Unhealthy lifestyles and ischaemic electrocardiographic abnormalities: the Persian Gulf Healthy Heart Study

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أنماط الحياة المنافية للصحة والاضطرابات الإقفارية على تخطيط كهربية القلب: دراسة القلب الصحي للخليج الفارسي

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الخلاصـة: درس الباحثون 3727 شخصاً تبلغ أعمارهم 25 عاماً فأكثر في منطقة شمال الخليج في إيران لتقيـيم معدل انتشار عوامل الاختطار القلبية الوعائية ومرض القلب الإقفاري وأنماط الحياة المنافية للصحة، فلاحظوا وجود عامل اختطار قلبي وعائي واحد أو أكثر لدى 96.0%، وأن ما يزيد على 60% من المشتـركين في الدراسة لديهم وزن غير صحي، وأن 8.3% منهم فقط يتناول المقادير الموصى بها من الفواكه والخضراوات، وأن 70.6% منهم غير نشيطين بدنياً، وأن 19.0% كانوا يدخنون في ذلك الوقت. أما معدل انتشار علامات مرض القلب الإقفاري على مخطط كهربية القلب فكانت 12.7%. ولوحظ تـرابط مستقل بين التدخين في وقت الدراسة أو في وقت سابق لها، وكذلك بين البدانة الجذعية، وبين هذه التغيرات التخططية لدى الرجال، وكما لوحظ ترابُط مع التدخين وقت الدراسة أو في وقت سابق لها ومع البدانة لدى النساء. كما يرتبط ارتفاع ضغط الدم والسكري ارتباطاً مستقلاً مع ازدياد اختطار تلك التغيرات.

ABSTRACT We assessed prevalence of cardiovascular risk factors, ischaemic heart disease (IHD) and unhealthy lifestyles in 3723 participants aged ≥ 25 years in the northern Persian Gulf region; 96.0% had ≥ 1 cardiovascular risk factor. Over 60% had unhealthy body weight, only 8.3% ate the recommended amount of fruits and vegetables, 70.6% were physically inactive and 19.0% were current smokers. Prevalence of electrocardiogram (ECG) with evidence of IHD was 12.7%. Present or past smoking and truncal obesity were independently associated with IHD ECGs in men, and past or present smoking and obesity in women. Hypertension and diabetes were independently associated with increased risk of IHD ECG.

Modes de vie malsains et anomalies électrocardiographiques évocatrices d'une ischémie : *Persian Gulf Healthy Heart Study* [étude sur la santé cardiaque dans le Golfe persique]

RÉSUMÉ Nous avons évalué la prévalence des facteurs de risque cardio-vasculaire, de la cardiopathie ischémique et des modes de vie malsains chez 3723 participants âgés de 25 ans ou plus dans la région du nord du Golfe persique ; 96,0 % présentaient au moins un facteur de risque cardio-vasculaire. Plus de 60 % avaient un poids corporel préjudiciable à la santé, seuls 8,3 % consommaient la quantité de fruits et légumes recommandée, 70,6 % étaient sédentaires et 19,0 % étaient des fumeurs au moment de l'étude. La prévalence de l'électrocardiogramme (ECG) mettant en évidence une cardiopathie ischémique était de 12,7 %. Le tabagisme actuel ou passé et l'obésité tronculaire étaient indépendamment associés à des ECG révélant une cardiopathie ischémique chez les hommes, et le tabagisme passé ou actuel et l'obésité chez les femmes. L'hypertension et le diabète étaient indépendamment associés à un risque augmenté d'ECG révélant une cardiopathie ischémique.

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Introduction

Mortality for cardiovascular disease (CVD) is decreasing in developed countries as a result of long-term promotion of healthy lifestyles and community prevention measures. However, with ageing populations and rapidly changing lifestyles (in particular tobacco smoking, unhealthy diets and physical inactivity), the burden of CVDs is increasing in almost all developing countries [*1,2*]. This poses a threat to the economies of the less-developed world [*3*].

Results of large, prospective cohort studies have shown that a healthy diet and lifestyle, along with low levels of serum cholesterol and blood pressure and not smoking, are associated with a low risk of coronary artery disease [*4–5*]. Lifestyle therapies which include a combination of diet and exercise modifications have been recommended in place of drug treatment for patients who fall into an intermediate range for coronary heart disease risk [*6*].

