



# Incidence of Cardiovascular Risk Factors in Oskoo (Northwest Iran): An Approach through WHO CVD-risk Management Package for Low–and Medium-Resource Settings on 37,329 Adults≥30 Years Old

Ahmadali Khalili<sup>1\*</sup>, Alireza Yaghoubi<sup>2</sup>, Naser Safaie<sup>2</sup>, Karim Eyvazi<sup>3</sup>, Rasoul Azarfarin<sup>2</sup>, Adel Ebrahimzadeh<sup>3</sup>, Azin Alizadehasl<sup>2</sup>, Ghader Safarzadeh<sup>4</sup>, Abbas Farzandan<sup>4</sup>, Amir Zamanzadeh<sup>4</sup>

<sup>1</sup>Department of Cardiac Surgery, Madani Heart Hospital, Tabriz University of Medical Sciences, Tabriz, Iran

<sup>2</sup>Cardiovascular Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

<sup>3</sup>Oskoo Health and Treatment Center, Tabriz University of Medical Sciences, Tabriz, Iran

<sup>4</sup>Biochemical Laboratory, Oskoo Health and Treatment Center, Tabriz University of Medical Sciences, Tabriz, Iran

#### ARTICLE INFO

Article Type: Research Article

Article History: Received: 14 Aug 2011 Revised: 27 Sep 2011 Accepted: 2 Oct 2011 ePublished: 12 Jan 2012

*Keywords:* Cardiovascular Disease Risk Factor Prevalence Community-based Study

#### ABSTRACT

Introduction: The aim of this study was to determine incidence of cardiovascular disease (CVD) risk factors [hypertension (HTN), obesity, Dyslipidemia (DLP), diabetes mellitus (DM) and smoking] in Oskoo. Methods: This study was planned according to WHO prouto CVD-risk management package for low and medium-resource settings\_and named . East Azerbaijan healthy heart program ب The pilot study of this program was done in Oskoo in 2007-2009. In this study, demographic data and CVD risk factors of 37,329 adults a ged≥30 years old living in Oskoo were collected. In addition, blood samples of 17,388 adults≥40 years old were taken (free of charge) for assessment of serum glucose and lipid profile. *Results*: The study covered 93.52% of Oskoo town population aged≥30 years old. We studied 18637 male (M) (91.50% coverage) and 18692 female (F) (95.52% coverage) participants. The incidence of HTN [SBP>140 & DBP>90 mmHg] was 16.25% (M:15.08%, F:17.29%), pre-hypertension [SBP=120-139 & DBP=80-89 mmHg] =37.78% (M:41.38%, F:34.18%), DM [fast blood glucose (FBS)≥126mg/dl] was 7.45% (M:6.35%, F:8.54%), smoking was 9.40% (M:17.00%, F:1.57%), hypercholesterolemia (>200mg/dl) was 47. 64% (M :42.46%, F :52.81%) and o besity [bo dy mass i ndex (B MI)  $\geq$ 27] was 50.47% (M:38.79%, F:62.09%). Conclusion: Considering high incidence of C VD risk factors (except smoking) in Oskoo adults ≥30 years, it is recommended that this pilot study expanded to all of East Azerbaijan. Free of charge taking blood samples from people  $\geq 40$ years to evaluate lipid profile and glucose levels is worthy to early detecting the prevalent DM or DLP in this target population.

## Introduction

In S eptember 2011, new W orld H ealth O rganization (WHO) r eport: Global atlas o n c ardiovascular disease(CVD) prevention and control states that CVDs are the leading causes of death and disability in the world.<sup>1</sup> Although a 1 arge pr oportion o f CV Ds is pr eventable, they c ontinue t o rise m ainly because p reventive measures are inadequate. In this report an estimated 17.3 million p eople died from.<sup>1</sup> about ni nety p ercent o f t he world, s to tal d isease b urden rises in middle-income countries, w hile o nly te n p ercent o f g lobal h ealth e x-penditure is assigned in these countries.<sup>2</sup>

