Risk factors of coronary artery disease in different regions of Saudi Arabia

A.K. Osman,* and M.M. Al-Nozha**

ABSTRACT A national nutrition survey was carried out in Saudi Arabia between 1989 and 1994. One objective was to investigate the prevalence of well-established atherogenic risk factors among adults 18 years and older, namely obesity, hypercholesterolaemia, hypertriglyceridaemia, diabetes mellitus and high systolic and diastolic blood pressure. Obesity prevalence was positively correlated with all five coronary artery disease risk factors investigated. Variation among regions in relation to the prevalence of these risk factors was observed. Saudi Arabia’s ecology has resulted in variation in the lifestyle and food consumption patterns of the people of the different regions, which might be a major underlying cause of the variation and high prevalence of coronary artery disease risk factors.

Les facteurs de risque de coronaropathies dans différentes régions d’Arabie saoudite

RESUME Une enquête nutritionnelle nationale a été réalisée en Arabie saoudite entre 1989 et 1994. Un objectif était d’enquêter sur la prévalence de facteurs de risque athéro-génètes bien établis chez les adultes de 18 ans et plus, à savoir l’obésité, l’hypercholestérolémie, l’hypertriglycéridémie, le diabète sucré et la pression artérielle systolique et diastolique élevée. Il y avait une corrélation positive entre la prévalence de l’obésité et l’ensemble des cinq facteurs de risque de coronaropathies qui faisaient l’objet de l’enquête. Une variation entre les régions en relation avec la prévalence de ces facteurs de risque a été observée. L’écologie de l’Arabie saoudite a provoqué une variation dans le mode de vie et les caractéristiques de la consommation alimentaire des habitants des différentes régions, ce qui pourrait être la cause sous-jacente majorante de la variation et de la forte prévalence des facteurs de risque des coronaropathies.

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Introduction

Hypertension, hypercholesterolaemia, diabetes mellitus, obesity and smoking are well established atherogenic risk factors. The rapid socioeconomic development during the past 3 decades in Saudi Arabia has been accompanied by drastic lifestyle changes. Diet may be one of the fundamental components of lifestyle contributing to increased risk of coronary heart disease [1]. It is evident that Saudis’ consumption of foods rich in animal protein, fat and sodium has increased [2,3]. These changes have been accompanied by the emergence of noncommunicable diseases such as coronary artery disease (CAD) and stroke.

Several hospital-based studies have shown a rise in the occurrence of angina, myocardial infarction and nephropathy [4–9]. Alwan has reported that there is a progressive increase in the occurrence of cardiovascular diseases and other noncommunicable diseases in the Eastern Mediterranean Region, and Saudi Arabia is no exception [10]. Community-based studies, although few, reveal the high prevalence of obesity (13.05% and 20.20% among males and females respectively), increasing with age [11]. Data from primary health care clinics have shown that obesity was found among 32.8% [12] and 25% [13] of attendees. Hypercholesterolaemia and hypertriglyceridaemia were reported among 9.5% and 5% among those attenders respectively [12]. The overall prevalence rates of diabetes mellitus and impaired glucose tolerance in Saudi Arabia have been reported to be 17.3% and 1.3% respectively in males and 12.18% and 2.2% respectively in females 30 years and older [14]. The prevalence of hypertension (≥ 140/90 mmHg) among Saudis of both sexes aged 18 years and older has been reported to be 20.4% for systolic blood pressure hypertension (SBPH) and 25.9% for diastolic blood pressure hypertension (DBPH), which is similar to rates reported in Western societies [15].

The prevalence rates of these CAD risk factors in neighbouring countries are also alarming. In Bahrain, overweight and obesity affect 79% of females and 56% of males aged 30–79 years [16]. In the United Arab Emirates, the prevalence of obesity among adults aged 30–64 years has been reported to be 27%, with women more affected. SBPH (≥ 140 mmHg) has been detected in 19%–25% of all participants and diabetes mellitus affected 11% of males and 7% of females [17]. The proportionate mortality rate for cardiovascular disease in Kuwait is 37% [18].

As Saudi Arabia has a diverse ecology, the aim of our study was to determine the prevalence of CAD cluster risk factors and to examine if there was any regional variation.