The Islamic Republic of Iran is an example of countries in the Eastern Mediterranean Region of the World Health Organization (WHO) which are undergoing a nutritional transition. Preliminary reports indicate that CVD is the leading cause of death in those over the age of 35 years [*7*]. The prevalence of CVD risk factors among the urban population in Tehran is high, particularly high total cholesterol, low high density lipoprotein (HDL)-cholesterol and high waist–hip ratio [*8*]. However, unhealthy lifestyles and CVD have not yet been studied and documented in the south of the Islamic Republic of Iran, in the region bordering the Persian Gulf and this places a major limitation on developing healthy lifestyle policies, strategic plans and programmes.

The main aim of this study was to characterize the prevalence of 4 unhealthy lifestyle patterns (unhealthy weight, inadequate fruit and vegetable consumption, lack of regular leisure-time physical activity and smoking) in the northern Persian Gulf region, and to determine the association between these lifestyles and electrocardiographic ischaemic abnormalities using the Minnesota coding criteria [*9*].

Methods

The Persian Gulf Healthy Heart Study (PGHHS), of which this study is a part, was designed to determine CVD risk factors among the population of the northern Persian Gulf area, to develop community-based projects to change the lifestyles of the population and to publicize the rising threat of CVD in the region. The PGHHS comprises 2 major components: Phase I is a cross-sectional prevalence study of unhealthy lifestyles and ischaemic heart disease (IHD) and associated risk factors. Phase II comprises a multiple intervention project to reduce CVD in the region. The study is being carried out by the Persian Gulf Health Research Centre in Bushehr University of Medical Sciences and Health Services. More details of the PGHHS are discussed on the Canadian Heart Health Database (http://www.med.mun.ca/g8hearthealth), project ID Number 168.

Community sampling

In the PGHHS, the protocol and guidelines of the WHO Countrywide Integrated Noncommunicable Diseases Intervention Programme for sample size in health behaviour surveys were used. The recommended minimum sample size to meet statistical requirements for detectable changes in risk factors in the population is 3000 [*10*]. In Phase I of the study, a multi-stage stratified

cluster random sampling technique was used to select 3000 people aged 25–64 years from major ports of Bushehr province (Iranian province with the greatest border with the Persian Gulf). The ports studied were Bushehr (the provincial capital, population 150 000, and annual coronary events of 481.05 per 100 000 for men and 156.61 per 100 000 for women, 2003 [*11*]), Genaveh and Deilam.

Almost all the households of the 3 ports were under the coverage of local health centres of Bushehr University of Medical Sciences and Health Services. A multi-stage stratified cluster random sampling technique was used to select households in the coverage area of each local health centre. The specifications dictated that approximately 2 persons per selected household could be included in Phase I. The total number of households selected in the area of each local health centre was proportional to the total number of households in that area.

Publicity concerning the study appeared in the local newspapers and on TV. The participants were informed about the study through a letter delivered by hand. After a primary educational input about CVD and its associated risk factors, they were invited to participate in the screening programme in a 12–14-hour fasting state the following morning at one of the local health service centres belonging to Bushehr University of Medical Sciences.

Survey procedure

Phase I was a cross-sectional survey in which each participant was examined only once. Examinations were conducted in 2003–04. All participants were asked to fast 12–14 hours and to present at the survey centre at 07.30–09.30. On arrival, information on age, sex, marital status, education, smoking, estrogen and/or progesterone usage or hormone replacement therapy, and drugs for angina, hypertension, diabetes and dyslipidaemia were recorded by trained interviewers using the WHO MONICA questionnaire [*12*]. A 6-item food frequency questionnaire of the Behavioral Risk Factor Surveillance System was used to assess fruit and vegetable consumption [*13*]. Physical activity was evaluated through a questionnaire based on the Countrywide Integrated Noncommunicable Diseases Intervention Programme and the Behavioral Risk Factor Surveillance System documents [*10,13*]. Blood pressure was assessed twice on the right arm after a 15-minute rest in a sitting position using a standard mercury sphygmomanometer. Height and weight were measured using a stadiometer. Heavy outer garments and shoes were removed before measuring height and weight. Body mass index (BMI) was calculated. Waist circumference was measured at the midway level between the costal margins and the iliac crests. Hip circumference was measured at the level of the greater trochanters. A resting 12-lead electrocardiogram was performed.

