more than women on work and leisure time physical activity. Accordingly, women are at higher risk of overweight and obesity. This finding is unlike the results of national survey (7) that reported women spent more time on leisure time related physical activity. On the other hand, the results of the present study indicated that leisure time related physical activity decreased with age in both sexes whereas regular physical activity particularly in adults and older people can reduce the risk of NCDs for mortality and morbidity.

Our findings indicated that almost 47.2% of the target population was either overweight or obese. The national survey in 2005 (7) reported a similar result and estimated that 54.7% of the Iranian population were overweight or obese. In addition, based on the present study, women are 1.8 more likely than men to be overweight or obese [95% CI 1.66 to 2.04]. We know that overweight and obesity are the results of unhealthy diet coupled with lack of physical activity. Furthermore, overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglyceride, and insulin resistance (12). Accordingly, it is expected the prevalence of hypertension, diabetes, and hyperlipidemia to be more common among women than among men. The analytic results of this study indicated this fact clearly. There was a significant association between female gender and obesity on one hand, and between female gender and hypertension, diabetes, and hyperlipidemia on the other hand. Thus women represent the target group for weight control programs and should

be the focus of the policymakers' special attention.
This study had several limitations. First, this was an observational study, hence could be prone to selection or information biases. However, we attempted as much as we could to take a balance sample of age-sex groups of the target population. Second, because data were collected through a sequential cross-sectional survey, incidence-prevalence bias might result from using prevalence odds ratio to estimate the association between variables under study. Third, the potential bias might have occurred in the results by those who refused to participate in the study as well as those who might have responded incorrectly or imprecisely to the questionnaire. Fourth, because data were collected cross-sectionally, we cannot determine the temporality of cause and effect among some variables such as obesity and hyperlipidemia and/or hypertriglyceridemia. Fifth, biochemical measurements were not undertaken for all years due to financial and logistic limitations.
Despite its limitations, the current study may have a number of implications for health care policy. First, the prevalence of several NCDs risk factors was evaluated in the target population for five sequential years. Second, the effect of age and gender on chronic diseases risk factors was indicated clearly. Furthermore, the association of BMI with blood pressure, blood sugar, cholesterol, and triglyceride was measured quantitatively as well. Therefore, we hope the results of present study help policymakers who plan preventive program to reduce incidence of NCDs predisposing factors.
The same survey with the same method and target population was conducted simultaneously in all provinces of Iran in 2005. Most of the results of present survey were confirmed by the results of the national survey. Accordingly, it is expected this survey can represent the profile of the NCDs risk factors in Iran in the last five years and its results may be generalized to the vast majority of Iranian population.
In conclusion, the results of this five-year survey indicated that the prevalence of cigarette smoking was very high particularly in men, fruits and vegetables consumption was very low, and work and leisure time related physical inactivity was high among the target population particularly in women. Almost most of the target population exposed to at least two or more risk factors. These evidences along with high prevalence of overweight and obesity, hyperglycemia, and hyperlipidemia particularly in the women promise a silent progressive epidemic of chronic diseases among Iranian citizens that may lead to an increasing growth of NCDs in the next decade.

Ethical Considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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Abriviations (A-Z)

BMI	Body Mass Index
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Diseases
DBP	Diastolic Blood pressure
FBS	Fasting Blood Sugar
HDL	High Density Lipoprotein
MOHME	Ministry of Health and Medical Education

NCDs	Non Communicable Diseases
OR	Odds Ratio
SBP	Systolic Blood Pressure
TC	Total Cholesterol
TG	Triglyceride
WHO	World Health Organization

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