Participants and methods

A national nutrition survey was carried out from 1989 to 1994 [3]. The information was collected through a community-based study. The study employed geographic and demographic stratification of the population and a cluster sampling method, and households selected were visited by trained health teams. Age, sex, socioeconomic status, occupation and family history of disease were recorded. Physical examination, including clinical examination, anthropometric measurements and signs of malnutrition (as well as nutritional background) was carried out. Blood pressure, total serum cholesterol (TC), fasting blood sugar (FBG) and triglycerides (TG) were measured. A total of 19,598 individuals were examined within 2837 households in 12 regions of Saudi Arabia. Participants were se-
lected randomly according to the density of population in each region.

Complete data were recorded for 13,700 individuals of all ages. A total of 6253 adults were selected and the sample was categorized in age groups of 18—< 21, 21—< 31, 31—< 40 and > 40 years. There were 2673 men and 3590 women.

Body mass index (BMI) is a valid and reliable measure for obesity in adults over age 18 years. Those under this age group will be reported separately. Only factors known to be well established CAD risk factors (except for smoking) were studied. Because smoking is socially and religiously unacceptable, the data collected could not be validated and were therefore excluded.

**Anthropometric measurements**

Weight was measured by precision dial scale (Seca Optima/Seca Medica 761). Participants were weighed in light clothing as far as possible and without shoes. Weight was recorded to the nearest 0.1 kg. The scales were calibrated before use in each household. Height was measured by Seca scale (Model 220). Individuals were measured barefoot and standing erect, with feet together and head against the measuring rod, looking straight ahead, with arms hanging loosely at the sides and palms facing thighs. The reading was recorded to the nearest 0.5 cm.

BMI is used as a measure of fatness [19]. It is calculated as: BMI = weight (kg)/height² (m²)

**Blood pressure**

Blood pressure was measured by primary health care physicians with extensive training. Cross-check quality control procedures were used to ensure the validity of the data throughout the country.

In systolic blood pressure measurements, the first Korotkoff phase (K1) was used, defined as the appearance of two consecutive beats. For diastolic blood pressure, the fifth Korotkoff phase (K5) was used, defined as the last beat before the disappearance of the sound. Participants were seated and the right arm was placed on the tabletop. The appropriate cuff size was used. A standard sphygmomanometer was used to determine the pressure necessary to obliterate the radial pulse. Blood pressure was measured to the nearest even number. Three blood pressure measurements were taken with a minimum of 30 seconds rest between each determination, and the values were used for calculation of the mean blood pressure.

**Blood samples**

Participants were instructed to come to the health centre in the vicinity of their homes in the morning after overnight fasting for 12 hours. At the centre, 5 mL of blood were withdrawn by venipuncture from the antecubital vein and collected in silicon-coated plain tubes. After 1 hour, the serum was separated by centrifugation using a Beckman centrifuge (model TJ-6) at 3000 rpm for 10 minutes. The sera were then separated and stored at −20°C in each of the health centres. Once the study area was covered, all the samples were collected from all the health centres and were flown in insulated boxes containing ice to the central survey laboratory in Riyadh. Once delivered, they were immediately stored at −20°C until used for serum TC and TG estimation.

Serum TC was estimated by an enzymatic colorimetric test in duplicate [20] using a cholesterol estimation kit 61 774 (BioMérieux, France). A subsample of 2451 individuals was tested for serum cholesterol level.

Serum TG was estimated by the method of Fossati and Pincipe in duplicate [21] using kit 62 236 (BioMérieux, France).
subsample of 2243 was tested for serum TG.

FBS was measured using haemoglu-
cotest strips and a Reflotrex glucometer
(Boehringer Mannheim) in a subsample of
2861 individuals.

**Definitions**
The following definitions were used.

* Arterial hypertension = systolic blood
  pressure ≥ 140 mmHg (SBPH) and diastolic
  blood pressure ≥ 90 mmHg (DBPH)
* Obesity = BMI ≥ 30 kg/m²
* Hypertriglyceridaemia = TG ≥ 150 mg/
dL
* Hypercholesterolaemia = TC ≥ 200 mg/
dL
* Diabetes mellitus = FBS ≥ 126 mg/dL
  [22,23].