A fasting blood sample was taken and all samples were promptly centrifuged and separated. Analyses were carried out at the Persian Gulf Health Research Centre on the day of collection using a Selectra 2 autoanalyser (Vital Scientific, Spankeren, Netherlands). Glucose was assayed by an enzymatic (glucose oxidase) colorimetric method using a commercial kit (Pars Azmun Inc., Tehran). Serum total cholesterol and HDL-cholesterol were measured using a cholesterol oxidase phenol aminoantipyrine and triglycerides using a glycerol-3 phosphate oxidase phenol aminoantipyrine enzymatic method. Serum low density lipoprotein (LDL)-cholesterol was calculated using the Friedewald formula.

Definitions

Fasting serum glucose of ≥ 126 mg/dL or use of antidiabetic measures was defined as diabetes [*14*]. Hypertension was defined according to WHO criteria (systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, or use of antihypertensive medication) [*15*].

Smoking was considered to be present when the participant smoked cigarettes or used a *shisha* (water pipe) daily. Healthy weight was defined as having BMI 18.5–24.9 kg/m^2. Overweight and obesity were defined as BMI 25.0–29.9 kg/m^2 and ≥ 30 kg/m^2 respectively. Truncal obesity was defined as waist–hip ratio ≥ 0.95 for males and ≥ 0.80 for females. Adequate fruit and vegetable consumption was defined as eating fruits or vegetables ≥ 5 times per day [*16*]. Respondents were classified as active at the recommended level if they reported sufficient physical activity of moderate intensity (≥ 30 minutes per day ≥ 5 days per week) or of vigorous intensity (≥ 20 minutes per day ≥ 3 days per week) [*17*].

The cut-off points for serum total cholesterol, HDL-cholesterol, LDL-cholesterol and serum triglycerides distributions used to assign subjects at different levels of risk were those derived from the National Cholesterol Education Program guidelines in the United States of America (Adult Treatment Panel III), September 2002 [*18*].

Electrocardiograms (ECGs) were coded on the basis of the Minnesota coding criteria [*19*]. Codes 1.1 and 1.2 were classified as myocardial infarction and codes 1.3, 4.1–4.4, 5.1–5.3 and 7.1 were classified as ischaemia. ECG with evidence of ischaemic heart disease (IHD ECG) was defined as myocardial infarction and ischaemia together.

Statistical methods

Statistical significance of any difference in the results for any 2 groups was determined by chi-squared analysis using 2 × 2 contingency tables. A 2-tailed *t*-test was used to compare mean values across groups. $P < 0.05$ was considered statistically significant.

Multiple logistic regression analysis was used to ascertain the associations between IHD ECG and unhealthy lifestyles and CVD risk factors.

For analysis of data, the sample population was divided into 4 age groups: 25–34, 35–44, 45–54, and 55–64 years. Statistical analysis was performed using the *SPSS* statistical software package, version 9.05.

Results

We approached a total of 5475 people and 3723 (46.9% males, 53.1% females) agreed to participate, a response rate of 68%. Of the studied population, 36.1% were 25–34 years, 29.1% 35–44 years, 22% 45–54 years and 12.7% 55–64 years.

Women had statistically significantly higher mean serum total cholesterol, LDL-cholesterol and HDL-cholesterol levels and significantly higher mean BMI but men had significantly higher mean triglyceride levels and diastolic and systolic blood pressure (Table 1).

Unhealthy lifestyle characteristics

An estimated 60.5% of the participants had an unhealthy body weight, only 8.3% ate the recommended amount of fruits and vegetables, 70.6% were physically inactive and 19.0% were smokers (Table 2).

Table 1 **Lipid profile, blood pressure and anthropometric measurements for adults from the northern Persian Gulf region**

Variable	Males Mean (SD)	Females Mean (SD)
Total cholesterol (mg/dL)	201.53 (52.17)	210.05 (51.52)[b]
LDL-cholesterol (mg/dL)	122.93 (51.42)	129.46 (63.53)[a]
HDL-cholesterol (mg/dL)	42.14 (44.53)	48.11 (47.60)[b]
Triglycerides (mg/dL)	182.20 (113.97)[b]	162.33 (97.85)
Diastolic blood pressure (mmHg)	82.56 (42.73)[b]	77.21 (20.64)
Systolic blood pressure (mmHg)	129.35 (43.40)[b]	121.38 (25.33)
Body mass index (kg/m^2)	25.93 (4.65)	28.44 (5.62)[b]
Waist to hip ratio	0.91 (0.12)	0.91 (0.14)
Fasting blood sugar (mg/dL)	92.09 (41.39)	93.08 (47.46)

[a]P = *0.001;* [b]P < *0.0001.*
SD = standard deviation.

