

# BAHRAIN MEDICAL BULLETIN

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*G Harvey Anderson*



## SPECIAL ISSUE

*Proceedings of workshop on  
Diet, Nutrition and  
Healthy Lifestyle in the  
Gulf Cooperation Council (GCC)  
Countries  
Manama - Bahrain  
6-8 December 1997*

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## BAHRAIN MEDICAL BULLETIN

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To encourage scientific research the Editors of the *Bahrain Medical Bulletin* also organises periodic workshops on research methodologies and related aspects as well as courses on writing and editing. A Research Advisory Panel has also been established to help investigators planning their research works. Social integration is maintained through regular lectures and seminars on subjects of public interest.

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The Editorial Board of the *Bahrain Medical Bulletin* welcomes works in the field of biomedical, clinical and other health related sciences.

**Manuscript Preparation:** Submitted manuscripts should be divided into sections each of which should be started on a new page. The sequences of heading should be as follows: title page, abstract, introduction, methods, results, discussion, conclusions, acknowledgements, references, tables, figures, captions, and legends to illustrations. Four copies of the complete article including all tables, and figures are required along with a covering letter requesting publication and authorising exclusive copyrights.

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**Discussion:** Provide implication and interpretation of findings and their limitations. Relate observations to relevant study and present status of knowledge. Do not repeat data from introduction or findings from the results section unless warranted. Avoid

lengthy literature review.

Unqualified statements must be supported by references. Link conclusions to goals of study. Affirm the "message" of the paper in the final paragraph.

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**Acknowledgement:** Only the names of persons whose contribution is not directly related to their job need to be acknowledged.

**References:** Include only retrievable up to data works directly related to the study. Number references consecutively in the order in which they are first mentioned in the text. Identify references in text, tables, and legends by Arabic numerals. Unpublished and personal observations are not accepted. Journal title abbreviations should follow the practices of *Index Medicus*. The Vancouver style to be used as shown in the sample below:

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**Book:** Stephen WJ. Primary health care in the Arab world. England: Somerset House, 1992:42-59.

**Chapter in Book:** Norman ME. Metabolic bone diseases. In: Behrman RE, Kleigman RM, Nelson WE, et al, eds. *Nelson Textbook of Pediatrics*. 14th ed. Philadelphia: WB Saunders Co, 1992:130-46.

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## EDITORIAL

Abdulrahman O. Musaiger, DrPH\*

The Arab Gulf Cooperation Council (GCC) countries have experienced dramatic changes in socio-economic status, dietary habits and lifestyle during the past three decades. These changes have led to a paradoxical situation, as both types of nutritional problems exist: those associated with affluence such as obesity, diabetes mellitus, cardiovascular disease, hypertension and cancer and those associated with underdevelopment such as growth retardation and iron deficiency anaemia. The GCC countries are, thus, facing a great challenge to prevent and control of these diet-related diseases. Lack of data as well as appropriate preventive programmes are considered the main obstacles to establish a plan of action to overcome these diseases.

The objectives of this workshop, therefore, are:

1. To review the current nutrition knowledge, status of nutrition and diet-related diseases in the GCC countries.
2. To identify the major diet and lifestyle-related risk factors for chronic diseases in the GCC countries.
3. To suggest recommendations to prevent and control diet-related diseases in the GCC countries.
4. To promote public awareness of nutrition and healthy lifestyles.
5. To exchange knowledge and experience among health and nutrition professionals in the Gulf.

### The Programme

International speakers and representatives from Gulf Cooperation Council (GCC) Countries participated in this workshop. The programme consisted of six sessions. The first session focused on the state of food, nutrition and diseases in the Arab and Gulf countries. The second session dealt with technical papers on the role of carbohydrates, fat and physical activity in the occurrence of chronic non-communicable diseases. The third session concentrated on the nutrition of pregnant women, adolescent girls, infants and young children in the GCC countries.

Case studies in the GCC countries were presented in the fourth session. This included case studies in Bahrain, Qatar, S. Arabia and the United Arab Emirates. The fifth session aimed to focus on programmes and actions to prevent and control nutritional problems. In the sixth sessions the participants were divided into two groups. The first group discussed actions needed to establish dietary guidelines, while the second group discussed actions needed to promote a healthy lifestyle and to prevent and control diet-related chronic non-communicable diseases.

### Recommendations

#### A. Actions needed to establish Food-Based Dietary Guidelines (FBDG)

1. The first step is to determine the purpose and goals for establishing FBDG.
2. Determine the critical health and nutrition problems in the region. This can be done through collecting and compiling the available data.
3. Collecting information on food consumption patterns in the region. This can be obtained from household budget surveys and other studies on food habits. Data on dietary intake by age and sex are more valuable to establish FBDG.
4. Establishing a committee consisting of members from governmental and non-governmental organizations as well as private sectors, to review and assess the available data on food, nutrition and health in the region.
5. The target groups and the message should be clearly defined.
6. A workshop on establishing FBDG then should be organized. The participants should be from all GCC countries, international organizations and private sectors.
7. Comprehensive and in-depth studies on food composition tables and dietary intake in the GCC countries are highly recommended.

#### B. Actions needed to promote healthy lifestyles

##### 1. Some problems facing the establishment of programmes to promote healthy lifestyles in the region:

- Representatives on the committees are not always multisectorial.
- Co-chairmanship of committees is lacking.
- Committee members are not always highly motivated.

##### 2. Responsibility for promoting healthy lifestyles:

A supreme board or committee on healthy lifestyles should be established. Such a structure should:

- Have political commitment and support at the highest level.
- Be multisectorial.
- Have an executive office with secretariat for implementation and follow up.

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- Include representatives of the Government Ministries of health, education, higher education, information, agriculture, industry, religious affairs, sports as well as NGO's, private sector and the community.

The Ministry of Health should lead the initiative to attain the political support and commitment necessary to establish the committee or the board, in each country.

### 3. Steps needed to establish the programme:

- Expand the responsibilities of existing health education department to become those of health promotion and protection.
- Reliable and accurate situation analysis including epidemiological data on risk factors, chronic diseases and health behaviour, available services and economic impact of these diseases.
- Dissemination of epidemiological information to policy makers.

- Developing a national policy on healthy lifestyles and a national action plan based on policy. This plan should have measurable targets set for achievements within the time frame and an evaluation component.

### 4. Main issues needed to be included in the programme:

- Developing a national plan for food and nutrition with special emphasis on healthy eating.
- Developing a national plan on control of tobacco and substance abuse.
- Developing a national plan on physical activity.
- Developing a national plan on injury prevention.
- Developing a national plan on sexual behaviour.
- Revision of school health curricula.
- Mobilizing the community to support healthy lifestyles.

## Carbohydrate, Behaviour and Health

G Harvey Anderson, PhD\*

The ingestion of all forms of dietary carbohydrate confers benefits to human behaviour and health. Dietary carbohydrate is an essential component of healthy diets. It is a macronutrient that not only provides energy, but also serves as an important regulator of the nervous system of human behaviours and of metabolism. Carbohydrate ingestion affects the nervous system through its provision of glucose and energy source and by its effect on neurotransmitter synthesis in the brain and by activation of the sympathetic nervous system. As a result, carbohydrate ingestion has a positive effect on several human behaviours, including appetite, sleep, activity, mood, cognition and physical performance. Through their effects on metabolism, high carbohydrate diets, compared with high fat diets, are generally associated with lower risk of chronic diseases, including obesity, diabetes, cancer and heart disease. An exception is dental caries which, in the absence of fluoridated water and attention to oral hygiene are increased by consumption of fermentable carbohydrate.

Dietary advice on carbohydrate should recognise the health benefits of all carbohydrate foods including those containing sugars, oligosaccharides and polysaccharides. An optimum diet contains at least 55% of total energy from carbohydrates, the sources of which may be selected, at least in part, on the basis of their glycemic index.

*Bahrain Med Bull 1998;20(3): 69-76*

Carbohydrate is the single most important source of food energy in the world, making up 40% to 80% of total food energy, depending on the cultural and economic status of the people. Carbohydrate includes, polyhydroxy aldehydes, ketones, alcohols, acids, their simple derivatives and their polymers having linkages of the acetal type. These are classified according to their degree of polymerization and may be divided into three principal groups, namely sugars, oligosaccharides and polysaccharides (Table 1).

Each of these three groups may be subdivided. Sugars may be monosaccharides, disaccharides, or polyols (sugar alcohols). Oligosaccharides include malto-oligosaccharides, principally those occurring from the hydrolysis of starch, and other oligosaccharides such as alpha-galactosides

(raffinose, stachyose, etc) and fructo-oligosaccharides. Polysaccharides are divided into starch (alpha-glucans) and non-starch polysaccharides (NSP), of which the major components are the polysaccharides of the plant cell wall such as cellulose, hemicellulose, and pectin.

The ingestion of all forms of dietary carbohydrate confers benefit to human behaviour and health. It is an essential component of healthy diets. It provides energy and is an important regulator of the nervous system, of behaviours, and of metabolism. Carbohydrate foods bring with them a wide array of essential nutrients and metabolically active substances important to the maintenance of health and prevention of diseases.

Table 1. The major dietary carbohydrates<sup>66</sup>

Class	Subgroup	Components
Sugars (1-2)#	Monosaccharides	Glucose, Galactose, Fructose
	Disaccharides	Sucrose, Lactose, Trehalose
	Polyols	Sorbitol, Mannitol
Oligosaccharides (3-9)#	Malto-oligosaccharides	Maltodextrins
	Other oligosaccharides	Raffinose, Stachyose, Fructo-oligosaccharides
Polysaccharides (>9)#	Starch	Amylose, Amylopectin, Modified Starches
	Non-Starch Polysaccharides	Cellulose, Hemicellulose, Pectins, Hydrocolloids

# Degree of polymerization

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## Carbohydrate and the Nervous System

During digestion and absorption, dietary carbohydrate produces glucose, which is essential to the normal functioning of the nervous system<sup>1</sup>. The nervous system depends on glucose as its major energy source. From the ingestion and metabolism of carbohydrate, the nervous system receives information that may influence brain neurotransmitter synthesis and function, and activate neuroregulatory process.

Carbohydrate ingestion has a positive effect on several human behaviours, including appetite, sleep, activity, mood and cognition and physical performance. Studies of carbohydrate and behaviour show that its effects are often subtle and hard to measure, but overall the conclusion is that its effect on behaviour is significant. Following is a review of the mechanisms by which carbohydrate affects the nervous system and behaviours.

### Carbohydrate as Energy Substrate

The brain has a very high metabolic activity relative to most other body organs. Although it comprises only 2% of adult body weight, it receives 15% of cardiac output and accounts for 20-30% of whole body resting metabolic rate. In a premature infant, up to 60% of the whole body resting metabolic rate may be due to the metabolic activity of the brain<sup>2</sup>. The respiratory quotient of the brain is 0.97, and since its glycogen store is only 0.1% of its weight, the brain depends on a continuous supply of oxygen and glucose to meet its high energy demands. The metabolic energy derived from glucose oxidation provides power for the brain's unceasing electrical activity, of which the main function is excitation and conduction.

In human infants, rates of cerebral energy metabolism and blood flow are associated during brain development, with the highest rates occurring during the period of active brain growth<sup>3</sup>. In five-week-old infants, cerebral glucose utilization is already at 71-93% of adult levels in most brain regions. Adult levels of cerebral glucose utilization are reached by two years of age. They continue to increase, however, until the child is three or four years old and are maintained until about nine years, at which time they begin to decline, returning to adult levels by 20 years of age. The high levels of brain energy metabolism in the first decade are due to the brain's basal energy needs as well as the biosynthetic requirements for the active maturational processes. The child's cognitive development is related to changes in blood flow in the different brain regions<sup>3</sup>.

Blood glucose in the normal individual may fluctuate over a relatively wide range without evidence of neurological consequences, because cerebral energy metabolism is not affected. When plasma arterial concentration falls from a normal level of 6-7 mmol/L to about 2.5-3 mmol/L, cerebral glucose content decreases in a directly proportional manner to whole blood glucose concentration; however cerebral energy metabolism remains the same. Below 2.5 mmol/L, glucose transport into the brain is diminished to a point where brain glucose no longer saturates hexokinase; it becomes rate-limiting and insufficient to support brain energy metabolism<sup>3</sup>.