There has been change over the last two decades in the geographical d istribution of the C VD incidence with

obvious decline in the de veloped c ountries and rise in the d eveloping c ountries i ncluding the M iddle E ast region. The Islamic Republic of Iran, as Middle East country was adopting the western lifestyle such as nutrition habits, smoking and physical inactivity that led to higher incidence of CVD risk factors in the related population. Such c hanges coupled with improvement in health s ervices have resulted in improving the life expectancy and the em ergence o f n on-communicable d iseases (NCDs) including CVDs. The CVDs are considered as the leading cause of death in Iran in the past 10 years.<sup>3</sup> There are two protocols to decrease the burden of CVDs. The population s trategy th at includes c ommunity-based st rategies, health promoting strategies and that minimal modification in CVD risk in community can remarkable re-

\*Corresponding author: Ahmadali Khalili (MD), Tel.: +98 411 3373900, Fax: +98 411 3363880, E-mail: khalilia@gmail.com Copyright © 2011 by Tabriz University of Medical Sciences duce the incidence of CVD. The alternative is to screening the risk factors in "high risk" adults undergo prophylactic therapies.<sup>4</sup> As we implemented in our study, these alternative s trategies, " population" (recruitment o f all adults) and "high r isk" (adults  $\geq$ 30 years old), can of course b e considered as complementary to a chieve the best results.

Most of community-based programs on CVD risk factors in Iran, including "Healthy Heart Programs", <sup>3,5,6</sup> were undertaken on limited s amples of the target population and then tried to integrate the results to entire population. On the other hand, frequently, the focus was on single or limited number of r isk factors, rather than on c omprehensive c ardiovascular risk. F or C VD p revention a nd control activities to achieve the greatest impact, a paradigm shift is required from the treatment of risk factors in isolation to comprehensive cardiovascular risk management To facilitate this shift, WHO developed the CVD-Risk m anagement p ackage t hrough an iterative process with collaborating experts that is named W HO CVD-risk m anagement pa ckage for l ow a nd m ediumresource settings.

According t o a bove-mentioned pa ckage, a po pulationbased s urvey of CV D r isk f actors w as c onducted i n Oskoo t own ne ar t o T abriz (northwest I ran) o n e ntire population aged  $\geq$ 30. The study was implemented under the supervision of C ardiovascular Research Center, Tabriz University of Medical Sciences from March 2007 to March 2009. Two n ovel as pects of th is s tudy were selecting adults aged  $\geq$ 30 years old rather than 15-64 years old to h ave be tter cover the at-risk population, and including all rural and urban population (health CVD-risk census) o f O skoo t own ra ther than s ampling a s mall number of general populations.

## Materials and methods

After a pproval of t he s tudy p roposal in Cardiovascular Research C enter ( Tabriz U niversity o f M edical Sciences), this p opulation-based s urvey was c arried ou t in East Azarbaijan province and named E ast Azerbaijan province healthy heart program The pilot study of this community-based program was done in Oskoo town near Tabriz (northwest Iran) in 2007-2009. The study population comprised people aged  $\geq$ 30 years old living in rural and ur ban areas of O skoo. O skoo i s at 10 km s outh of Tabriz with a population of 88,433 according to the national c ensus in 2006. A ccording to the c ensus results, the number of Oskoo people aged  $\geq$ 30 years old was 37,329 consisting of 18,637 male and 18,692 female.

We pl anned t he s tudy a ccording t o W HO pr otocol , WHO CVD-risk management package for low and medium-resource settings, <sup>7</sup> The package is aimed to carry out in a range of healthcare facilities in low- and middleresource departments, in developing countries, therefore, it has been planned for three situations that mirror usually encountered resource a ccessibility strata in s uch s ettings. The minimum criteria that describe the three scenarios, in accordance with the skill-level of the health staff and the diagnostic and therapeutic facilities and health services available, are shown in Appendix 1. Full text of this package was translated to Persian, copied and distributed in all rural and urban "Health and Treatment Centers". The three main scenarios of this package were explained in detail at several meetings in O skoo to the health managers, practitioners, and staff.