Table 2 **Prevalence of unhealthy lifestyle among adults from the northern Persian Gulf region**

Variable	Males (*n* = 1746)		Females (*n* = 1977)		Total (*n* = 2723)	
	No.	%	No.	%	No.	%
Inadequate fruit & vegetable consumption	1624[a]	93.0	1790	90.5	3414	91.7
Unhealthy body weight	946	54.2	1308[b]	66.2	2254	60.5
Current smoking	436[b]	25.09	267	13.5	703	19.0
Physical inactivity	1169	67.0	1460[b]	73.8	2629	70.6

[a]P = *0.005;* [b]P < *0.0001.*

Overall, 8.1% (9.0% of males and 7.3% of females; $P > 0.05$) of adults engaged in none of these unhealthy lifestyle practices, 38.6% in 1, 40.7% in 2, 12.0% in 3, and 0.7% in all 4 (0.6% of males and 0.8% of females; $P > 0.05$).

Risk factors for CVD

Overall, 96.0% of the participants had ≥ 1 cardiovascular risk factor and 79.5% (81.9% of men and 77.6% of women) had ≥ 2 risk factors ($P < 0.0001$).

Prevalence of hypertension and cigarette smoking were statistically signi-ficantly higher among men ($P < 0.0001$), but the prevalence of obesity (including truncal obesity) was significantly higher in women ($P < 0.0001$) (Table 3).

A total of 181 (4.8%; 9.8% of men and 0.5% of women, $P < 0.0001$) were ex-cigarette smokers, and 316 (8.5%; 7.1% of men and 9.6% of women, $P < 0.0001$) were ex-shisha smokers. Only 29.6% engaged in regular physical activity. Men engaged in vigorous physical activity more than women (21.9% versus 8.9%; $P < 0.0001$); however there was no statistically significant difference for moderate intensity physical activity (20.4% for men and 21.8% for women).

Table 3 **Prevalence of cardiovascular risk factors among adults from the northern Persian Gulf region**

Variable	Males (*n* = 1746)		Females (*n* = 1977)		Total (*n* = 2723)	
	No.	%	No.	%	No.	%
Physical inactivity	1169	67.0	1460[a]	73.8	2629	70.4
Overweight	424	24.3	418	21.1	842	22.6
Obesity	158	9.0	398[a]	20.1	556	14.9
Truncal obesity	516	29.6	1780[a]	90.0	2296	61.5
Diabetes	136	7.8	174	8.8	310	8.3
Hypertension	491[a]	28.1	404	20.4	895	24.0
Smoking (cigarette)	346[a]	19.7	7	0.4	353	9.5
Smoking (shisha)	101	5.8	261[a]	13.2	362	9.7

[a]P *< 0.0001.*

Table 4 shows the distribution of serum total cholesterol and triglycerides; 51.0% had triglyceride levels < 150 mg/dL while 1.5% had ≥ 500 mg/dL. The prevalence of borderline high and high total cholesterol was 30.2% and 22.0%, respectively. High serum triglyceride was more prevalent in men than women, but high serum total cholesterol level was more prevalent in women ($P < 0.0001$ for both).

Table 4 also shows the distribution of serum LDL-cholesterol and HDL-cholesterol by sex over different levels of risk. For LDL cholesterol, 25.9% of the population were in the moderate risk range, 130–159 mg/dL; 12.6% had levels of 160–189 mg/dL; and 7.2% had levels > 190 mg/dL. High serum LDL-cholesterol was more prevalent in women than men ($P < 0.0001$). Overall, 47.9% of the participants had HDL-cholesterol levels in the high-risk range, < 40 mg/dL. This differed markedly between men, 58.5% at risk, and women, 38.5% at risk ($P < 0.001$).

Prevalence of ischaemic heart disease end points

Table 5 shows prevalence of ischaemic heart disease end points among the study participants. Myocardial infarction was determined in 53 cases (1.4%); ischaemia in 421 cases (11.3%). Prevalence of ECG with evidence of ischaemic heart disease (IHD ECG) was 12.7% (10.4% for men and 14.7% for women; $P < 0.0001$).