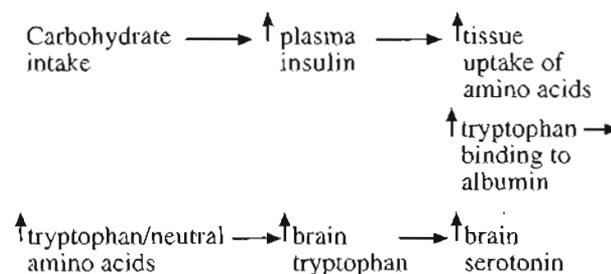
Under normal conditions, physiological and endocrine factors control blood glucose within narrow ranges in the normal

individual, both after a meal and in the absence of food, ensuring that the brain has available an excess of this critical nutrient. The availability of blood glucose may be modified, however, by endocrine disturbances (eg. diabetes) or with aging, when fluctuations in dietary carbohydrate intake and blood glucose levels affect the availability of glucose as an energy substrate.

### Carbohydrate and Brain Neurochemistry

In the early 1970s, it was shown that carbohydrate consumption by rats resulted in an increase in the synthesis of the brain neurotransmitter 5-hydroxy-tryptamine, or serotonin<sup>4</sup>. This observation provided a physiological mechanism linking carbohydrate consumption to behaviour. Serotonin is a neurotransmitter known to regulate many behaviours, including appetite, sleep and mood.

The effect of carbohydrate consumption on brain serotonin is explained primarily by the digestion of carbohydrate to glucose and the resulting release of insulin as summarised below:



In animal species such as the rat and probably man, the transport Km of the blood-brain-barrier carrier system is approximately equal to the plasma amino acid concentration. Thus, competition among plasma amino acids is the primary determinant of the relative rate of uptake of each amino acid<sup>5</sup>. For this reason, a relative increase in transport of tryptophan into the brain will occur only if its concentration in plasma has increased relative to its competitors. Conversely, if there is a large increase in the concentration of other large neutral amino acids, as occurs when protein is consumed, the increase in plasma tryptophan is relatively small and the brain uptake of tryptophan decreases.

Carbohydrate consumption increases brain synthesis of serotonin, because it provides an increased brain uptake of tryptophan. Under usual brain concentrations of tryptophan, the enzyme converting tryptophan to serotonin is not fully saturated by the substrate. With diet-induced shifts in the availability of tryptophan, synthesis of serotonin is affected.

### Carbohydrate and the Sympathetic Nervous System

The effect of carbohydrate on the brain is also reflected in the sympathetic nervous system (SNS)<sup>1</sup>. This system regulates many vegetative processes, including blood flow, blood pressure, activity of visceral smooth muscle and glands, and metabolic reactions. Regulation achieved via the SNS occurs as a result of its direct innervation of most body tissues and its communication at these sites through the release of norepinephrine (NE), which exerts physiological and metabolic effects.

Of the three macronutrients, carbohydrate appears to have the strongest influence on SNS activity. Plasma NE levels increase following a meal of glucose but not after a meal of protein or fat<sup>6</sup>. In humans, about one-third of the observed rise in resting metabolic rate (RMR) during glucose infusion can be accounted for by an increase in SNS activity<sup>7</sup>.

### Carbohydrate, Behaviour and Performance

Normal meals have definite effects on mood and performance in humans. The composition of a meal, for example, protein or carbohydrate content, influences these behaviours<sup>8</sup>. These effects have usually been attributed to altered serotonin function, because protein and carbohydrate have been found to affect brain serotonin in rats<sup>9</sup>. Although it is difficult to prove, whether serotonin accounts for the acute effects of these two macronutrients in humans<sup>8</sup>, the effects of carbohydrate consumption on behaviour are clear. They can be illustrated by examining its effect on appetite, sleep, mood and cognition, hyperactivity and physical performance.

#### Appetite Control

Carbohydrate foods, including those containing simple sugars, are easily recognised by the body as a source of calories and their ingestion leads to decreased appetite<sup>10,11</sup>. In general, carbohydrates are more satiating than fats, but less so than protein<sup>12</sup>.

Carbohydrates in the form of glucose, fructose, sucrose (table sugar), maltodextrins and starch, when given to humans in preloads or meals, suppress later food intake in amounts roughly equivalent to their energy value<sup>10,12</sup>. Sugars in the amount of at least 50g (about the quantity in one and one-half soft drinks) given from 20 to 60 minutes before a meal, produce detectable decrease in meal-time food intake<sup>10</sup>. The monosaccharide fructose, however, is more effective than glucose in reducing meal-time intake and the desire to eat, when given as the only source of carbohydrate<sup>13</sup>. However, when consumed with other carbohydrate, no differences are seen between the different sugar treatments<sup>14</sup>. In meals eaten 30 minutes after preloads of cereal with either fructose or sucrose added, almost perfect compensation for the preload calories was seen when compared with a no-breakfast (water) preload.

In children, it is clear that both the energy content and sweetness of sugars decrease subsequent food (energy) intake and selection of sweet foods, respectively<sup>15</sup>.

#### Sleep

Studies in adult humans have indicated that more sleep occurs following a carbohydrate feeding, compared with water. In adult males, a liquid carbohydrate lunch has been reported to provide a longer postprandial sleeping time than no lunch<sup>16</sup>. Carbohydrate drinks taken before bed time by older adults enhance sleep duration and quality<sup>17</sup>.

In infants, consumption of carbohydrate alone can cause sleep. Based on the serotonin hypothesis, one study provided a 10% glucose feed containing added tryptophan (the serotonin precursor) and reported that newborns entered active and quiet sleep earlier than when receiving a balanced formula<sup>18</sup>. Less dramatic results were obtained in a more recent study in which a 6.7% lactose solution was fed<sup>19</sup>. The

failure of the lactose treatment to produce the effects observed when a 10% glucose solution with tryptophan was fed could be expected<sup>18</sup>. Lactose, composed of glucose and galactose, would stimulate much less tryptophan uptake by the brain than the glucose plus tryptophan mixture.

### Mood and Cognition

Over the past two decades, there has been considerable effort made to define the effect of short-term nutritional intake on mood and cognition<sup>16,20,21</sup>. It is clear that food intake affects mood, but it is less clear whether carbohydrate is the key component.

Breakfast intake is generally associated with an improvement in cognitive performance later in the morning. In contrast, lunch intake is associated with an impairment of mid-afternoon performance on mental tasks and more negative reports of mood. Intake of nutrients late in the afternoon appears to have a positive effect on subsequent performance on tasks involving sustained attention or memory<sup>20</sup>. Carbohydrates may play a role in these responses.

The hypothesis that carbohydrate consumption will alter mood because of its presumed effect on brain serotonin has driven much of the research on the relationship between diet carbohydrate and mood. Evidence in support of the hypothesis has been gained from studies of both tryptophan supplementation and tryptophan depletion. Tryptophan supplementation has been used to treat many neuropsychiatric disorders, with variable success<sup>22</sup>. In normal subjects, supplementation results in a decrease in appetite, an increase in lethargy and sleepiness<sup>23</sup>. Tryptophan depletion, obtained by feeding subjects an amino acid mixture free of tryptophan, has consistently resulted in a lowering of mood in normal and depressed subjects<sup>8</sup>. However, most studies, usually conducted at lunchtime, show either no specific effect of carbohydrate or no difference between high and low carbohydrate meals. Generally, mood alterations occur in early afternoon regardless of type of meal. Usually observed is a reduction in vigour, anger and depression scores<sup>21,24</sup>.

In contrast to the inconsistent effect of carbohydrate on mood in healthy experimental subjects, there is strong evidence that individuals make use of carbohydrate to counteract negative mood states<sup>25</sup>. Because a serotonin deficit enhance negative mood states<sup>8</sup>, the drive to consume carbohydrate to correct negative mood status is assumed to be linked to a reduction in serotonin synthesis. Although this link is not proven, it appears that carbohydrate intake is consumed as a self-administered mood regulator in:

- tobacco withdrawal symptoms<sup>26</sup>
- alcohol withdrawal<sup>27</sup>
- seasonal affective disorders<sup>28</sup>
- obesity<sup>9</sup>
- premenstrual syndrome<sup>29</sup>

Consumption of carbohydrate has been shown to enhance cognitive function. The beneficial effect of carbohydrate is best shown after acute treatment with glucose drinks. The influence of glucose-containing drinks on cognitive function has been extensively examined in healthy adults. Acute doses of glucose improve cognitive performance in several situations, in comparison to a saccharin- or aspartame-

containing placebo drink<sup>30</sup>. In general, the beneficial effects occur within one hour. Some have suggested that the effects may vary with task complexity<sup>31,32</sup> and may be restricted to declarative memory<sup>33</sup>. Declarative memory is defined as memory that is accessible to conscious awareness: a memory that can be declared or stated<sup>34</sup>. This memory includes episodic memory (specific time and place events) and semantic memory (facts and general information) and is the memory expressed on tests of recall or recognition.

The strongest effect of glucose on memory may be in populations with pre-existing memory deficits or vulnerabilities to memory disorders<sup>35</sup>. Pronounced improvements in memory occur after glucose drinks are consumed by early subjects<sup>36,39</sup> and by those who are cognitively impaired<sup>40</sup>. Abundant animal research, showing that glucose attenuates memory impairments caused by drugs and other amnesic agents, supports this notion<sup>41-46</sup>.

### Hyperactivity

A persistent myth about sugar is that it causes hyperactivity in children. The association to arise in the minds of parents who have observed that their children are excited at parties, and other celebrations, when sweet foods are served. Teachers have similar subjective opinions based on the classroom activity of some of their students, perhaps because they would like to have a simple explanation of children's behaviour. As well, a number of poorly designed studies in early literature have given some credence to this myth.

Numerous studies investigating the hypothesis that there is a relationship between sugar intake and children's behaviour have been reported in the peer-reviewed literature of the past 15 years. As summarised by White and Wolraich<sup>47</sup>, results from 14 published studies, representing 16 controlled challenge studies and over 400 subjects do not support the hypothesis that refined sugar affects hyperactivity, attention span, or cognitive performance in children. To the contrary, a small but statistically significant decrease in motor activity has been observed in some children whose parents believed that they became hyperactive after consuming added sugar<sup>48</sup> and in children whose behaviour had not been considered hyperactive after consuming sugar<sup>49</sup>.

### Physical Performance

There is one aspect of human performance that clearly benefits from carbohydrate intake, and that is physical performance. At rest and during low intensity exercise, fat metabolism is the main provider of energy for resting metabolic processes and muscle contraction. However, a higher exercise intensities, the metabolism of carbohydrate reserves, such as blood glucose and liver and muscle glycogen, are the main providers of fuel for muscle contraction. In endurance activities, fatigue results when these substrata reach critically low amounts or are decreased, primarily because of reduced availability of substrate for the nervous system<sup>50</sup>.

The optimization of carbohydrate availability to enhance performance has received much interest in the field of sports nutrition, and perspective have changed greatly in the past fifty years. The timing and frequency of carbohydrate intake at various stages are important determinants for optimizing fuel availability to maximise performance<sup>51</sup>. Pre-exercise

carbohydrate feedings are used to optimise substrate availability, whereas post-exercise carbohydrate ingestion promotes the re-synthesis of muscle and liver glycogen. Feedings during exercise, based on readily digested carbohydrates or sugars, provide a readily available source of exogenous fuel as stores deplete. Recognition of this essential role of carbohydrate has led to a marked change in advice over the past forty-five years to athletes performing prolonged exercise<sup>51</sup>. Forty-five years ago, long distance runners were advised to consume only water after every 5 km past 15 km. Now it is suggested that both water and carbohydrate may be appropriate every 3 km.

### Carbohydrates and Maintenance of Health

Carbohydrate provides the majority of energy in the diet of most people. Carbohydrate-containing foods not only provide substrate for energy production, but also carry with them many important nutrients and phytochemicals. They are important in the maintenance of glycemic homeostasis and gastrointestinal integrity and function. High carbohydrate diets (55% or more of energy) are associated with reduced chronic disease, especially obesity and its co-morbid conditions.

### Glycemia

Carbohydrates in food are digested to provide primarily glucose in the bloodstream. The effects of foods on blood glucose can be compared by means of the glycemic index.