**Statistical analysis**
All analyses were performed with GLM
procedure of Statistical Analyses System
(Cary, North Carolina, United States of
America). Chi-squared test was used for
testing the significance of the difference in
percentages of BMI, TC, TG, DBPH and
SBPH and FBS in the different regions.
Values for these parameters were extracted
from a subsample of 2056 individuals and
were used to test the correlation between
these parameters. Values of $P < 0.05$ were
considered to be statistically significant.

**Results**

Table 1 shows the prevalence (%) of obesity,
SBPH and DBPH in the different regions. The prevalence of obesity ranged
from 33.9% in Hail to 11.7% in Jizan with
an overall prevalence rate of 20.8%. Mecca
had the highest prevalence of SBPH
(27.9%) and the lowest was reported from
Jizan (17.0%). Al-Taif had the highest prev-
ance of DBPH (36.2%), and Mecca
(22.0%), Riyadh (22.1%) and Asir (22.1%)
had the lowest. The overall prevalence of
high blood pressure among the population
was 20.4% and 25.9% for SBPH and
DBPH respectively.

Table 2 shows total serum hyper-
cholesterolaemia, hypertriglyceridaemia
and diabetes mellitus among populations of
the different regions. The highest prev-
ance of hypercholesterolaemia (58.2%)
was recorded in Hail and the lowest in Asir
(27.7%), with overall prevalence of 35.4%.
Al-Qassim had the highest prevalence of
hypertriglyceridaemia (65.4%) and the
lowest was reported from Jizan (28.7%),
with an overall prevalence of 49.6%. Di-
abetes mellitus prevalence ranged from
23.2% in Al-Sharqia to 4.5% in Farasan,
with an overall prevalence of 13.2%.

There were statistically significant dif-
ferences between the regions in relation to
obesity, hypercholesterolaemia, hypertrig-
lyceridaemia, SBPH and DBPH and diabe-
tes mellitus (Tables 1 and 2).

Table 3 shows that the prevalence of
obesity for all adults increased significantly
($P < 0.001$) with age in all regions except
for males in Hail and Jeddah and both sexes
in Al-Sharqia, Farasan and Tabouk. In all
regions, the prevalence was significantly
higher in females of every age ($P < 0.001$, $P
< 0.02$ and $P < 0.05$) than males, with the
exception of Tabouk. Al-Sharqia and Jed-
dah where the differences were not signifi-
cant. However, the prevalence of obesity
throughout all regions increased signifi-
cantly with age for both sexes ($P < 0.001$),
with overall prevalence rates of 15.6% and
24.9% among males and females respect-
ively.

Table 4 shows the correlation of BMI
with TC, TG, SBPH, DBPH and FBS. All
five variables were positively correlated with BMI. Pearson correlation coefficient (r) and P-value for BMI versus TC, TG, SBPH, DBPH and FBS were 0.210 (P < 0.0001), 0.196 (P < 0.0001), 0.216 (P < 0.0001), 0.235 (P < 0.0001) and 0.214 (P < 0.001) respectively.

**Discussion**

The present study shows that the cluster of CAD risk factors was highly prevalent among the people of Saudi Arabia. Reports from hospital-based studies show a high prevalence of obesity, hypertriglyceridaemia, hypertension and diabetes mellitus. Similar findings have been reported in a few isolated community-based studies [11–14]. Several studies have shown that the prevalence of arterial hypertension in Saudis is relatively high among the middle-aged population and that females are more affected than males [24–26]. Reports from neighbouring Arab states show similar alarming rates [16–18]. Sedentary lifestyle has been reported to be a causative factor for the high prevalence rates of obesity, hypertension and diabetes mellitus in Bahrain [16].