In addition, the WHO steps of risk factors for NCDs was explained to health practitioners and staff. This protocol utilizes stratified levels of risk factor appraisal including gathering information a pplying que stionnaires (step 1), physical assessments (step 2), and taking blood samples for biomedical check-up (step 3).<sup>8</sup>

We a lso co ordinated the O skoot hree m ain biomedical laboratories to refer to target rural and urban "health and treatment ce nters" to i n-site ta king blood s amples f or biomedical as sessment of f asting blood g lucose (FBS), cholesterol (Chol), triglyceride (TG), high density lipoprotein (HDL) and low de nsity lipoprotein (LDL) i n 17,388 adults≥40 years old. These biochemical assessments were free of charge and majority of the study cost was spent to 17,388 laboratory assessments of FBS and full lipid profile.

Through t wo years (M arch 2007 t o M arch 2009) the questionnaires of 37,329 participants were completed by health practitioners and staff and transmitted to C ardiovascular Research Center in Tabriz to entering the data in SPSS statistical package data-sheet (SPSS Inc, Chicago, IL, USA; v. 16.0). Moreover, the results of 17,388 biochemical t ests w ere c ollected a nd e ntered t o S PSS data-sheet. The d escriptive d ata of p articipants such as demographic characteristics and frequencies of various CVD risk factors consisting: hypertension (HTN), obesity [ body m ass i ndex(BMI)  $\geq 27$ ], dyslipidemia (DLP), diabetes mellitus (DM) [FBS  $\geq 126$  mg/dl] and smoking and s ome pr e-risk f actors i ncluding: p re-hypertension (Pr-HTN) [SBP=120-139 & DBP=80-89 mmHg] in both genders and different age groups were determined. The definitions of all CVD risk factors and biochemical measurements w ere m ade a ccording t o WH O p rotocol WHO CVD-risk management package for low and medium-resource s ettings  $\downarrow$ .<sup>7</sup> The reader is r eferred t o f ull text package for detail study of CVD-risk management in three consecutive scenarios.

## Results

The s tudy c overed 93. 52% of O skoo t own po pulation aged  $\geq$ 30 years. We s tudied 18,637 male (M; 91.50% coverage) and 18,692 female (F; 95.52% coverage) participants. Figure1 shows the age pyramid of the adults  $\geq$ 30 years in both men and women. The summary of risk factors i ncidences a re p resented in Ta ble 1. Th ese risk factors incidences include: hypertension [SBP $\geq$ 140 and DBP $\geq$ 90 mmHg] =16.25%, pre-hypertension [SBP=120139 and DBP=80-89 mmHg] =37.78%, diabetes mellitus [fast blood glucose (FBS)  $\geq$ 126mg/dl] =7.45%, smoking=9.40%, hypercholesterolemia (>200mg/dl) =47.64% and obesity [body mass index (BMI)  $\geq$ 27] = 50.47%. The pr evalence of m orbid ob esity (BMI>30) i n t he present study in men was 18.2% and women was 37.2% (in total=27.6%).



Fig. 1. Age pyramid of Oskoo population≥30 years old in men and women (each bar is 5-year interval).

Table 1. Incidence of cardiovascular risk factors in Oskoo adults≥30 years old

	Men	Women	Total
	n=18637	n=18692	n=37329
Hypertension	15.35%	17.29%	16.25%
(SBP≥140 or DBP≥90)			
Diabetes Mellitus	06.35%	08.54%	07.45%
(FBS≥126mg/dl) <sup>ª</sup>			
Cigarette smoking	17.00%	01.57%	09.40%
Hypercholesrolemia	42.46%	52.81%	47.64%
(>200mg/dl) <sup>b</sup>			
Obesity (BMI≥27)	38.79%	62.09%	50.47%

<sup>a,b</sup> Fast blood glucose (FBS) and cholesterol measurements were done in adults≥40 years old.