Glycemic index (GI) is defined as the incremental area under the blood glucose response curve of a 50g carbohydrate portion of a test food expressed as a percent of the response to the same amount of carbohydrate from a standard food taken by the same subject. Using the GI makes it possible to select carbohydrate foods that have the most beneficial effect on metabolism. In general, low GI foods are preferred over high GI foods. The GI of some selected foods is given in Table 2.

Table 2. Glycemic index of selected foods<sup>53</sup>

<i>Food</i>	<i>Index(%)</i>
Bread, white	100
Bread, whole meal	100
Rice, brown	81
Rice, pol., boiled 10-25 min.	81
Ice cream	69
Milk	45
Yoghurt	52
Sucrose	83
Fructose	26
Glucose	138
Beans, baked (canned)	70
Beans, soya (canned)	22
Peas, chick (canned)	60
Potato, new, white boiled	80
Potato, smashed	98
Cornflakes	121
Puffed Rice	132
All Bran	74
Potato chips	74

It is clear from Table 2 that the GI is affected by the composition of the carbohydrate, and by the presence of factor protein in the food. The glycemic response to common foods such as rice, whole-meal bread, potatoes, and many breakfast cereals is equal to or higher than the glycemic response to equivalent amounts of sucrose. This is because the starch in these foods as legumes, dairy products, and foods high in fat is lower than that of sucrose, because they contain components that slow the digestion and absorption of their carbohydrate. The GI of sucrose is only 83% of the GI of the standard, which is white bread<sup>52</sup>. Sucrose's lower glycemic response is explained by the effect of its components, glucose and fructose. Glucose alone has a GI of 138% relative to white bread, whereas the GI of fructose is only 26%<sup>52</sup>.

Because sugars create a lower insulin demand than do many starchy foods, there is no metabolic basis for the myth that sugars cause hypoglycemia<sup>53</sup>. Experimental studies have shown, as well, caloric sweeteners do not cause hypoglycemia.

### Obesity

In North America, obesity has been described as an epidemic. In the United States, prevalence of overweight is currently at a high of one-third of the adult population (based on body mass index of > 27.8 for men and > 27.3 for women)<sup>54</sup>, and one-fifth of the children. For adults, the increase in prevalence was almost 8% (from 25.4% to 33.3%) between surveys conducted in 1976-80 and 1988-91. For children 12-19 years, the increase in prevalence was 5% (from 15% to 20% for males and from 17% to 22% for females). Severe obesity, defined as a BMI of 30 kg/m<sup>2</sup> or higher, is found in approximately 22% of American adults<sup>55</sup>.

The main dietary factor contributing to obesity in North America has been judged to be its fat consumption and the resulting high energy-density of foods<sup>56</sup>. Some studies show that the energy intake compensation is less precise at meals that follow the consumption of a preload high in fat, compared with one high in carbohydrate<sup>57</sup>. Many high-fat foods such as ice-cream and chocolate contain sugar, which might suggest that sugar consumed in this combination is a factor encouraging excess fat intake<sup>11</sup>. However, sugar-fat combinations alone are not likely the cause of excessive energy consumption. Furthermore, the role of fat per se is uncertain. Dietary surveys have shown that fat consumption has been decreasing gradually in the US during the past 15 years, yet the incidence of obesity continues to increase<sup>58</sup>. So not only does sugar not appear to be the culprit, but fat intake alone is not likely to be the sole explanation for obesity.

Nevertheless, epidemiological studies show an inverse relationship between carbohydrate intake, including sugars and obesity<sup>11</sup>, and a direct relationship between fat intake and obesity<sup>56</sup>. For example, a study of 11,626 Scottish men and women aged 25-64 years reported the lowest prevalence of obesity in those consuming the highest total carbohydrate, total sugar, and added (extrinsic) sugars. The highest prevalence of obesity was among those with the highest consumption of fat relative to added sugar<sup>59</sup>. Furthermore,

there is no relationship between the amount of sugar available in the food supply of a nation and the incidence of obesity in its population<sup>60</sup>.

Given the complex aetiology of obesity, it is far too simplistic to attribute its origin to the composition of a particular food or of the food supply. Reviews of the literature have led to the conclusion that the prevalence of paediatric overweight is due to the dramatic decrease in physical activity<sup>61,62</sup>. Fewer than 40% of high school students engage in vigorous physical activity more than three times per week<sup>63</sup>.

The lower prevalence of obesity in Canada (14%) than that in the United States (22%)<sup>64</sup> has been attributed to the higher activity levels of Canadians, even though the food supply is similar. Therefore, in the presence of an abundant and palatable food supply, the most effective strategy in the prevention of obesity may be high-volume, low-intensity (prolonged endurance) exercise<sup>65</sup>.

Excess body fat (obesity) arises very simply from the energy imbalance caused by eating too many calories and using too few of them. The sociological factors accounting for this problem vary from country to country and the understanding of these should be the basis of programmes and food-based dietary guidance aimed at the prevention of obesity.

### Diabetes

One sequence of obesity is an increased risk of diabetes mellitus. The symptoms are caused by insulin deficiency that results either from decreased insulin production or from a diminished effect of insulin at the cellular level. The most prevalent form of diabetes is non-insulin-dependant diabetes mellitus (NIDDM). It starts most often in adulthood and is associated with obesity.

The major disease-management objectives for NIDDM focus on weight control through energy-reduced diets and increased physical activity. In the 1970s and 1980s, the diabetes associations of many countries began to recommend that fat in the diet should be reduced and the energy replaced by carbohydrate<sup>53</sup>. The recent FAO/WHO report on carbohydrates in nutrition<sup>66</sup> suggests that consuming a wide variety of carbohydrate foods is now acceptable, and that 60% to 70% of total energy should be derived from a mix of monosaturated fats and carbohydrate. Diabetics should consume high-carbohydrate foods, emphasising fruits, vegetables and whole grains. These foods are recommended because of their slow release of glucose, which reduces the metabolic demands on insulin.

There has been a wide belief that simple sugars should be avoided in the dietary management of diabetes. However, there is no scientific evidence for this belief. Sugars are not more rapidly digested and absorbed than other starches<sup>67</sup>. Thus, sugar in moderation is also now accepted as a component of diets for diabetics, because it has a low GI (Table 2). Sugars have not been directly implicated in the aetiology of diabetes, and recommendations allow intakes of sucrose and other added sugars, providing that: (a) they are not consumed in excess of the total energy allowance; (b) the nutrient-dense foods and non-starch polysaccharide (NSP)-rich foods are not displaced; and (c) they are consumed as part of a mixed meal<sup>68</sup>.

## Hyperlipidemia and Cardiovascular Disease

Dietary advice for people with coronary heart disease is to reduce the intake of fat and increase the intake of carbohydrate-rich foods, rich in NSP, especially cereals, vegetables and fruits. Certain NSPs, such as beta-glucans, have been shown to have a serum cholesterol-lowering effect when consumed in naturally-occurring foods, in enriched forms, or in dietary supplements<sup>66</sup>.

Hyperlipidemia is the elevation of blood lipids and is believed to be an aetiologic factor in the process of atherosclerosis. There is no evidence that sucrose plays a role in the aetiology of coronary heart disease; however, it has been recognised for years that large amounts of dietary sugars, about two to three times the average consumption, can raise blood lipids.

The potential effect of sucrose consumption on blood lipids is explained partly by fructose's unique metabolic pathway in the liver. There is evidence that it is a better substrate than glucose for lipid synthesis. Therefore, it should not be a surprise to find an elevation of blood triacylglycerol concentrations in some subjects who are given excessive quantities of either fructose or sucrose. However, in studies in which amounts of sugars typical of the Western diet were provided, such responses were not observed, except in some carbohydrate-sensitive individuals<sup>69</sup>. There is no evidence that this occurs when the increase in carbohydrate is due to increased consumption of vegetables, fruits and appropriately processed cereals<sup>66</sup>.

## Dental Caries

Caries prevalence has decreased markedly during the past 20 years in developed countries despite consistently high sugar consumption<sup>70</sup>. The reason is that tooth decay is influenced by many factors in addition to diet, including oral hygiene procedures, fluoride delivery, bacterial components of plaque, the amount and composition of saliva, type of preventive and restorative care and immunological response of the individual. The consumption of sugar and other fermentable carbohydrates, in the absence of fluoridated water, toothpaste and attention to oral hygiene, does increase the incidence of dental caries. However, it is recommended that when such circumstances exist, the most effective approach is to improve oral hygiene and to use fluoride dentifrices. Dietary restrictions have not proven as effective<sup>70,71</sup>.

## Food Guides

Dietary advice must be transmitted to the public in the form of food-based dietary guidance in order to have an effect on the health status of the population. Food guides play this role in many countries.

The major nutrition education tool used in many countries is the national Food guide. Both Canada and the US have developed new Food Guides that incorporate their national dietary guidelines. In the past, the Food Guides concentrated on expressing a dietary pattern that would provide the individual with the essential nutrients in recommended amounts. The new Food Guides are a departure from the past as they recommend a dietary pattern that would not only meet the requirements for essential nutrients, but would also lead to a diet higher in carbohydrate and lower in fat

than currently consumed. Both the Canadian and American Food Guides are centres around food groups and both have a new category of foods, one that includes sugars, fats and oils.

The Canadian Food Guide<sup>73</sup> incorporates the four food groups in a rainbow design. Meat and alternatives are arranged along the small, inner arc. Next come the milk products, then vegetables and fruits, and finally grain products along the large, outer arc. The design gives the visual cue that the greatest quantity of food should be selected from the grains group. A category of "Other Foods" is identified as not part of any food group, and includes foods that are mostly fats and oils, mostly sugar, high fat or high salt snack foods, beverages, herbs spices and condiments. It is acknowledged that "These foods can be used in making meals and snacks and are often eaten with foods from the four food groups", but it is recommended that they be consumed in moderation. Instructions on using the Food Guide include advice on reducing fat, but no mention is made of reducing sugar.

The US Food Guide<sup>73</sup> is in the form of a pyramid, showing five food groups, with the grain group at the base. The vegetable group and the fruit group share the next level of the pyramid and on top of these are the milk and meat groups, sharing equally the next level in the pyramid. The visual impression is that one should consume less of those foods higher up the pyramid. At the very top is the category of fats, oils and sweets. The consumer is advised that "These foods supply calories, but little or no vitamins and minerals".

Thus, both the Canadian and American Food Guides are designed to help the individual select carbohydrate food as the foundation for a healthy diet. Food selection based on the Food Guides will provide 55% of the energy, or greater from carbohydrate. Explicit in the Guides is also a recognition of the role of all forms of carbohydrates, including the sugars, oligosaccharides and polysaccharides and that food carbohydrates are more than an energy source. Food containing carbohydrate bring with them a wide array of nutrients and other metabolically and physiologically active components, such as fibre and phytoestrogens, which are beneficial to health. As well, the carbohydrate sweeteners are important not only for their contribution to hedonic value, but for their role in food preparation, such as bread making and preservation. As 10-12% of dietary energy, added sugars provide an important contribution to the benefit of carbohydrate consumption. Although the role of sugars in the diet and their effect on health has been controversial in the past, all recent evaluations<sup>70,74,75</sup> have concluded that current consumption levels in the developed countries are consistent with healthy diets. With the exception of dental caries, sugars do not have any specific role in the aetiology of chronic disease.

The recent FAO/WHO report<sup>66</sup> recommends that in choosing carbohydrate foods, both glycemic index and food composition be considered. It will be some time before a complete knowledge of the GI of foods is available, although considerable information has been derived<sup>52</sup>. In the meantime, recognition of the determinants of the GI can help in perspective the metabolic, physiological and behavioural effects of consuming food carbohydrates.

## CONCLUSION

**Carbohydrate consumption has beneficial effects on human behaviour including appetite, sleep, mood, cognition and physical performance. The optimum intake of at least 55% of total energy from a variety of carbohydrate sources is associated with the maintenance of health and avoidance of chronic disease.**

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## Dietary Fat and Chronic Diseases

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Dietary guidelines for the prevention of chronic diseases usually include several recommendations on fat intakes. This review, therefore, focuses on dietary fat intakes in relation to cardiovascular disease, cancer and obesity. Dietary guidelines on the type of fat to eat are issued in terms of the major classes of fatty acids, (saturated, monounsaturated and polyunsaturated fatty acids).