We also found regional variations in the prevalence of CAD risk factors. Hail had the highest prevalence of obesity (33.9%) and hypercholesterolaemia (58.2%). Al-Qassim had the highest prevalence of hy-

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**Table 1** Prevalence (%) of obesity, diastolic hypertension (DBPH) and systolic hypertension (SBPH) by region

<table>
<thead>
<tr>
<th>Region</th>
<th>Obesity BMI ≥ 30 kg/m²</th>
<th>DBPH DBP ≥ 90 mmHg</th>
<th>SBPH SBP ≥ 140 mmHg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total no.</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Al-Qassim</td>
<td>396</td>
<td>105</td>
<td>26.5</td>
</tr>
<tr>
<td>Riyadh</td>
<td>1238</td>
<td>268</td>
<td>21.7</td>
</tr>
<tr>
<td>Hail</td>
<td>357</td>
<td>121</td>
<td>33.9</td>
</tr>
<tr>
<td>Tabouk</td>
<td>234</td>
<td>59</td>
<td>25.20</td>
</tr>
<tr>
<td>Al-Sharqia</td>
<td>477</td>
<td>132</td>
<td>27.7</td>
</tr>
<tr>
<td>Jizan</td>
<td>435</td>
<td>51</td>
<td>11.7</td>
</tr>
<tr>
<td>Aseir</td>
<td>902</td>
<td>146</td>
<td>16.2</td>
</tr>
<tr>
<td>Medina</td>
<td>570</td>
<td>86</td>
<td>15.1</td>
</tr>
<tr>
<td>Al-Taif</td>
<td>640</td>
<td>153</td>
<td>23.9</td>
</tr>
<tr>
<td>Mecca</td>
<td>519</td>
<td>100</td>
<td>19.3</td>
</tr>
<tr>
<td>Jeddah</td>
<td>372</td>
<td>61</td>
<td>16.4</td>
</tr>
<tr>
<td>Faraeen</td>
<td>70</td>
<td>11</td>
<td>15.7</td>
</tr>
<tr>
<td>Total</td>
<td>6210</td>
<td>1293</td>
<td>20.8</td>
</tr>
</tbody>
</table>

P-value* < 0.001 < 0.001 < 0.001

*Chi-squared, the significance of the differences of percentage of obesity, DBPH, SBPH among the regions
hypertriglyceridaemia (65.4%). Jizan and Asir had among the lowest prevalence rates for the cluster of CAD risk factors. Al-Sharqia had the highest prevalence rate for diabetes mellitus (23.2%) and the second-highest prevalence rates for obesity (27.7%) and hypercholesterolaemia (54.2%). Traditional consanguinity and a genetic basis [27] could partly explain the high prevalence of diabetes mellitus and obesity in this region.

The ecology of Saudi Arabia ranges from inland desert to temperate highlands in the south-west, lowlands in the south and coastal regions in the east, south and west. The people of these regions differ in relation to ethnicity, climatic conditions, eating habits and socioeconomic status. Variations in the prevalence rates of major CAD risk factors among and within populations by sex, ethnicity, social class and geographic regions have also been reported in the WHO/MONICA project [26].

Our study shows that BMI was positively correlated with TC, TG, blood pressure and FBS. It is clear from this that obesity, which is a reflection of lifestyle and food consumption patterns, might contribute to the high prevalence rates for hypertension,

Table 2 Prevalence (%) of hypercholesterolaemia, hypertriglyceridaemia and hyperglycaemia by region

<table>
<thead>
<tr>
<th>Region</th>
<th>Hypercholesterolaemia</th>
<th>Hypertriglyceridaemia</th>
<th>Hyperglycaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TC ≥ 200 mg/dL</td>
<td>Gt ≥ 150 mg/dL</td>
<td>FBS ≥ 126 mg/dL</td>
</tr>
<tr>
<td></td>
<td>Total no.</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Al-Qassim</td>
<td>184</td>
<td>60</td>
<td>32.6</td>
</tr>
<tr>
<td>Riyadh</td>
<td>315</td>
<td>89</td>
<td>28.2</td>
</tr>
<tr>
<td>Hail</td>
<td>55</td>
<td>32</td>
<td>58.2</td>
</tr>
<tr>
<td>Tabouk</td>
<td>39</td>
<td>14</td>
<td>35.9</td>
</tr>
<tr>
<td>Al-Sharqia</td>
<td>155</td>
<td>84</td>
<td>54.2</td>
</tr>
<tr>
<td>Jizan</td>
<td>192</td>
<td>64</td>
<td>33.3</td>
</tr>
<tr>
<td>Asir</td>
<td>372</td>
<td>103</td>
<td>27.7</td>
</tr>
<tr>
<td>Medina</td>
<td>257</td>
<td>60</td>
<td>27.9</td>
</tr>
<tr>
<td>Al-Taif</td>
<td>338</td>
<td>150</td>
<td>44.4</td>
</tr>
<tr>
<td>Mecca</td>
<td>384</td>
<td>147</td>
<td>38.3</td>
</tr>
<tr>
<td>Jeddah</td>
<td>45</td>
<td>16</td>
<td>35.6</td>
</tr>
<tr>
<td>Farasan</td>
<td>85</td>
<td>29</td>
<td>34.1</td>
</tr>
<tr>
<td>Total</td>
<td>2451</td>
<td>600</td>
<td>05.4</td>
</tr>
</tbody>
</table>