**Table 2.** Incidence of pre-hypertension, hypertension stage 1 and  $2^*$  in Oskoo adults≥30 years old.

		Men	Women	Total
Systolic blood	Pre- hypertension	41.38%	34.18%	37.78%
pressure	Stage 1 Stage 2	8.23% 4.29%	9.14% 5.05%	8.69% 4.68%
Diastolic blood pressure	Pre- hypertension	28.31%	27.20%	27.75%
-	Stage 1 Stage 2	7.75% 3.84%	8.87% 4.43%	8.31% 4.14%

\* Definitions presented in Appendix 3.

Table 3 .Incidence of diabetes mellitus\*, smoking and obesity in Oskoo adults≥30 years old

	Diabetes mellitus (FBS≥126 mg/dl)		Smoking		Obesity (BMI≥27)	
Age groups	Men	Women	Men	Women	Men	Women
30-	1.8	1.6	13.75	1.06	26.5	58.3
35-	2.4	3.3	15.80	1.13	33.4	68.9
40-	4.0	4.6	20.61	1.08	44.2	67.5
45-	4.9	7.4	21.03	1.94	50.1	68.6
50-	5.9	10.0	19.64	1.66	49.5	66.6
55-	9.1	10.6	19.30	2.39	43.9	58.7
60-	9.6	13.5	13.31	2.20	45.8	49.4
65-	7.3	9.8	14.36	2.22	38.0	46.9
70-	9.0	14.8	15.19	2.09	31.6	40.3
75-	5.6	9.0	10.60	1.95	28.0	39.4
80+	5.7	5.2	11.25	2.05	30.6	25.3
	Laura (	EDC) week		مقارباه محتام	> 10	مسم ملما

Fast blood sugar (FBS) was measured in adults≥40 years old.

Blood pressure (BP) of all population aged  $\geq 30$  years were m easured by standard protocol and recorded. The classification of stages of systolic and diastolic BP was done according to Chobanian *et al.*<sup>9</sup> definition (Appendix 2). One of the most important finding of this study is detecting the very high incidence of systolic and diastolic pre-hypertension in b oth men (41.38% and 28.31%, respectively) and women (34.18% and 27.20%, respectively; Table 2).

Table 3 demonstrates the incidence of diabetes mellitus, smoking and obesity in different age groups (in 5 years intervals) in b oth g enders. The incidences of D M and obesity gradually increased by advancing age from 30 to 75 years and then decreased in b oth g ender. Wo men have hi gher incidences of D M and o besity in all age groups than men. The incidences of cigarette smoking in men were significantly higher among women in all age groups. Highest frequency of s moking in men were in age between 40-60 years old (about 20%) and in women in ages higher than 55 years old (about 2%; Table 3).

The unique aspect of this survey was measuring of lipid profile in 17,388 adults a ged more than 40 y ears that spent most of the study cost including total cholesterol, triglyceride, lo w d ensity lip oprotein (LDL), and hi gh density lipoprotein (HDL). Table 4 shows detail of incidences of dyslipidemia in different a ge groups in both genders. The incidences of dyslipidemia were distributed homogenously in all ag e g roups. We f aced h igh incidence of h ypercholesterolemia, v ery h igh frequency of hypertriglyceridemia, relatively low in cidence of "High LDL" and vey high frequency of "Low HDL" on both sex in all age groups. Women have higher incidences of hypercholesterolemia, h ypertriglyceridemia an d "High LDL" than men; however, men showed lower levels of HDL (and higher incidence of "Low H DL"). In this study, we considered cut-off point of 160 mg/dl for defining of "High LDL" and if regarding the cut-off point

of 130 m g/dl in adults with more than t wo CV D risk factors and cut-off point of 100 mg/dl in diabetics, it is

possible to obtain the higher incidence of "High LDL" in target population.