However such advice may be over-simplistic considering the very variable effects of individual fatty acids - even those within the same class - on atherogenic and thrombogenic factors. This is particularly relevant in the case of trans unsaturated fatty acids which have more atherogenic effect on blood lipids than saturated fatty acids and therefore need to be considered separately to avoid confounding the assessment of the atherogenicity of fat intakes. The potentially undesirable effects of a low fat, high carbohydrate intake on blood triacylglyceride (raising effect) and HDL cholesterol (lowering effect) concentration, which may be offset by intakes of PUFA n-3 (oil fish), will also be explored. The variability of individual fatty acids, including trans, in terms of their impact on blood lipid concentrations, thrombogenic factors and cancer will be briefly discussed.

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Dietary fat intakes are implicated in the aetiology of many of the major diseases responsible for mortality in developed countries. Thus several components of dietary guidelines issued in these countries concern advice on the amount and type of fat that should be eaten (Table 1). In general populations are advised to reduce the total amount of fat consumed from an average intake of approximately 40% of total energy intakes to 30-35%<sup>1,2</sup>. Advice on the type of fat to eat is given in terms of the three major classes of fatty acids. Saturated fatty acids (SFA) should not exceed 10% of average energy intakes, polyunsaturated fatty acids (PUFA) should contribute up to - but not exceed - a further 10% of energy intakes, while monounsaturated fatty acids (MUFA) should represent the major type of fat eaten (10-15% of energy intake on average). In some countries, for example the UK and Ireland, more detailed advice is given where it is recommended that intakes of trans unsaturated fatty acids, which are estimated to contribute an average of 2% of energy in the UK, should not increase further, and that PUFA of the n-3 series should be increased.

Table 1. Dietary guidelines on fat intakes

Fat	UK population	US NCEP1	US NCEP2
Total fat (%)	<=33	<30	<30
SFA (%)	<=10	<10	< 7
MUFA (%)	--	10-15	10-15
PUFA (%)	< 10 (n6+n3)	<10	<10
Trans (%)	<=2		
Cholesterol (mg/day)	245	<300	<200

The rationale for these recommendations is mainly based on what is known about the relationship between diet and cardiovascular disease where an extensive field of research focuses on fat intakes in particular. Diets which provide a high proportion of energy intake as fat contribute to the development of obesity, especially in cases where physical activity levels are low. Obesity and low physical activity levels are, in turn, major risk factors for Non-Insulin-Dependent Diabetes Mellitus (NIDDM). Both obesity and NIDDM promote the development of cardiovascular disease. In contrast to cardiovascular disease relatively little is known about the relationship between dietary fat and cancer. Nonetheless current dietary guidelines on fat intakes reflect what is understood about the prevention of cancer.

### Obesity and NIDDM

Spiralling increases in the prevalence of obesity have been reported in Britain and the US over the past decade. In a recent review<sup>3</sup> outline how, in Britain, average fat intakes have been significantly increasing and physical activity levels have been significantly decreasing in the years when obesity prevalence was growing dramatically. Other experimental work supports the hypothesis that the interaction between a high fat diet and low physical activity levels may be a significant factor in the phenomenal increases in obesity prevalence observed in developed countries over recent years<sup>4</sup>.

Strong support for the fattening effects of a high fat consumption is evident in the recent report from the Scottish Heart Study which included over 11,000 men and women<sup>5</sup>. This study found that the leanest adults used carbohydrate (including sugar) as a dietary energy source rather than fat

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while the opposite was true for the most obese adults; the leanest adults had the lowest intake of fat and the highest intake of carbohydrate (including sugars), while the most obese adults consumed the highest amount of fat and had the lowest intakes of carbohydrates. Many dietary studies have found that low fat intakes are usually associated with high sugar intakes and vice-versa. In fact this is often referred to as the fat-sugar see-saw. The inverse relationship between dietary intakes of fat and sugar suggest that recommendations which advise populations to reduce fat and sugar intakes simultaneously may be unrealistic.

The recent surge in incidence of NIDDM mirrors the trends in obesity discussed above and reflects the strong association of obesity and NIDDM. A recent report from the Centre for Diseases Control in Atlanta (Table 2) outlines the importance of obesity prevention (which emphasises a reduction in fat intakes) and increased physical activity to counteract these trends. The type of fat that should be eaten to minimise the atherogenic lipid profile associated with NIDDM are discussed in the section on PUFA-3.

Table 2. US diabetes cases at record level

1980-1994:	+ 33% increase in blacks + 11% increase in whites
Risk factors:	older age, race, ethnicity, family history, obesity and physical inactivity

**Cardiovascular Disease**

Dietary fat mediates its effects on cardiovascular disease through atherogenic and thrombogenic factors. Atherosclerosis is a long-term process beginning in teenage years. In general, the atherogenicity of dietary fat intakes can be assessed in terms of blood lipid concentrations which are an important focus for primary prevention programmes. Thrombosis is less well understood and although it is likely to be involved in the development of atherosclerosis, it is a much more acute process<sup>6</sup>. Anti-thrombogenic factors can, therefore, be much more effective in reducing the risk of acute events in cases where atherosclerosis is established, for example, middle-aged men in populations where cardiovascular disease is prevalent, or in secondary prevention (in patients with established cardiovascular disease). The latter was demonstrated clearly in the Diet and Reinfarction Trial where in men (n2033) post myocardial infarction who were randomised to receive the anti-thrombogenic diet therapy of PUFA-3 (oily fish) were found after two years to have experienced a significant reduction in mortality compared with the group receiving anti-atherogenic intervention<sup>7</sup> (Table 3).

Table 3. Effects of different dietary interventions on death and Ischaemic Heart Disease (IHD) event in men (n2033) post myocardial infarction

Dietary advice	RR* of death	RR of IHD event
Fat	0.97	0.91
Fish	0.71**	0.84
Fibre	1.27	1.23

\*RR- Relative risk

\*\*p<0.05

The effects of the very strict NCEP Step 2 (Table 1) on the plasma lipoprotein profiles in 72 men and 48 women were recently reported from a meta-analysis of five previously published studies<sup>8</sup> and discussed in an editorial review<sup>9</sup>. There was a large variability found in the blood lipid response to this diet and this was found to be mainly due to genetic influences in men and age in both sexes. The environmental factors were as well controlled as possible in that all food and drink was provided during the study, body weight was stabilised, alcohol and vitamin supplements were excluded, subjects on lipid lowering medication, and those with disorder likely to affect results, were excluded. Age and genetic factors were able to explain 48% of the variance in Low density lipoprotein (LDL) response in men while age explained a corresponding 13% of the variance in women.

The authors conclude that baseline LDL cholesterol concentrations, as a marker of genetic background, are the primary determinant of LDL response to an NCEP Step 2 diet in men. However, the decline in LDL cholesterol may be overestimated by predictive equations based on changing the dietary fat composition in men with low LDL cholesterol concentrations and may be underestimated in those with elevated levels. The determinant of variability of LDL response in women are less clear but age appears to play a role.

**Individual Fatty Acids Vs. Major Classes of Fatty Acids**

Considering that dietary guidelines on the type of fat should be eaten are issued in terms of the three major classes of fatty acids - SFA, MUFA and PUFA - the highly variable effects that individual fatty acids (even those within the same class) have on blood lipid concentrations may seem surprising. The changing emphasis from the major fatty acid classes to individual fatty acids is described very well by Kris-Etherton and Yu<sup>10</sup>. The variable effects of individual SFA, MUFA and PUFA on total blood cholesterol, LDL cholesterol and high density lipoprotein (HDL) cholesterol may be due to the potency of myristic acid at raising blood cholesterol levels which can be compared with the neutrality of stearic acid.

Considering unsaturated fatty acids: Although oleic acid (MUFA) has a neutral or mildly hypocholesterolaemic effect compared with the more potent hypocholesterolaemic effects of linoleic acid (PUFA-6), nonetheless the beneficial effects of oleic acid on HDL cholesterol levels are likely to be clinically significant.

**Trans Fatty Acids**

A trans fatty acid occurs when the isomeric configuration of the hydrogen carbons at a double bond position are changed from the normal cis configuration - where both atoms are on the same side of the carbon chain - to the trans configuration where the atoms occur on different sides of the carbon chain. In the normal cis configuration there is a 'kink' in the molecule which does not allow the fatty acids to fit closely together - thus resulting in greater fluidity - and the fat will be liquid at room temperatures. The trans configuration results in straighter molecules which like SFA fit closely together and are solid at room temperature.

There are different dietary sources of trans fatty acids (Table 4). Some occur naturally in dairy foods and meat due to

the hydrogenation of palmitoleic and linoleic acid in the rumen of cattle by bacteria. This hydrogenation occurs at temperatures of 37°C in the presence of hydrochloric acid. The types of trans fatty acids produced from animal sources have been part of the human diet for generations

Table 4. Relative risk of coronary heart disease (CHD) in 69,181 women relative to trans fatty acid intake

	Quintiles of trans fatty acid intake				
	1	2	3	4	5
Total trans isomers	1.0	1.23	1.11	1.36	1.67*
Vegetable sources	1.0	1.43	1.11	1.39	1.78*
Animal sources	1.0	0.76	0.69	0.55	0.59

\* $p < 0.05$

Early this century the process of hydrogenating vegetable and marine oils to manufacture hard fats which are useful for the production of margarines, cakes and biscuits was started. This introduced a new range of trans fatty acids into the human diet. These vegetable and marine sources of trans fatty acids are produced by passing hydrogen gas over the oils at very high temperatures in the presence of a catalyst. The hydrogenation of double bonds occurs more randomly and there is also a tendency for positional isomerisation to occur (where the double bond migrates up or down the carbon chain). The variety of different isomers, both trans and positional, produced by this process is manifold. In the case of the highly unsaturated marine oils the majority of fatty acid isomers produced by hydrogenation remain unidentified.

Total dietary intakes of trans fatty acids have been declining in recent years particularly those of vegetable and marine origin. Currently average intakes of total trans fatty acids are estimated to contribute 2% of energy in the UK diet<sup>1</sup> and 2.6% of energy in the US diet. In the Gulf region intake of trans fatty acids are likely to be low and vegetable and marine sources of trans fatty acids would not be an issue for those following the traditional diet of the area.

Recently a large prospective study of coronary heart disease risk among women reported that the relative risk of developing heart disease was increased by 67% for women having the highest, compared to those having the lowest, intakes of total trans fatty acids. From food intake data this American study was able to determine that this risk was associated specifically with trans fatty acids from vegetable sources only (where the risk increase was 78%) and that there was no increased risk associated with the consumption of trans fatty acids from animal sources<sup>11</sup>.

Another study provides further evidence of the negative effects of trans fatty acids where high dietary intakes (9% of energy intake) of elaidic acid (t18:1) was found to significantly elevate lipoprotein (a) (Lp(a)). Lp(a) is a lipoprotein that is associated with atherosclerosis and thrombosis and blood concentrations were previously understood to be wholly determined genetically<sup>12</sup>. However, the high intakes of elaidic acid (t18:1) used in the experimental diets (9% of dietary energy) are unlikely to occur in the diet under normal circumstances<sup>12</sup>.

### PUFAn-3

Oily fish is the main dietary source of PUFAn-3 fatty acids eicosapentaenoic acid (EPA;20:5) and docosahexaenoic acid (DHA;22:6). How ingestion of these fatty acids can invoke an anti-thrombogenic response is described by Simopoulos<sup>13</sup>.

Dietary intakes of PUFAn-3 inhibit the production of PUFAn-6 (arachidonic acid: AA;20:4) from linoleic acid. EPA replaces AA in phospholipid membranes and competes with AA for enzymes to produce a different series of eicosanoids in platelets and endothelial cells which have an anti-aggregatory effect. In addition EPA competes with AA and produces leukotrienes series 5 instead of the leukotrienes series 4 produced by AA. The balance is favour of leukotrienes series 5 has anti-inflammatory effects which may be significant for the management of chronic inflammatory disease such as arthritis and inflammatory bowel disease. Recently it has been postulated that leukotrienes series 5 may be protective against cancer<sup>14</sup>.

The balance between PUFAn-3 and PUFAn-6 have, therefore, important implications for health. It is a matter of concern that the dramatic changes in human fat intakes, which have occurred over the last 100 years or so, have resulted in a much higher ratio of PUFAn-6:PUFAn-3<sup>13</sup>. Considering the effects of PUFAn-3 this may be significant in relation to cardiovascular disease and cancer.