Association between IHD ECG and lifestyle patterns

In multiple logistic regression analysis for association between IHD ECG and lifestyle characteristics, past or present smoking [odds ratio (OR) = 1.37; 95% CI: 1.00–1.87, $P = 0.04$] and truncal obesity (OR = 1.78; 95% CI: 1.30–2.45; $P < 0.0001$) were independently associated with IHD ECGs in men, past or present smoking (OR = 1.66; 95% CI: 1.26 –2.19; $P < 0.0001$) and obesity (OR = 1.37; 95% CI: 1.04–1.81; $P = 0.02$) were also independently associated with IHD ECG in women (Table 6).

Association between IHD ECG and coronary artery risk factors

In multiple logistic regression analysis to ascertain the association between IHD ECG and coronary artery risk factors, hypertension (OR = 2.39; 95% CI: 1.73 –3.30; $P < 0.0001$) and diabetes (OR = 1.82; 95%

Table 4 **Serum levels of lipids and lipoproteins over different categories of risk for cardiovascular disease among adults from the northern Persian Gulf region**

Risk factor (mg/dL)	Males (*n* = 1746)		Females (*n* = 1977)	
	No.	%	No.	%
Triglycerides				
< 150 (normal)	818	46.8	1082	54.7
150–199 (borderline high)	355	20.3	367	18.6
200–499 (high)	534	30.6[a]	510	25.8
≥ 500 (very high)	40	2.3[a]	17	0.9
Total cholesterol				
< 200 (desirable)	899	51.5	880	44.5
200–239 (borderline high)	521	29.8	605	30.6[a]
≥ 240 (high)	327	18.7	491	24.8[a]
LDL-cholesterol				
< 100 (optimal)	486	27.9	433	21.9
100–129 (near optimal)	505	29.0	579	29.3
130–159 (borderline high)	446	25.6	517	26.2
160–189 (high)	210	12.0	258	13.1[a]
≥ 190 (very high)	92	5.3	176	8.9[a]
HDL-cholesterol (mg/dL)				
< 40 (low)	1021	58.5[a]	761	38.5
40–59 (borderline)	656	37.6	984	49.8
≥ 60 (high)	65	3.7	214	10.8

[a] *P* < 0.0001

LDL = low density lipoprotein; HDL = high density lipoprotein.

Table 5 **Prevalence of myocardial infarction, ischaemia and ischaemic electrocardiogram (ECG) in different age groups using Minnesota coding criteria among adults from the northern Persian Gulf region**

Age (years)	Males (*n* = 1746)						Females (*n* = 1977)					
	Myocardial infarction		Ischaemia		Ischaemic ECG		Myocardial Infarction		Ischaemia		Ischaemic ECG	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
25–34	7	1.1	35	5.6	42	6.7	2	0.3	67	9.3	69	9.5
35–44	6	1.2	28	5.6	34	6.8	1	0.2	71	12.2	72	12.3
45–54	7	1.9	41	11.0	48	12.9	11	2.5	75	16.9	86	19.3
55–64	14	5.5	44	17.3	58	23.3	5	2.2	60	25.9	64	28.4
Total	34	1.9	148	8.5	182	10.4	19	1.0	273	13.8[a]	291	14.7[a]

[a] P *< 0.0001 females in comparison to males.*

Table 6 **Multivariately adjusted odds ratios relating ischaemic heart disease electrocardiogram (dependent factor) with unhealthy lifestyle characteristics and cardiovascular disease (CVD) risk factors among adults from the northern Persian Gulf region**

CVD risk factor	Males (*n* = 1746)			Females (*n* = 1977)		
	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Past or present smoking	1.37	1.00–1.87	0.04	1.66	1.26–2.19	0.0001
Obesity	1.25	0.91–1.71	NS	1.37	1.04–1.81	0.02
Truncal obesity	1.78	1.30–2.45	< 0.0001	0.90	0.60–1.36	NS
Physical inactivity	1.00	0.72–1.38	NS	1.25	0.95–1.65	NS
Inadequate fruit & vegetable consumption	0.83	0.44–1.59	NS	1.24	0.82–1.86	NS
Low serum HDL-C	1.06	0.76–1.47	NS	1.55	1.17–2.05	0.002
Hypertension	2.39	1.73–3.30	< 0.0001	2.13	1.61–2.80	< 0.0001
Diabetes	1.82	1.16–2.84	0.009	2.23	1.57–3.17	< 0.0001

OR = adjusted odds ratio; CI = confidence interval; NS = not significant.
HDL-C = high density lipoprotein cholesterol.