	Hyperch (>20	nolestrolemia 00 mg/dl)	Hyperti (>1	riglyceridemia 50 mg/dl)	H (>10	igh LDL 60 mg/dl)	Low	/ HDL
Age groups	Men	Women	Men	Women	Men	Women	Men (≤40mg/dl)	Women (≤50mg/dl)
30-	38.2	40.5	54.6	59.0	13.0	11.9	53.8	32.8
35-	40.3	48.2	52.9	48.7	15.1	19.0	64.3	37.6
40-	38.1	45.5	51.8	53.4	11.5	16.5	61.9	43.5
45-	43.5	48.6	57.5	53.5	15.3	17.3	63.1	46.0
50-	47.5	55.8	51.6	60.8	17.0	25.4	65.2	47.9
55-	44.8	62.9	50.7	64.5	17.8	31.2	66.1	50.6
60-	44.2	58.4	47.3	65.6	15.8	25.2	65.4	44.4
65-	45.1	58.9	46.9	58.0	18.2	23.0	65.8	47.2
70-	42.2	55.5	43.9	55.2	14.3	24.4	70.9	46.3
75-	41.59	47.4	43.2	59.8	11.9	27.3	66.4	52.7
80+	32.9	50.8	42.4	57.8	13.7	18.9	63.7	38.1

Table 4. Incidence of dyslipidemia in Oskoo adults ≥40 years old.

#### Discussion

This study has examined the CVD r isk factor status of urban and rural people a ged 30 years old and over in Oskoo town in northwest Iran. In general, there was a high prevalence of CVD r isk factors in particular, such as Obesity, high cholesterol, low-HDL cholesterol, and hypertension, especially in women.

About ninety percent of the world s disease burden including CVD occurs in developing countries, while only ten percent of global h ealth e xpenditure is assigned in these countries. <sup>4</sup> About 78% of all NCD deaths occur in low and mid dle-income co untries. CVD a counts f or 48% of a ll N CD de aths and a mong the six WHO r egions, the Eastern M editerranean region has the highest CVD a ge-standardized mortality rate. <sup>4,10</sup> The CVD has become a l eading c ause of de ath i n u nder-developed states and rates are expected to increase further over the next y ears. In addition, it has been estimated that high blood p ressure a counts for a s m uch a s five p ercent of the total death rate in developing countries, smoking for 4.0%, hypercholestrolemia for 2. 1% and ob esity f or 2.7%. <sup>4</sup>

#### Hypertension

The pr evalence of h ypertension among O skoo a dults aged 30 and o ver was 16. 25%, and higher i n w omen (17.29%) than in men (15.35%). Our overall prevalence rates for hypertension were similar to Seyffarshad *et al.*<sup>11</sup> study of CVD risk factors in East Azarbaijan province in 2007 t hat r eported t he i ncidence of 22. 35% f or HTN (Men=19.4% and women=21.9%). Sadeghi-Bazargani *et al.*<sup>6</sup> also reported the similar prevalence r ate of HTN (18.0%) from A rdabil in 2011. Our results were somewhat lower than that reported in other literature : Rodri-

guez-Ojea *et al.*<sup>12</sup> in 2011 showed the prevalence of self creported HTN in 23.5% of adults aged 45-60 years old and Bovet *et al.*<sup>4</sup> reported the rate of 31.6% in Republic of Seychelles in east of Kenya. McDonald and Pickart <sup>10</sup> reported rate of 23% for HTN in Eastern Mediterranean adults with age 30 years old and over in low and middleincome population group in 2004. In a analysis Perdigao *et al.* <sup>13</sup> revealed that in Portugal, women reported high BP more often than men with prevalence of 23.2% and 16.1% in women and men, respectively.

#### Diabetes mellitus

In the pr esent s tudy the pr evalence of D M was 7.45% (men=6.35 a nd w omen=8.54%). Seyffarshad *et al.*<sup>11</sup> reported the p revalence rate of 5 .52 f or E ast Azerbaijan, men and 4.64% in this province, women. Bovet *et al.*<sup>4</sup> showed the prevalence of 9.3% (men 9.6%; women 9.0%) in east A frican region. In our study women have higher rate of D M but t hese t wo s urveys d emonstrated the vice v ersa. The p revalence rates of f diabetes in the Perdigao, study <sup>13</sup> in different regions of Portugal were 4.6% to 8.9%. Comparing the prevalence rates of DM in East Azarbaijan province (Seyffarshad study <sup>11</sup>) in population 1 5-64 years o ld a nd o ur s tudy of Oskoo a dults aged  $\geq$  40 years, it is revealed that higher prevalence of DM in our s tudy somewhat could be r elated to h igher age of participants in Oskoo study.