### PUFAn-3, Hypertriacylglyceridaemia and NIDDM

Dietary intakes of PUFAn-3 have potent triacylglyceride (TAG) lowering effects and variable effects on LDL and HDL concentrations. With increasing dietary increments of EPA and DHA there is a corresponding decrease in blood concentrations of total TAG and of the main TAG carrying very low density lipoprotein (VLDL)<sup>15</sup>. This has clinical relevance for subjects at risk of hypertriglyceridaemia such as obese patients, patients with NIDDM and post-menopausal women for whom the combination of hypertriacylglyceridaemia with low HDL concentrations represents an atherogenic profile.

A recent post-prandial study of post-menopausal, non-diabetic women (n10) examined their response to the recommended low fat (25%) high carbohydrate (60%) NCEP step 2 diet compared with a high fat (45%) low carbohydrate diet (40%)<sup>16</sup>. These workers found that the low-fat, high-carbohydrate diet yielded a more atherogenic response in blood lipid concentrations. Furthermore this study also found that the low-fat, high carbohydrate diet had a more adverse effect on post-prandial insulin concentrations<sup>16</sup>. These findings question the wisdom of advising post-menopausal women to adopt very low fat diets. It also has implications for subjects with abnormal glucose control who tend to develop hypertriacylglyceridaemia.

A recent report from a large multi-centre study, which included over 400 male and female patients with NIDDM, suggests that PUFAn-3 given as a small daily dose of EPA and DHA (equivalent to a portion of oily fish) can be effective at ameliorating hypertriacylglyceridaemia without adversely affecting glycaemic control<sup>17</sup>. The TAG-lowering response was more significant in diabetics whose HDL levels were initially low. Previous studies have yielded inconsistent findings about the effects of PUFAn-3 on glycaemic control.

This recent study involved a 6 month follow-up period and the protocol did not allow any change in oral hypoglycaemic agents. The authors conclude from their findings that a moderate dose of PUFA<sub>n</sub>-3 can provide a suitable option for the management of patients with hypertriacylglyceridaemia including those who have abnormal glucose control<sup>17</sup>.

### Dietary Fat and Cancer

Investigating the relationship between dietary fat intakes and cancer is inherently difficult due to methodological problems. This review will outline the direction of current research on the role of dietary fat in relation to the cancers affecting the colon and the breast.

The association between meat intakes and incidence of colon cancer is apparent in international comparisons using data on per capita meat consumption<sup>18</sup>. However, there are many other differences between these countries besides their meat consumption pattern which may equally define their risk of colon cancer. Greeks, for example, enjoy high intakes of meat but have a low risk of developing colon cancer. Within high risk countries a high fat intake and a low consumption of fruit and vegetables are positively associated with risk of colon cancer which may be important risk factors associated with a high fat intake<sup>18</sup>.

International cross-country comparisons show a similar positive association between fat intakes and the incidence of breast cancer. However this has not been shown in prospective studies: "in large prospective epidemiological studies, little evidence has been seen to support any major positive association between dietary fat and risk of breast cancer over the range of 15-45% or more of energy from fat"<sup>19</sup>. However recent studies indicate that individual fatty acids, rather than the total amount of fat or the major classes of fatty acids, may provide the key to how fat intakes may be associated with an increased risk of breast cancer<sup>14</sup>. There is no evidence to link intakes of saturated fatty acids as a class with breast cancer. While there is no evidence of a protective effect of MUFA per se, there have been a number of studies suggesting a protective effect of olive oil (higher socio-economic status of high olive oil consumers). Animal studies suggest that PUFA<sub>n</sub>-6 may have a carcinogenic effect while PUFA<sub>n</sub>-3 may be protective due to the production of leukotrienes series 5. Finally, the Euramic study, which included adipose tissue biopsies found an increase in breast cancer risk associated with greatest stores of trans fatty acids.

### CONCLUSION

**A reduction in fat intakes combined with an increase in physical activity levels is recommended to reduce the increasing prevalence of obesity. While increased physical activity is known to be directly effective in reducing insulin resistance, a reduction in the prevalence obesity will have a 'knock-on lowering' effect on NIDDM incidence.**

**A moderate reduction in fat intakes diets combined with an increase in PUFA<sub>n</sub>-3 may reduce cardiovascular risk**

**in subjects with hypertriacylglyceridaemia (patients who are obese or have NIDDM, and post-menopausal women). Intakes of individual fatty acids rather than of the major classes of fatty acids may be more critical in determining risk of cardiovascular disease. Intakes of individual fatty acids may explain the relationship between dietary fat and cancer.**

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# Physical Activity and Health

Adam Drewnowski, PhD\*

A gain in body weight results from a long-term imbalance between energy intake and energy expenditure. Apart from genetic factors, likely causes of overweight are reduced physical activity, excess energy intake, or both. Under conditions of energy need, the body metabolizes all available fuels and diet composition has no impact on the amount or rate of weight loss. In contrast, when energy is consumed in excess, it is disposed of according to an oxidative hierarchy. Whereas excess carbohydrate and protein promote their own oxidation, dietary fat does not. As a result, increased fat intake, typically associated with a consumption of a varied and energy-dense diet, can lead to increased fat storage. Physical activity can restore energy balance and so prevent weight gain. Though carbohydrate is an important fuel for exercise, its body stores are small in comparison to those of fat and protein. Carbohydrate consumption during intensive exercise, whether in liquid or solid form, optimizes exercise performance by virtue of sparing glycogen stores. In contrast, low intensity aerobic exercise increases the oxidation of fat and so contributes to weight control. Aerobic exercise can be maintained for long periods of time, in trained individuals, with fat oxidation proportionally increasing with time. As physical activity moves the energy equation in the direction of greater energy need, diet composition plays a lesser role. An exercise prescription together with a balanced diet is the key to shaping health habits, especially for adolescents.

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The development of obesity among children, adolescents, and adults is the combined outcome of a genetic predisposition, excess energy intake, and insufficient energy expenditure<sup>1,2</sup>. Studies on the development of human obesity have tended to emphasise potential genetic mechanisms as well as the macronutrient composition of the obese diet.

Population-based studies have addressed shifts in health and eating habits in the course of the nutrition transition and their relationship to the growing prevalence of childhood obesity worldwide<sup>1</sup>. Economic development in different parts of the world has been associated with a common transition from a staple carbohydrate-based diet to a more diverse eating pattern characterised by an increased proportion of milk, meat, dairy products and more vegetables and fruit. The emerging global diet is more energy-dense, more palatable, more varied, as well as higher in dietary sugars and fats.

Whereas much research on human obesity has focused on genetic and food intake variables, physical activity remains a neglected part of the energy equation. Yet, in every case, the nutrition transition has been associated with other marks of growing prosperity, notably urbanisation, motorized transport, and a more efficient food supply. As a result, growing exposure to energy-dense foods has been associated with declining physical activity and ever-lower levels of energy expenditure. While limiting energy intakes is a recognised component of dietary guideline, the benefits of physical activity have not always been made clear. Exploring the connections between changing dietary habits, physical activity and health is the focus of this review.

## Energy Balance Equation

A gain in body weight results from a long-term imbalance between energy intake and energy expenditure. Apart from genetic factors, likely causes of overweight are overeating, inactivity or both. For inactive persons, diet composition can play an important role<sup>2</sup>. When food energy is consumed in excess, it is disposed of according to an oxidative hierarchy. Whereas excess carbohydrate and protein promote their own oxidation, dietary fat does not. As a result, carbohydrate and protein balance are maintained. In contrast, increased fat intake, typically associated with a consumption of a varied and energy dense diet, does not promote its own oxidation and leads to increased fat storage.

Epidemiological studies support a connection between high fat intake and obesity. Dietary fat, the most concentrated source of calories, promotes energy intakes, either by failing to suppress appetite, or by increasing the overall palatability of the diet<sup>3</sup>. High fat diets also reduce the thermic effect of food, that is the amount of food energy that is dissipated as heat. Studies conducted with 9- and 10- year old children<sup>4</sup> found a significant relationship between body fat and fat intakes, calculated as percent total energy. In contrast, body fat and carbohydrate consumption were inversely linked, even when sex, total energy intake, physical fitness and parental body mass were taken into account.

The fat content of the diet becomes less important under conditions of energy need. When energy intake is severely restricted, the body metabolises all available fuels equally, so that diet composition has no impact on the amount or the rate of weight loss. Expending more energy through increased

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physical activity is another way to create energy need. Greater energy expenditure can restore energy balance and so prevent weight gain, even with an energy-dense diet.

A sedentary lifestyle interacts with the fat content of the habitual diet. In a series of studies<sup>5</sup>, measured energy intakes and energy expenditure, the latter measured either in respiratory chambers or using the doubly labelled water technique, of male participants consuming three different diets. The data showed that for low-activity participants positive energy balance was achieved for a diet containing no more than 25% of energy from fat. In contrast, highly active participants reached a positive energy balance on a diet containing as much as 54% of energy from fat. In other words, high levels of energy expenditure permit the consumption of a high-fat diet without the danger of weight gain<sup>5</sup>. It is the combination of inactivity and a high-fat diet that is most detrimental to health.

### Physical Activity

Energy expended in the course of physical activity varies with the duration and intensity of exercise, and is affected further by body weight and fitness level. According to some reports, enhanced energy expenditure can continue even after exercise; high intensity weight-lifting was reported to elevate energy expenditure above baseline for several hours.

Most of the energy needed for sustained exercise is provided by the body fat stores. Though carbohydrate is an important fuel for exercise, its body stores are small in comparison to those of fat and protein. Carbohydrate consumption during intensive exercise, whether in liquid or solid form, optimizes exercise performance by virtue of sparing glycogen stores. Soft drinks and energy bars have become popular with athletes and are used to promote peak performance.

In contrast to high-intensity efforts, low intensity aerobic exercise increases the oxidation of fat and so contributes to long-term weight control. Aerobic exercise can be maintained for long periods of time, in trained individuals, with fat oxidation proportionately increasing with time. As sustained physical activity moves the energy equation in the direction of greater energy need, the fat content of the diet becomes less important. Cross country skiers and other endurance athletes regularly consume energy-dense diets without any risk of gaining weight. For optimal health, any shift toward a high energy diet ought to be compensated for by a corresponding increase in physical activity.

### Children and Physical Activity

Levels of physical activity among children in the US and other developed nations are low<sup>6</sup>. Increased physical activity is associated with higher energy intakes, coupled with lower body fat and a higher proportion of fat-free mass<sup>7</sup>. A recent study among 10 year old French children examined eating habits of active versus inactive boys and girls<sup>8</sup>. Activity patterns were determined by questionnaire completed by the parents and the child. The questions assessed daily activity (walking, running, cycling, skating) weekly activity (sports participation) or occasional activity (during holidays).

On the average, the low activity group engaged in 11.6 h of activity per week, as opposed to 19.4 h for the active group. Boys were more active (15.3 h/wk) than girls (12.5h/wk).

More active children had higher energy intakes<sup>8</sup>. The 200 kcal difference was accounted for by a gain in carbohydrate intakes, including sucrose. Active children consumed more energy at breakfast and in the afternoon. Energy intakes at lunch and dinner were similar for the two groups. As in other studies, increase in physical activity was associated with lower percentage of energy from fat. Additional benefits of physical activity, apart from direct effects of exercise, might be related to a shift in eating habits toward energy-providing carbohydrate foods<sup>8,9</sup>.

### Physical Activity and Health

The traditional diet in the Gulf countries, consisting of rice, bread, milk, dates, vegetables and fish is gradually giving way to a diet containing more meat, dairy products, and other energy dense foods. The nutrition transition, both in the Gulf and elsewhere, has been associated with a corresponding shift in disease patterns, away from infectious disease and toward a greater prevalence of chronic illness, obesity and diabetes. Improved diet and better quality of life, together with better health services, have contributed to a major increase in life expectancy in the Gulf region<sup>10</sup>.

However, low physical activity levels pose a problem for adolescent health. Cars, television, growing urbanisation and absence of exercise programmes in schools all contribute to an epidemic of inactivity. Public health policies and other initiatives, so often focused on dietary intakes, ought to take physical activity into account.