P-value* < 0.001 < 0.001 < 0.001

*Chi-squared, the significance of the differences of percentage of hypercholesterolaemia, hypertriglyceridaemia and hyperglycaemia among the regions

TC = total serum cholesterol
TG = triglycerides
FBS = fasting blood sugar
Table 3 Prevalence of obesity (%) (BMI ≥ 30 kg/m²) by age and sex in the different regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Age (years)</th>
<th>All ages</th>
<th>P-value for all ages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Qassim</td>
<td>14.2,13.3</td>
<td>11.5,25.4</td>
<td>27.7,36.7</td>
</tr>
<tr>
<td>Riyadh</td>
<td>5.4,15.0</td>
<td>9.9,23.3</td>
<td>16.3,42.8</td>
</tr>
<tr>
<td>Jeddah</td>
<td>21.3,24.3</td>
<td>17.4,26.0</td>
<td>27.6,39.9</td>
</tr>
<tr>
<td>Tawouk</td>
<td>11.1,5.8</td>
<td>14.3,24.4</td>
<td>31.0,38.1</td>
</tr>
<tr>
<td>Al-Sharqia</td>
<td>8.6,19.9</td>
<td>21.3,21.5</td>
<td>32.5,43.2</td>
</tr>
<tr>
<td>Jizan</td>
<td>9.5,7.7</td>
<td>3.2,10.7</td>
<td>7.4,22.6</td>
</tr>
<tr>
<td>Asir</td>
<td>4.8,2.7</td>
<td>6.6,15.1</td>
<td>26.2,31.6</td>
</tr>
<tr>
<td>Medina</td>
<td>3.6,6.4</td>
<td>6.6,16.6</td>
<td>14.2,24.6</td>
</tr>
<tr>
<td>Al-Taif</td>
<td>2.7,10.3</td>
<td>5.9,23.0</td>
<td>17.4,46.2</td>
</tr>
<tr>
<td>Mecca</td>
<td>9.4,10.3</td>
<td>13.7,16.5</td>
<td>14.8,30.8</td>
</tr>
<tr>
<td>Jeddah</td>
<td>14.3,11.1</td>
<td>17.1,11.4</td>
<td>13.0,25.2</td>
</tr>
<tr>
<td>Farasan</td>
<td>0,0</td>
<td>0,30.7</td>
<td>11.1,28.5</td>
</tr>
<tr>
<td>All regions</td>
<td>9.0,16.5</td>
<td>10.4,22.1</td>
<td>20.7,32.7</td>
</tr>
</tbody>
</table>

*Significant increase with age within the same sex (P < 0.001)
⁺No significant difference within the same sex
M = males  F = females
NS = not significant