In a report from all WHO r egions (Africa, The Americas, E astern M editerranean, E urope, S outh-East Asi a, and Wes tern P acific), in E astern M editerranean region, population with a ge 30 years old and ov er in l ow a nd middle-income g roups in 2 004, the p revalence o f D M was highest (17%) among the regions; in other regions the p revalence o f DM r anged between 4 t o 9%. Africa showed the lowest pr evalence (4%) b ut has the highest mortality rate for diabetes. <sup>10</sup>

### Obesity

In the present study if the definition of the obesity was considered a s B MI $\geq$ 27, then the rates were 38.79% in men and 62.09% in women (50.47% in total). However, in some studies the definition of obesity was B MI>30 and considering this cut-off point the prevalence rates of obesity in our study were 18.20% in men and 37.20% in women aged 30 years and over.

The overall prevalence rates of obesity and overweight population were similar to Hajian et al.<sup>14</sup> study that reported the rates of 18.8% and 34.8% in men and women, respectively in urban population aged 20-70 years, in the north of Iran in 2007. In these two studies, the rate of obesity in women was higher in men. Also in these two surveys, in both genders, particularly in females, the rate of obe sity was r aised by i ncreasing a ge.<sup>14</sup> Sadeghi-Bazargani et al. reported the p revalence r ate o f overweight and obesity of 58.9% in Ardabil (northwest Iran) in 2011.<sup>6</sup> Seyffarshad *et al.* reported the rate of obesity (BMI>30) 17.29 in women and 8.79 in men aged 15-64 years old in East Azarbaijan province in 2007.<sup>11</sup> These rates lower than our study results even considering higher a ge o f o ur s tudy pa rticipants (30 years old). Rodriguez-Ojea et al. also reported the prevalence of obesity 23% in males and 45% females in an urban Cuban population aged 45-60 years, regarding the age group of participants; the results are similar to our findings.<sup>12</sup>

## Smoking

The o verall p revalence o f c urrent s mokers w as 9 .4% (17.0% in men; 1.6% in women), and was lower than studies c onducted with a similar methodology in Ea st Azarbaijan (14.9% [2 0.3% i n m en; 1.1% i n w omen]<sup>11</sup> and also in neighboring p rovinces (15.7% [ 29.0% in men; 2.6% in women] in Ardabil)<sup>6</sup>, as well as the country as a whole (19% [31% in men; 6% in women]).<sup>15</sup> Farzadfar et al. in a national and s ub-national s urvey reported the prevalence of smoking in different regions in I ran a s f ollows: In s outheast region w as 25% (men=35%, women=14%); n orth a nd n ortheast 20% (men=32%, women=7%); west 21% (m en=33%, women=6%) and central region 17% (men=31%, women=3%).<sup>15</sup> This study was do ne i n 2011 a ccording t o registered data of 2005 and as presented above, all prevalence rates were higher than our study results in both genders.

# Dyslipidemia

Comparison of h ypercholesterolemia prevalence rates is complicated for r easons related to the c riteria u sed to define it, the demographic structure of the studied population, and the methods used for diagnosis. For example, we d efined h ypercholesterolemia as le vels>200mg/dl while in other studies levels such as>190 mg/dl<sup>16</sup> to levels > 232mg/dl<sup>10</sup> or > 240mg/dl<sup>11</sup> were c onsidered as cut-off values. In addition, some researchers report the prevalence r ates from t arget population b ased o n s elf-reporting of this variable, but the others, collect the data from blood samples of the participants.

In the present study in Oskoo population a ged 40 years and over, the overall prevalence of hypercholesterolemia (>200 mg/dl) was 47.46%. Women had higher frequency of h ypercholesterolemia (5 2.81%) t han m en (42 .46%). In a 2003 s ystematic r eview of pr evious studies <sup>16</sup>, the proportion of individuals with total cholesterol  $\geq$ 190 mg/dl was 64%, and in the study in the Central region of Portugal <sup>17</sup>, individuals with a mean age of 47±12 years, 46.7% had h ypercholesterolemia that is s imilar to o ur findings.