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10. Musanger AO. Diet-related chronic disease in the Arab Gulf states; the need for action. *Ecol Food Nutr* 1994;32:91-94. increase in physical activity.

## Food Consumption Patterns and Nutrition Situation in the Arab Countries

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Since ancient time the traditional diet of the region was basically a mixture of wheat and legumes. Fruit and vegetables were also commonly consumed. However, the rapid changes in lifestyle during the past three decades have led to great changes in food and nutrition status in the Arab countries. The average per caput energy intake increased by 30% and fat intake by 45%. The largest increases in food consumption were seen in sugar, fat and oil, red meat and poultry. Consequently the trend of diet-related diseases has changed. The prevalence of diabetes, heart disease, hypertension, cancer and obesity has increased dramatically, especially in the Arab Gulf countries, Jordan, Tunisia, Egypt and Lebanon. At the same time micronutrient deficiencies such as iron-deficiency anaemia, iodine deficiency disorders and vitamin D deficiency are common in most Arab countries. A plan of action for prevention and control of nutritional problems in these countries is highly recommended.

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### Food Consumption Patterns

Studies on food consumption, particularly on dietary intake in the Arab countries are lacking. Reviewing the food availability and food consumption patterns in the Region is a difficult task due to the large socio-economic, geographical and cultural differences among countries, as well as due to insufficient and nonrelevant statistical data. The current review on trends in food consumption depends on FAO Food Balance sheets which show total availability per commodity. It is well known that Food Balance sheets do not show the differences that may exist in the diets consumed by different socio-economic groups, ecological zones and geographical areas within a country, neither do they provide information on seasonal variation in food availability.

Using two relevant indicators, per caput GNP and Daily Energy Supply (DES), derived from FAO Food Balance Sheets, the Arab Region can be divided into three major groups of countries as follows<sup>1</sup>:

1. High-income countries with GNP/caput above US \$6000 and DES above 3000 kcal/caput/day. This group included petroleum exporting countries: Libya, Saudi Arabia, Kuwait, the United Arab Emirates (UAE), Qatar, Bahrain and Oman.
2. Middle income countries with GNP/caput between US \$600 and US \$3000 and DES between 2700 and 3300 kcal/caput. This group includes Algeria, Egypt, Iraq, Iran, Jordan, Lebanon, Morocco, Syria and Tunisia.
3. Low-income countries with GNP/caput below US \$600 and DES between 2000 and 2300 kcal/caput. This group includes Djibouti, Mauritania, Somalia, Sudan and Yemen.

The petroleum-exporting countries which are comparatively sparsely populated have an average daily energy supply (DES) exceeding 3000kcal/caput. Cereal consumption seems to have reached a ceiling, with a contribution to the calorie supply of 35% to 40%. Sugar consumption is rising despite its already very high level (30 to 40 kg per caput per annum) and its contribution to the calorie supply of about 10% to 15%. The same trend may be seen for oils and fats, with consumption around 30 kg per caput per annum and contribution to calorie supply of 30%. Consumption levels of animal products are high, comparable to those in industrialized countries: 60 to 70 kg of meat, 150 to 180 kg of milk and 8 to 12 kg of eggs per person per annum.

The average per caput calorie supply in the middle-income countries as a whole is between 2700 and 3300 kcal. Cereals contribute more than half the calorie supply and are at present around 200 kg per caput per annum. Wheat is by far the most popular cereal in these countries where, in many circumstances, it is largely imported and heavily subsidized. Wheat is being supplemented by rice in Jordan, Iraq and Egypt and by barley in Morocco despite its rapid rise in consumption. Only in Egypt is there still substantial direct consumption of maize (58 kg/caput/year). Sugar consumption has also risen considerably to reach an average level of 30 to 40 kg per person per year. Similarly, vegetable oil consumption (12 to 15 kg) has increased two-fold or more between 1972-74 and 1984-86 in several countries (Algeria, Lebanon and Egypt). Sugar, oils and fats contribute 20% to 30% of calorie intake. Consumption of animal products is also rising and is reaching the level of 20 kg for meat and 60 to 100 kg for milk per person per year. Their contribution

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to calorie intake is around 10% and they supply 20% to 30% of the total protein in the diet. Fruit and vegetable consumption has also risen appreciably in almost all countries of this group. In the major consumer countries such as Syria, Lebanon, Iraq, Tunisia and Egypt, the per capita consumption is 200 to 300 kg of fruit and vegetables per year while in other countries such as Algeria and Morocco consumption is far more modest (less than 199 kg/caput/year).

In summary, the diet in the intermediate countries is being diversified, with a sufficient calorie intake to cover the energy requirement of most of the population but it is actually undergoing structural changes towards higher consumption of sugar, fats and animal products<sup>1,2</sup>.

The main feature of the diet in low-income countries is the insufficient supply of calories 2000 to 2300 kcal/person/day with cereals and roots and tubers contributing 60% to 80% of total calorie supply. Wheat in Yemen, sorghum in the Sudan, and a mixture of several cereals in Mauritania (wheat, rice and millet) and in Somalia (wheat, rice and sorghum) constitute the main staple foods. In quantitative terms, cereals supplies are a little more than 100kg per person per year in Somalia and the Sudan whereas in other countries it is higher and ranges from 160 to 180 kg. Per caput sugar supply is also rising and attain 20 to 25 kg per year and vegetable oils are levelling at 8 to 10 kg with the two combined contributing 15% to 25% of total calorie intake, a figure significantly different from the intermediate countries (20% to 30%) and the high-income countries (40% to 50%).

Protein supply is 60 to 70 g per person per day with the exception of Mauritania, a traditional consumer of fish, milk and meat and where per caput protein supply is 96 g per day. About 60% to 80% of proteins in the other countries are of plant origin, contributed mainly by cereals. In summary, the diet in low-income countries is insufficient in calories. It is little diversified, traditionally cereal-based with insufficient fruit and vegetable intake, and with cereals contributing 60% to 80% of total calorie and protein intake<sup>1</sup>.

## NUTRITION SITUATION

### Protein-Energy Malnutrition (PEM)

Comprehensive nutritional surveys have been carried out in some countries of the Region. However, adhoc surveys have been conducted in most of countries. Findings of these surveys revealed that PEM is a problem of concern in infants and young children in the Arab countries. Nevertheless, the magnitude of the problem varies from country to another. In general, the prevalence of undernutrition among infant and young children is very low in Kuwait, low in most Gulf states, relatively high in middle-income countries and very high in Sudan, Yemen and Djibouti.

Moderate and severe underweight (weight-for-age) is highly prevalent in Sudan and Yemen (20%-40%). Weight for age is more sensitive to any deterioration or improvement in the health of the child. Change in weight is also a very rapid indicator since it can take place in a matter of a few days. Excluding the low income countries, the prevalence of wasting is low in most Arab countries (2%-3%). Wasting (weight-for-height) is more specific to the child's degree of thinness than the measurement of weight for age, which does not distinguish between a tall thin child and a short fat one. Stunting (height-for-age) is more prevalent compared

to underweight and wasting, 12%-50%. Stunting is a stable measure that reflects the total increase in size of the child up to the moment that it is determined, and therefore the child's total previous health history<sup>3</sup>.

### Micronutrient Deficiencies

Micronutrient deficiencies are amongst the most common nutritional problems worldwide. The common micronutrient deficiencies of public health significance are iron deficiency anaemia, iodine deficiency disorders and vitamin A deficiency. According to WHO about 149 millions are at risk and affected by iron deficiency anaemia in the Eastern Mediterranean region. The corresponding figures for iodine disorders and vitamin A deficiency are 45 and 14 millions, respectively<sup>4</sup>.

Iron deficiency anaemia is the main nutritional problem in all Arab countries. It is estimated that about 30%-70% of pregnant women in the Region suffered from iron deficiency anaemia. The prevalence ranged from 10% to 50% among pre-school children, and from 20% to 70% among school children. Main causes of this problem are poor dietary intake of iron, low iron absorption, parasitic infection, malaria, vitamin A deficiency, multiparity and early age of marriage<sup>5</sup>.

In many of the Arab countries endemic goiter has been a familiar condition for decades with the result that alarming prevalence rates in certain regions have continued unchecked.

Results of surveys indicate that the Near East Region which include all Arab countries have about 15 countries in which iodine deficiency disorders (IDD) might pose a public health problems<sup>6</sup>.

The prevalence of IDD ranged from 6% to 80%. The main countries reporting these disorders are Egypt, Iraq, Jordan, Lebanon, Sudan, Syria, Algeria and Tunisia. Iodine deficiency disorders were also reported in some mountain areas in Saudi Arabia and the United Arab Emirates, but these disorders are not common health problems<sup>7,8</sup>. Low iodine in soil and in most foods commonly consumed are the main causes of IDD in this Region.

Despite abundant sunlight in this part of the world, vitamin D deficiency was found to be a public health problem in some countries. Rickets is a major public health problem in Yemen. A study in the North part of Yemen showed that 27% of children under five years of age had rickets. The condition was most common at the end of the first year and had disappeared by the fifth year<sup>9</sup>.

Vitamin D deficiency among infants and children has been confirmed in Jordan. This may be due to use of non-fortified milk and cereals, in addition to lack of exposure to sunlight during the period of children's rapid growth. A higher prevalence of vitamin D deficiency was reported among children in poor slums and remote villages<sup>10</sup>. Several studies in Saudi Arabia suggest low levels of vitamin D in mothers' plasma and in their infants. This indicates the role of the pathogenesis of rickets in infants born to mothers with inadequate vitamin D status, and the disease has its origin in the perinatal period. Even among Saudi adults, vitamin D deficiency is frequently seen<sup>11</sup>. Factors responsible for prevalence of vitamin D deficiency are: low exposure to sunlight, wrapping of infants for a long time, low dietary

intake of vitamin D and unavailability of other nutrients, especially calcium.

Few studies were carried out on vitamin A deficiency in this Region. Studies in Djibouti, Egypt, Iraq, Jordan, Lebanon, Oman, Somalia, Sudan and Yemen indicate that vitamin A deficiency is a public health problem, though the prevalence varied from country to country.

The national survey (1991) in Oman showed that 20.8% of those surveyed had serum retinal levels less than 0.70 mol/l, indicating a moderate to severe subclinical problem.

Children aged 19 months were mostly affected (22.8%) having serum retinal levels less than < 0.70 mol/l. Results of a biochemical study in Riyadh, Saudi Arabia, revealed that 10% of the population surveyed had serum retinal levels less than 0.70 mol/l, and that 1.1 had serum values less than 0.33 mol/l, indicating that VAD is not a severe problem. In Yemen it was found that 62.4% of children aged 1-5 years had serum retinal levels less than 0.70 mol/l<sup>12</sup>.

## **DIET-RELATED CHRONIC DISEASES**

Diet-related chronic diseases such as cardiovascular diseases, hypertension, diabetes, cancer and obesity have become the major health problem in high income countries, and in some urban areas in other countries in the Region.

### **Cardiovascular disease (CVD)**

Cardiovascular diseases in general are emerging as a major health problem in most of the Arab countries. Although reliable mortality data are hard to obtain, and some countries do not report death by cause, data provided from Arab countries of the Gulf, Iraq, Jordan and Syria revealed that CVD were the leading cause of death, representing 18% to 40% of total deaths<sup>13</sup>.

Studies on risk factors associated with CVD in the Arab countries are limited. However, studies conducted in some countries on the risk factors profile and related lifestyle patterns reveal levels generally similar to those in industrialized communities. High fat and cholesterol diet, lack of physical activity, obesity, diabetes, hypertension and tobacco smoking were the main factors responsible for the high incidence of CVD in the Arab countries<sup>13</sup>.

Available data indicate a considerable and progressive increase in tobacco consumption over the last three decades.

Imports and manufacture of cigarettes are progressively increasing. Data also demonstrate high rates of smoking in populations of the Arab countries, especially among men<sup>13</sup>.

### **Hypertension**

Several studies have examined blood pressure levels in the Arab population. Using the WHO criteria of 160/95, the prevalence rates of hypertension ranged from 10% to 17% of adult population. Some epidemiological surveys on hypertension (>140/90) reported prevalence rates among adults of up to 30% in some urban areas. The prevalence of hypertension appears to be lower in rural than urban areas<sup>13</sup>.