CI: 1.16–2.84; $P = 0.009$) were associated with an independently increased risk of IHD ECG findings in men, and independent effect of diabetes (OR = 2.23; 95% CI: 1.57 –3.17; $P < 0.0001$), hypertension (OR = 2.13; 95% CI: 1.61–2.80; $P < 0.0001$) and low HDL cholesterol (OR = 1.55; 95% CI: 1.17–2.05; $P = 0.002$) on IHD ECG in women (Table 6).

Discussion

The prevalence of engaging in all 4 healthy lifestyle characteristics (healthy weight, adequate fruit and vegetable consumption, regular leisure-time physical activity and not smoking) was 0.7% in the Northern Persian Gulf. The findings in this report document the low prevalence of healthy lifestyles in this region, which is even lower than the overall American 2000 BRFSS data (only 3% of adults engaged in all 4 healthy lifestyle characteristics in Michigan) [*19*].

Only 8% of participants in our study ate the recommended amount of fruits and vegetables compared to about 25% among adults in the United States of America [*16*]. Compared with multiple 24-hour recalls or records that include fruit and vegetable intakes from mixed foods and condiments, the module that we used underestimates the proportion of adults consuming 5 or more servings of fruits and vegetables each day [*20*], however our findings of low consumption of fruits and vegetables underscore the need to develop cost-effective dietary approaches in the Persian Gulf region.

In an American report, adults aged ≥ 18 were recommended to participate in a minimum of 30 minutes of moderate-intensity physical activity on most days of the week [*21*]. The majority of people in the United States of America do not comply with this recommendation: in 2001 and 2003, more than half the adults did not participate in physical activity at the recommended level [*22*]. In comparison, only around 29% of our participants from the northern Persian Gulf reported physical activity that met or exceeded recommended levels of physical activity, using the 2002

questionnaire. This was based on self-reported data and is subject to recall bias, but the low prevalence of physical activity is consistent with the reported 70%–80% physical inactivity in a previous national study [*23*].

In the mid-1980s, the WHO MONICA Project sampled 48 populations for cardiovascular risk factors. In all but one male population (China) and in most of the female populations, 50%–75% of adults aged 35–64 years were overweight or obese [*24*]. This can lead to metabolic changes and raise the risk of noncommunicable diseases, including heart disease and type 2 diabetes [*25*]. Even in developing countries, the adverse health consequences of overweight and obesity have begun to replace undernutrition and infection as the main causes of early death and disability. In our study of adults ≥ 25 years in the northern Persian Gulf, prevalence of overweight/obesity was 37.6%.

Since the introduction of the Minnesota code, several epidemiological studies have concentrated on estimating prevalence of ECG abnormalities in a standardized way. A high prevalence of ECG-based possible ischaemia (IHD ECG) (12.3% for women and 7.5% for men) was reported from an urban population in Isfahan, central Islamic Republic of Iran [26]. We also found a high prevalence of IHD ECG in 10.4% of male and 14.7% of female participants. These rates are higher than other countries in Asia [*27–31*] and are comparable with those reported from industrialized countries [*31*]. These findings indicate that there is a high prevalence of coronary artery disease among the Northern Persian Gulf population.

A small number of population-based studies have reported the association of ischaemic findings in ECG and CVD risk factors [*30,32*]. In the Belgian study, regarding the influence of lifestyle characteristics on prevalence of ischaemia-like ECG changes, significant associations were observed for obesity and diabetes [*32*]. Electrocardiographic IHD evidences in the Japanese study were predominantly associated with blood pressure level in both sexes [30]. One of the strengths of both the present study in the northern Persian Gulf and the Belgian study was the ability to relate association of ischaemia-like ECGs with lifestyle characteristics. Our study showed that IHD ECGs evidence was predominantly associated with current and/or past smoking in both sexes, and truncal obesity in men and obesity in women. In multiple logistic regression analysis, hypertension and diabetes were independently associated with IHD ECGs in both sexes and low HDL cholesterol in women.

Our findings indicate that unhealthy lifestyle patterns for CVDs which occurs very frequently among the northern Persian Gulf population have a significant association with nonfatal ischaemic heart disease by electrocardiogram criteria.

Overall, the results of Phase 1 of the PGHHS, provide regional and province-wide prevalence data on behavioural risk factors which could be used for strategic planning in prevention of atherosclerosis at local, regional and national levels to combat the epidemic of CVD in the northern Persian Gulf region.

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