# Limitations

The present study had some limitations. It was a pilot study in a small city near Tabriz in northwest Iran. However this study covered nearly all population $\geq$ 30 years old and provided a complete database of the target population. It was als o n ot a representative sample of East Azarbaijan pr ovince p opulation but s erved a s a pi lot study of the application of epidemiological research methods and the determination of novel cardiovascular risk factor status in this province. For that reason, the conclusions are only valid for the population studied (i.e. adults aged  $\geq$ 30 years old). This study was a cross-sectional study in na ture, and therefore, no causal relationships can be directly assessed.

# Conclusion

Considering high incidence of CVD risk factors (except smoking) in O skoo r ural and urban population aged 30 years and over, it is recommended that this pilot study should be expanded to all of East Azerbaijan province or could be conducted in other states with low-middle income. It is emphasized that free of ch arge taking blood samples from all people  $\geq 40$  years old to evaluate lipid profile and glucose levels is worthy to early detecting the undiagnosed a nd p revalent D M or D LP in this t arget population.

## Acknowledgements

The study was funded by Cardiovascular Research Center, Tabriz University of Medical Sciences (Tabriz, Iran).

# Ethical issues

Not applicable in this research.

# **Conflict of interests**

No conflict of interest to be declared.

#### References

- Global a tlas o n cardiovascular d isease p revention a nd control (cited 2011 November) available from: http://www.who.int/cardiovascular diseases/en/
- Murray CJL, Lopez AD. The global burden of disease: a comprehensive a ssessment o f m ortality a nd di sability from diseases, injuries and risk factors in 1990 and projected to 2020. Cambridge, UK: Harvard University Press; 1996.
- 3. Sarrafzadegan N, Kelishadi R, Esmaillzadeh A, Mohammadifard N, Rabiei K, Roohafza H, et al. Do lifestyle interventions work in de veloping countries? Findings from the Isfahan Healthy Heart Program in the Islamic Republic of Iran. **Bull World Health Organ**. 2009; 87(1):39-50.
- Bovet P, Shamlaye C, Gabriel A, Riesen W, Paccaud F. Prevalence of cardiovascular risk factors in a middle- income c ountry and e stimated c ost of a treatment strategy. BMC Public Health. 2006; 6:9.
- Bozorgmanesh M, Hadaegh F, Sheikholeslami F, Azizi F. Cardiovascular risk and all-cause mortality attributable to diabetes: Tehran Lipid and Glucose Study. J Endocrinol Invest. 2012;35(1):14-20
- Sadeghi-Bazargani H, Jafarzadeh H, Fallah M, Hekmat S, Bashiri J, Hosseingolizadeh G, et al. Risk factor investigation f or c ardiovascular h ealth t hrough W HO S TEPS a pproach in Ardabil, Iran. Vasc Health Risk Manag. 2011; 7:417-24.
- WHO CVD-risk management package for low and medium-resource settings (cited 2007 March) A vailable from:http://whqlibdoc.who.int/publications/2002/9241545 852.pdf.
- 8. Bonita R, D ecourten M, D wyer T, J amrozic K, Wi nkelmann R. Surveillance of risk factors for noncommunicable diseases: the WHO STEPwise approach. Geneva, Switzerland: World Health Organization; 2002.
- Esteghamati A, Meysamie A, Khalilzadeh O, Rashidi A, Haghazali M, Asgari F, et al. Third national Surveillance of R isk F actors of N on-Communicable D iseases (SuRFNCD-2007) in Iran: methods and results on prevalence of di abetes, hy pertension, o besity, c entral o besity, and dyslipidemia. BMC Public Health. 2009; 9:167.