Detection rate and the level of awareness among hypertensive persons are generally low. In the report from Iraq, only 19% of hypertensives were aware of their high blood pressure

prior to the survey. Similarly, in Pakistan, for every known case of hypertension, there are three undetected cases. Hypertension, like diabetes, may remain asymptomatic for years and is only detected when one of its devastating consequences occurs<sup>13</sup>.

### **Diabetes mellitus**

Diabetes and impaired glucose tolerance, are increasingly encountered. During the last decade, data on the epidemiology and clinical characteristics of the two types of diabetes have been reported from several countries. On the basis of various diagnostic criteria, diabetes has been detected in 4.3%, 4.8% and 5% of Egyptian, Iraqi, and Saudi Arabian samples, respectively. Based on the results of epidemiological surveys using the WHO standardized criteria, it is estimated that 10% of Tunisians and 14% of Omanis in the age range 30-64 years have diabetes. A survey in Oman, using WHO diagnostic criteria, revealed a prevalence of 9.8% in a sample of people aged 20 years and over. The intermediate category of impaired glucose tolerance, which may be associated with increased susceptibility to macrovascular complications, affects an additional proportion of people. In the Omani survey, this condition occurred in 10.9% of the sample, and so the overall prevalence of glucose tolerance abnormalities exceeded 20%<sup>14</sup>.

The proportion of non-insulin dependent diabetics who suffer from obesity ranges between 75% in Iraq to 46% in Sudan. A substantial proportion of insulin dependent diabetes presents with ketoacidosis. This serious and potentially fatal condition has been reported to be present in 82% and 67% of diabetic children at the time of diagnosis in Sudan and Saudi Arabia respectively, and is the presenting manifestation in about 30% of Iraqi diabetics<sup>15</sup>.

While these data demonstrate the high susceptibility of the Arab populations to diabetes, reports have also shown that diabetics develop long term complications such as coronary heart disease at a rate similar to that seen in Western countries. This means that up to 20% of non-insulin dependent diabetics have been found to have retinal complications at the time of first diagnosis and that most would develop them over subsequent decades. A substantial proportion of people with IDDM eventually develop end stage renal failure and the majority of the diabetic population will eventually develop a potentially lethal cardiovascular complication<sup>15</sup>.

### **Cancer**

Cancer has become the third cause of death in many countries of the Region, behind diseases of the circulatory system and accidents and injuries. Published reports on the magnitude of the cancer problem are scarce and population based cancer registries are established in only a few countries. However, hospital-based data are available from the major cancer treatment centers in most countries in the Region. Generally, the common cancers among males include lung, lymphoma, bladder, stomach and mouth/pharynx. Among females, breast, urinary bladder, lymphoma and cervix are common cancer sites. However, regional variations exist, as can be observed from the country profiles; for example, high frequencies of nasopharyngeal carcinoma in males and uterine cervical cancer in females are reported from Morocco and Sudan<sup>16</sup>.

## Obesity

Obesity, which is considered a risk factor for several chronic diseases, has reached alarming levels in many countries in the Region, especially among women. Using the cut-off of more than 25 Body Mass Index (BMI), the prevalence of overweight and obesity ranging from 50% to 70% in women in the Arab countries of the Gulf, Jordan, Lebanon, Egypt and Tunisia. The corresponding percentages for men are 15% to 55%<sup>17</sup>.

Factors associated with obesity have not been well investigated. Some studies showed that lack of physical activity, high intake of energy rich foods, sedentary life-style, multiple pregnancies, ethnic background, family history of obesity and socio-cultural factors are linked with obesity among adults in the Region.

## CONCLUSION

The Arab countries face several nutritional problems; growth retardation in infants and young children, micronutrient deficiencies and diet-related chronic diseases. The prevalence of these problems vary from country to country, due to difference in socio-economic status, health facilities and food availability. Although some of the Arab countries have formulated a National Nutrition Plan of Action to overcome the nutritional problems, none of these countries have put this plan in implementaiton. The need for practical and effective programmes to prevent and control of nutritional problems in the Arab countries are highly recommended. These programmes should be carried out in cooperation and coordination with several governmental, private and industrial sectors.

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## Appendix. Summary of Nutritional Problems in the Arab Countries

Problems	Countries most affected	Major underlying causes
Undernutrition in general and PEM in infants and young children	Sudan, Somalia and Yemen	Food Scarcity Poverty High infection Lack of nutrition awareness Poor sanitation
Maternal malnutruon	Somalia, Sudan and Yemen	Dietary inadequacy Early age at marriage Frequent pregnancies at short intervals High energy cost due to work during pregnancy Lack of maternal care
Anaemia (especially iron deficiency anaemia)	All the countries	Unsound food habits Low iron intake Low iron absorption Parasitic infestation Malaria Multiparity
Iodine deficiency Disorders (IDD)	Egypt, Iraq, Lebanon, Libya, Sudan and Tunisia	Low iodine in soil and food commonly consumed
Vitamin A deficiency	Sudan and Yemen	Unsound food habits Low vitamin A intake Infection
Vitamin D deficiency	S. Arabia, Yemen, Jordan (and may be in most countries especially among infants)	Use of unfortified food Lack of vitamin D in foods Lack of exposure to sunlight
Diet-related chronic diseases: cardiovascular disease, hypertension, diabetes, obesity, dental caries and some types of cancer	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE, Tunisia, Jordan and Egypt Sizeable proportion of population in urban areas is affected too, in other countries	Excess intake of certain nutrients Sedentary lifestyle Smoking Lack of physical activity High intake food rich in fat and sugar

## Change in Dietary Habits, Lifestyle and Trend in Diseases in the GCC Countries

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The GCC countries have experienced a rapid change in dietary habits and lifestyle during the past three decades with the sharp increase in income as a result of the oil revenue. The traditional diet, which consisted of dates, milk, rice, brown bread, fish and vegetables has changed to a more westernised diet. Lifestyle has changed markedly as physical activity has diminished and a sedentary lifestyle has become the norm. Studies showed that about 20-25% of men practised exercise compared to about 6-10% of the women. A high percentage of both adults and children watched television for more than three hours daily. Women and adolescent girls were more likely to watch television than men and adolescent boys. These changes in food habits and lifestyle have lead to a great change in morbidity and mortality patterns. Infectious diseases have gradually disappeared and chronic non-communicable diseases are becoming more apparent.

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The GCC countries, namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates have experienced a rapid change in socio-economic status, food consumption patterns, lifestyle and health status during the past three decades, mainly due to the oil boom and sharp increase in income. These changes have their impact on the nutritional and health situation of the Gulf community, with development of a paradoxical nutrition status, as both under and over-nutrition exists. Under-nutrition manifested as growth retardation among preschool children and anaemia in young children, adolescent girls and pregnant women, while over-nutrition manifested as overweight and obesity and diet-related non-communicable diseases.

The improved standards of living and health services in these countries have lead to improvement in life expectancy, which increased from 50-59 years in the 1950s to more than 70 years in the 1990s. This situation has participated in the occurrence of several chronic diseases, especially cardiovascular disease, diabetes mellitus, hypertension and cancer. Additionally, the sedentary lifestyle and shifting from traditional diet to more westernized diet play an important role in changing the trends in diseases and the nutrition status of the population. The objective of this paper is to highlight the current changes in nutrition, health, lifestyle and food habits in the GCC countries<sup>1</sup>.

### Change in Dietary Habits

There has been a drastic change in food consumption patterns in the GCC states during the past three decades. The traditional diet which consisted of dates, milk, rice, brown bread, fish and vegetables has changed to a more diversified diet. The consumption of dates, fruits and vegetables has decreased gradually, especially among children and adolescents. Brown bread has been replaced by white bread and fast foods have become the most common foods preferred

by young people<sup>2</sup>. Cereal consumption seems to have reached a ceiling, with a contribution to overall dietary energy supply of 35-42%. The main cereals consumed are rice and wheat and the rice consumed is polished and contains only 0.5% crude fiber<sup>3</sup>. Wheat is mostly consumed as bread made from flour with an extraction rate of 70-75%. Sugar consumption is rising from an already relatively very high level of 80-110 g/head/day and contributes 10-15% of daily energy supply. The same trend was seen for oils and fats, with consumption around 80 g/head/day and contributing 30% of daily calorie supply. The consumption of animal products is high compared to most developing countries (160-190 g meat, 400-490 g milk, and 22-32 eggs/head/day)<sup>4</sup>.

Studies on the intake of complex carbohydrates in the Arab countries are at most scanty. This is mainly due to the lack of information on the fiber content of several foods consumed, as well as to a general neglect of the role of fiber in health and disease in nutritional surveys. However, since fiber is found only in the carbohydrate portion of the diet, it is widely accepted that the level of fiber in the Arab diet is decreasing. This can be assumed from the evidence for a decrease in the percentage of dietary intake from carbohydrates in most countries in the Arab region. Foods in the region are becoming increasingly processed with the result that grain products tend to be more refined and thus lose their fiber content. A further decrease in fiber intake take place with a decrease in the consumption of whole grains. Fresh fruits and vegetables are considered rich sources of dietary fiber. The trend in consumption of these foods can be a good indicator for fiber intake in the Arab countries.

Food frequency studies of fruits and vegetables intake in the Arab Gulf states indicate low intake<sup>5-7</sup>. Between 59% and 23% of adults did not consume fresh fruit daily, and between 50% and 19% did not consume vegetables daily (Table 1). According to Pender<sup>8</sup> using the four groups guide, an adult should consume at least two to four servings of

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Table 1. Frequency of intake of fresh vegetables and fruits in some GCC countries

Country	Age (years)	Sex	Sample size	Food	Daily	% Frequency intake <sup>1</sup>		
						4-6/w	1-3/w	Rarely or none
Bahrain Musaiger & Al-Roomi (1996) <sup>7</sup>	30-79	M	299	Veg <sup>2</sup>	78.9	2.3	10.4	8.4
				Fruit	63.5	4.7	19.1	12.7
	30-79	F	217	Veg	81.1	3.7	9.7	5.5
				Fruit	65.4	6.5	12.4	15.7
Oman Musaiger (1992) <sup>2</sup>	15-50	F	900	Green Veg	50.3	3.1	31.3	15.4
				Yellow Veg	33.2	3.9	11.1	51.8
				Citrus Fruit	76.5	2.0	2.6	18.0
UAE Musaiger & Radwan (1995) <sup>6</sup>	18-30	F	215	Veg	59.1	20.0	7.9	13.0
				Fruit	40.9	32.1	9.3	17.7
Musaiger & Abuirmeileh (1998) <sup>22</sup>	20-80	M	1090	Veg	59.6	22.8	15.4	2.2
				Fruit	46.2	24.6	25.7	4.7
	20-80	F	1122	Veg	64.7	17.2	15.3	2.8
				Fruit	52.5	21.4	22.0	4.1

<sup>1</sup> Frequency per week

<sup>2</sup> Veg = Vegetables

fruit and a similar number of servings of vegetables per day. Thus a high proportion of adults in the Gulf community do not consume the amount of fruits and vegetables currently regarded desirable. The relationship between the intake of high-fiber foods, such as fruits and vegetables and the occurrence of chronic non-communicable diseases is well documented<sup>9</sup>. A recent study in Bahrain showed the patients with myocardial infarction tended to consume fruits and vegetables less frequently per week than community control subjects<sup>10</sup>.

The intake of fiber-rich foods by children and adolescents in most Arab Gulf countries is alarmingly low. The dietary habits of school children and adolescents in the region are characterized by low intake of fresh fruits, vegetables and milk and a high intake of carbonated beverages and foods. In general the food habits of the Arab Gulf adolescent particularly in urban areas, have become similar to that reported for Western communities in relation to snacking patterns and consumption of fast foods<sup>11-13</sup>. These changes in food habits may in part explain the increase in diet-related chronic disease in the Gulf region.