Table 4 Pearson correlation coefficient (r) of BMI with TC, TG, SBP, DBP and FBS

<table>
<thead>
<tr>
<th></th>
<th>BMI ≥ 30 kg/m²</th>
<th>TC ≥ 200 mg/dL</th>
<th>TG ≥ 150 mg/dL</th>
<th>SBP ≥ 140 mmHg</th>
<th>DBP ≥ 90 mmHg</th>
<th>FBS ≥ 126 mg/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td>0.210⁺</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TG</td>
<td>0.196**</td>
<td>0.376**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBPH</td>
<td>0.216**</td>
<td>0.184**</td>
<td>0.169⁺</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDBPH</td>
<td>0.006**</td>
<td>0.195**</td>
<td>0.100⁺</td>
<td>0.095**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FBS</td>
<td>0.214**</td>
<td>0.255⁺</td>
<td>0.218⁺</td>
<td>0.231⁺</td>
<td>0.212⁺</td>
<td>1</td>
</tr>
</tbody>
</table>

*P < 0.001
⁺Not significant
BMI = body mass index  TC = serum total cholesterol
TG = triglycerides     SBP = systolic blood pressure
DBP = diastolic blood pressure  FBS = fasting blood sugar
hypercholesterolaemia and hypertriglyceridaemia. It also shows that the prevalence of obesity increased significantly with age in males in seven regions and in females in nine regions, with females more affected. Diabetes mellitus followed the same pattern as obesity. This is in agreement with Kaplan, who noted that obesity leads to glucose intolerance and hyperinsulinaemia, which in turn precipitate hypertension and dyslipidaemia [28]. However, Reaven noted that increases in both plasma catecholamines and renal tubular reabsorption of sodium and water can be seen in response to hyperinsulinaemia and that either may lead to an increase in blood pressure [29]. Al-Nozha et al. reported a high dietary sodium intake among Saudis [2]. This may also predispose to hypertension among those sensitive to sodium.

Almost 50% of the population in our study had hypertriglyceridaemia. Al-Kanhal and Osman showed that fat consumption among Saudis had increased from 40 g per capita per day in 1971 to 121 g per capita per day in 1992, providing 39.6% of the total energy intake [30]. Miller suggested that dietary fat might influence both the atherosclerotic and thrombogenic components of coronary heart disease [31]. Factor VII coagulant activity (VIIIC) is a risk factor for coronary heart disease and it is positively associated with dietary fat intake suggesting that fat-rich diets are accompanied by hypercoagulable state. However, he showed that reduction in total fat consumption is followed by a decrease in VIIIC within 24 hours. Serum TC is an indicator of low-density lipoprotein cholesterol (LDL-C). Growing evidence suggests that oxidative modification of LDL may be of particular importance in atherogenesis as oxidized LDL has been shown to be cytotoxic. Therefore inhibiting LDL oxidation will ultimately inhibit the atherosclerotic process. One such approach is to enhance the endogenous antioxidant defence system within the LDL particle with lipophilic antioxidants such as vitamin E and beta-carotene or supplementing the aqueous phase antioxidant capacity with ascorbic acid [32]. It is well established that nutrition plays an important role in the prevention of conventional atherogenic risk factors such as obesity, diabetes mellitus and hyperlipidaemia.

The national nutrition survey [3] showed that the daily energy intake in Jizan was 3174 kcal per capita with 36.4% derived from fat. In Al-Qassim it was 2782 kcal and 35.4% respectively. In spite of the similar fat contributions to total daily energy intake, the prevalence of obesity and hypertriglyceridaemia was lowest in Jizan compared with all other regions. Al-Qassim residents are primarily engaged in trade and government administrative jobs, while fishing and farming are the two most common occupations in Jizan. Fish and vegetable consumption is very frequent in the latter while very rare in Al-Qassim [3].

Bainton et al. [33] showed that plasma TG concentration predicted major ischaemic events after adjustment was made for TC and high-density lipoprotein cholesterol and other risk factors. Fish oil has a lowering effect on TG and this is generally accepted to be associated with hepatic output of very-low-density lipoproteins in humans [34] and consequently a low plasma level of low-density lipoproteins. This might explain the lower prevalence of hypertriglyceridaemia in Jizan.

**Conclusion**

Lifestyle, particularly eating habits, seems to be the main underlying cause of the CAD
risk factors we investigated. Therefore, a comprehensive understanding of the pathogenesis of CAD risk factors in the regions as well as the mechanisms of nutrients interaction and energy expenditure are essential prerequisites for planning successful nutrition intervention strategies for primordial and primary prevention and control of CAD.

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References