 McDonald M, Pickart F. The Global Burden of Noncommunicable D iseases. (cited 2011 D ecember) A vailable from: http://www.pfizer.pt/Files/Billeder/Pfizer%20P%C3%BA

http://www.pnzer.pt/Files/Billeder/Pnzer%20P%C3%BA blio/Not%C3%ADcias/Global%20Burden%20of%20Non communicable%20Diseases.pdf

- 11. Seyffarshad M, Kousha A, Pourdowlati S, Karamouz M, Farahbakhsh M, Hakimi S, et al. Cardiac Risk Factor Analysis i n E ast A zerbaijan, Iran. **Cardiology**. 2007; 3(1):1-4.
- 12. Rodriguez-Ojea A, Alonso C, Yarnell JW, Woodside JV. Status of novel cardiovascular risk factor and cardiovascular di sease risk in an u rban C uban po pulation--a p ilot study. **J Health Popul Nutr**. 2011; 29(5):510-5.
- Perdigao C, R ocha E, D uarte J S, S antos A, M acedo A. Prevalence a nd d istribution of t he m ain c ardiovascular risk f actors i n P ortugal--the A MALIA s tudy. Rev P ort Cardiol. 2011; 30(4):393-432.
- Hajian-Tilaki K O, Heidari B. Prevalence of obesity, central obesity and the associated factors in urban population aged 20-70 years, in the north of Iran: a population-based study and regression a pproach. Obes Rev. 2007; 8(1):3-10.
- 15. Farzadfar F, Danaei G, Namdaritabar H, Rajaratnam JK, Marcus JR, K hosravi A, et al. National and subnational mortality effects of metabolic risk factors and smoking in Iran: a comparative risk assessment. **Popul Health Metr**. 2011; 9(1):55.
- Costa J , B orges M , Ol iveira E , GO UVEIA M , VA Z CARNEIRO A. [Incidence and Prevalence of H ypercholesterolemia i n P ortugal:A S ystematic R eview. P art I ]. Rev Port Cardiol. 2003; 22:569-77.
- Santiago LM, Serra e Silva P. [coronary heart disease risk: the result of population s creening by the c entral region branch of the Portuguese heart f oundation]. Rev P ort Cardiol. 2003; 22:1039-48.5.

RESOURCE	SCENARIO	SCENARIO TWO	SCENARIO THREE
Human resources	Non physician health worker	Medical doctor or specially trained nurse	Medical doctor with access to full specialist care
Equipment	Stethoscope Blood pressure measurement device Measuring tape or weighing scale Optional: test tubes, holder, burner, solution or test strips for checking urine glucose	Stethoscope Blood pressure measurement device Measuring tape or weighing scale Test tubes, holder, burner, solutions or test strips for checking urine glucose and albumin	Stethoscope Blood pressure measurement device Measuring tape or weighing scale Electrocardiograph Ophthalmoscope Urine analysis Blood analysis: fasting blood sugar, electrolytes, creatinine, cholesterol and lipoptoteins
Generic drugs	Essential: thiazide diuretics Optional: metformin (for refill)	Thiazide diuretics Beta blockers Anglotensin converting enzyme inhibitors Calcium channel blockers (sustained release formulations) (Reserpine and methyldopa if the above antihyperten- sives are unavailable) Aspirin Metformin (for refill)	Thiazide diuretics Beta blockers Angiotensin converting enzyme inhibitors Calcium channel blockers (sustained release formulations) (Reserpine and methyldopa if the above antihyperten- sives are unavailable) Aspirin Insulin Metformin Gilbenclamide. Statins (if affordable) Angiotensin receptor blocker (if affordable)
Other facilities	Referral facilities Maintenance and calibration of blood pressure measure- ment devices	Referral facilities Maintenance and calibration of equipment	Access to full specialist care Maintenance and calibration of equipment

Appendix 1. Characteristics of the three scenarios in the WHO CVD-Risk Management Package

#### Appendix 2. Classification of Systemic Blood Pressure for Adults

Category	Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)
Normal	<120	<80
Pre-hypertension	120–139	80–89
Stage 1 hypertension	140–159	90–99
Stage 2 hypertension	≥160	≥100

Reprinted with permission from Chobanian AV, et al: Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. Hypertension 2003;42:1206–1252