#### Change in Lifestyle Patterns

In addition to the change in food consumption patterns, the other changes in lifestyle are increase in smoking, decrease in practising exercise and sedentary lifestyle patterns. Smoking has been repeatedly found to be one of the risk factors for several chronic diseases. A secular trend of increasing cigarettes smoking among both males and females in the GCC countries was reported. In Bahrain, Hamadeh et al<sup>14</sup> showed that 33% of men and 9% of women aged 15-80 years were smokers. In Kuwait, the prevalence of smoking was higher as 52% of men and 12% of women aged 20 years and above were smokers<sup>15</sup>. Interestingly, smoking among physicians is higher in the region compared to the western region. Bener et al<sup>16</sup> found that although 91% of

physicians in the United Arab Emirates agreed that smoking is hazardous to health, 36% of them were current smokers and 31% were former smokers. The prevalence of smoking among university students in the Gulf is also high. Hamadeh et al<sup>17</sup> reported that 27.5% of Gulf medical male students aged 18-31 years were smokers, compared to 2% of female students at the same age group.

Passive smoking, especially among women, seems to be a problem of concern in the Gulf region. Studies showed that women and other family members were regularly exposed to a smoking environment at home and at work. In the United Arab Emirates, 37% of married women were exposed to smoking, mostly from their husbands<sup>18</sup>. In Qatar, about 38% of mothers reported that their husbands were current smokers<sup>19</sup>. In Bahrain, 20% of men and 45% of women aged 30-49 years had one or more smokers in their families<sup>7</sup>.

Studies on practising exercise in the Gulf region are very limited and mostly focused on exercise as a risk factor for heart disease, rather than studying the exercise habits in the community. In Bahrain, Musaiger and Al-Roomi<sup>7</sup> found that as age increased the practise of exercise decreased. The prevalence of exercise among men decreased from 20% to 7.5% at age 30-49 years and 50-79 years, respectively. The corresponding proportions for women at the same age were 10% and 6%, respectively. Additionally, television occupied most of leisure time of the people in the Gulf, especially adolescent girls and women. About 41% of mothers in Oman watched television for more than 4 hours a day<sup>5</sup>. In Bahrain the majority of men (77%) and women (80%) reported watching television daily<sup>7</sup>. This is consistent with a sedentary lifestyle pattern which may have a role in the aetiology of some chronic diseases.

Studies on risk factors associated with diet related chronic diseases in Bahrain are at most scanty. Al-Roomi et al<sup>10</sup> carried out a population-based case-control study to explore

the importance of lifestyle in the occurrence of Acute Myocardial Infarction (AMI) among Bahrainis aged 30-79 years. The findings showed that the prevalence of tobacco smoking among the first-time AMI cases (64%) was higher than that among controls (44%), with current cigarette smokers being 2.1 times more likely to have an episode of myocardial infarction than those who had never smoked regularly. Walking regularly and spending less time watching television at home also appeared to be associated with a reduced risk of developing AMI.

Because the AMI cases and community controls had different sex and age distributions, multiple logistic regression was used to estimate the risks of the occurrence of AMI in relation to hypertension, diabetes, lifestyle and dietary habits. The adjusted OR (adjusted for age, sex and several other confounding variables) for the occurrence of an episode of first-time AMI in a subject with a history of hypertension was 5.04 and in those with a history of diabetes 3.28. The risk of developing AMI, in line with many studies from western communities, was higher among men than women in those not currently married and increased with older age. Although 22% of first-time AMI cases were obese subjects (BMI>30), this proportion was lower than that among the community controls (33% were obese) using weight as a single measurement, the mean weight of cases was slightly lower than that of controls (66.5 kg + 16.1, and 68.4 kg + 14.9, respectively)<sup>10</sup>.

The same study showed people who did not walk regularly for exercise who reported infrequent intake of fresh fruits and who infrequently consumed fresh vegetables were still at an increased risk of developing myocardial infarction, even after adjusting for the effects of all the other factors. Similar findings were obtained when the logistic regression analysis was repeated excluding those aged 60-79 years (30 cases and 130 controls).

### Change in Diseases Trends

The changes in food habits, life expectancy and lifestyle in the GCC countries has led to a greater change in morbidity and mortality patterns. Infectious diseases have gradually disappeared and chronic non-communicable diseases are becoming apparent. Diseases of the circulatory system such as Ischaemic Heart disease, Acute Myocardial Infarction, Cerebrovascular disease and Artherosclerosis are now the major cause of death in the Gulf, representing 25% to 37% of total annual deaths (Table 2).

Table 2. Deaths due to diseases of circulatory system, neoplasms and accidents and injuries in the GCC countries

Country	Year	% of total death		
		Circulatory system disease	Neoplasms	Accidents & injuries
Bahrain	1993	28.6	12.3	8.2
Kuwait	1994	36.7	12.4	10.6
Oman	1992	24.3	11.3	6.3
Qatar	1994	34.0	12.0	19.0
UAE	1992	25.0	8.0	--

Source: Reference No. 23

Hypertension has long been recognized as a risk factor for CVD. Using the WHO blood pressure criteria of 165/95 mmHg, the prevalence rates have been reported to range from 10% to over 17% of the adult population. Obesity, which is considered a risk factor for several chronic illnesses, has reached an alarming level in many countries in the region, especially among women. Using the criterion of BMI (Body mass index: weight in kg divided by height<sup>2</sup> in m<sup>2</sup>) of 25 the prevalence of overweight and obesity among women ranged from 50% to 70%, while the prevalence among men ranged from 15% to 54%. Non-insulin-dependent diabetes is a serious health problem in the region.

The prevalence of this type of diabetes is about 5% in population samples in Saudi Arabia, Iraq and Egypt. In the age range 30-63 years, 10% of Tunisians and 14% of Omanis have been estimated to have diabetes. The survey from Oman which used the WHO diagnostic criteria revealed the highest prevalence in the Arab region; 9.8% of the population sample aged over 19 years. Cancer has become the third cause of death in these countries, behind the cardiovascular diseases and injuries and accidents. The percentage of deaths due to cancer ranged from 6% to 19%. The main sites for cancer are lung, gastrointestinal, breast, liver and prostate, respectively<sup>1,9,20,21</sup>.

### Constraints to the control of diet-related chronic diseases in the Gulf<sup>1</sup>

Prevention and control of diet-related chronic diseases have received little attention in all Gulf countries. This can be attributed to the following factors:

1. Most health services focus on curative procedures for chronic diseases rather than preventive measures. The most sophisticated technology to treat these diseases, especially heart diseases, is employed and this makes a heavy load on the budget of health services, affecting expenditure on the preventive health.

2. Lack of epidemiological studies related to factors associated with chronic diseases. Although some of the risk factors are well established, it is believed that the magnitude of these factors may not be the same as those reported in Western countries. In addition there are some socio-cultural factors and behavioral changes which may differ from Western countries and play an important role in the prevalence of some chronic diseases.

3. Inadequate health information system. Although the reporting systems in health sectors in the Gulf have improved, the health information system is still ineffective for monitoring the health status of the community. This is mainly due to the lack of specialized staff rather than the lack of information technology.

4. Inadequate health and nutrition education. In general, health education programmes in the Gulf are far from being effective. This is mainly due to lack of specialized personnel in the mass media and incorrect selection of appropriate educational channels and target groups. Nutrition and health education in the region often pays little attention to preventing and managing diet-related chronic diseases. Even when this is done it is usually based on foreign sources without taking into consideration the local circumstances.

5. Insufficient information on prevention and management

of chronic diseases especially in health and medical curricula. Nutrition is given a low priority in medical and paramedical education in all the Gulf countries. There is no central programme for prevention and control of local nutritional problems. In some health colleges, nutrition is either only taught in mother and child health curricula, or given at a rather elementary level.

6. Unclear food subsidy policies. In the 1970s the Gulf countries established food policies to keep the price of staple foods within the purchasing power of the majority of the population. The main foods subsidised are rice, wheat, sugar, oils, fats and meat. This policy may encourage an increase in the intake of foods rich in energy and animal fat. It is recommended that the governments in the Gulf should change their policies so as to promote the consumption of foods that provide protection for chronic diseases such as vegetables, fruits and fish. These foods have become more expensive and are out of the reach of many low socio-economic families.

7. Absence of a Food and Nutrition policy. There is no food and nutrition policy in any of the Gulf countries. These countries carry out projects and programmes of various types in the fields of agriculture, health, social policy and education that are directly or indirectly related to control of nutritional problems. These programmes are often developed in isolation from other activities.

## CONCLUSION

Although reliable data on the pathogenesis of chronic diseases in the Gulf are lacking, it is widely thought that the causation of these diseases is not simply the high intake of foods rich in fat and free sugars but rather results from a mixture of several factors such as sedentary life-style, high income, ignorance and low education and sociocultural factors as well as an increase in smoking and consumption of alcoholic drinks<sup>9</sup>.

A major challenge for the Gulf countries is therefore to adapt to the current health situation by developing new programmes and services related to prevention and control of chronic diseases. At the same time, these countries should maintain essential programmes to control infectious diseases.

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# Smoking in the Gulf Cooperation Council (GCC) Countries

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**Review of available documents on smoking shows variation in the number and nature of studies in the Gulf Cooperation Council (GCC) countries. The majority of the studies done were smoking prevalence studies while few were on tobacco consumption, smoking related diseases, and mortality attributed to smoking.**

The prevalence of smoking among males in the Arabian Gulf is higher than that of their female counterparts. The prevalence of smoking among males is higher in Kuwait and Saudi Arabia than Bahrain and Oman while that of females is highest in Kuwait. Smoking among physicians is high in the GCC countries compared to Western countries. Comparing smoking among physicians in GCC countries, Kuwait and UAE are on the top for male physicians, and Saudi Arabia and Kuwait for female physicians. However, there are differences in the type of physicians sampled. The prevalence of smoking among male and female medical and non-medical university students as well as male secondary school students is high in the region. The prevalence data however lack uniformity in definition of a smoker and do not separate the data by nationals and expatriates.

The adult cigarette per capita consumption has generally declined in the early 90s compared to that of the late 80s. All the GCC countries seem to have similar health warnings and statements of content and control of tar and nicotine. The recent decrees on smoking control in Bahrain and Kuwait have put these countries ahead in other aspects of control.

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The exact date of tobacco introduction to the Gulf Cooperation Council (GCC) countries; Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE) is unknown but it is assumed that smoking became popular at the beginning of the 18th century<sup>1,2</sup>. The major forms of tobacco products that are in use in the GCC countries are cigarettes and the waterpipe, whereas the extent of the cigar and pipe smoking is less prevalent. Tobacco cultivation is practised in Oman and the UAE but cigarette manufacturing is not practised in any of these countries<sup>3</sup>.

Review of the available documents on smoking shows variation in the number and nature of studies in the GCC countries. The majority of the studies done were smoking prevalence studies which considered the adult population or population subgroups<sup>4-32</sup>. Studies on tobacco consumption<sup>33</sup>, smoking related diseases (not reviewed in this paper)<sup>34-40</sup>, and mortality attributed to smoking<sup>13,40</sup> are few.

## PREVALENCE OF SMOKING

*I. Prevalence of Smoking in the Adult Population* (Table 1).

**Men** – The prevalence of daily smoking among adult ( $\geq 15$

Table 1. Prevalence of smoking among men and women in GCC countries

Country	Date of survey	Prevalence		Source
		M	F	
Bahrain				CSO, 1993 <sup>a</sup>
Bahraini	1991	21.9	6.9	
Non-Bahraini		24.9	2.9	
Total		23.5	5.7	
Bahraini	1982	30.6	9.5	Hamadeh, 1992 <sup>b</sup>
Non-Bahraini		40.4	7.9	
Total		33.1	9.2	
Kuwait	1991	52.0	12.0	WHO, 1996 <sup>a</sup>
	1989	34.0	6.0	
Kuwaiti	1980	42.7	7.5	WHO/EMR <sup>d</sup>
Non-Kuwaiti		55.0	14.6	
Oman	1990's	23.5	1.6	Al-Naqeeb, 1981 <sup>c</sup>
Oman				Hasab, 1996 <sup>c</sup>
Saudi Arabia				
Al-Baha		52.7	--	Al-Bedah, 1989 <sup>a</sup>
Riyadh (Saudi)	1994	40.0	8.2	Saeed et al., 1996 <sup>a</sup>
Riyadh	1993	--	4.8	Al-Faris et al., 1995 <sup>c</sup>

*a* Smoker = current daily smoker

*b* Smoker = current occasional and daily smoker

*c* Smoker = current cigarette smoker

*d* Smoker = not specified

*e* Smoker = Current smoker

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years) males is highest in Kuwait<sup>4</sup>, and Saudi Arabia<sup>5,6</sup>. A higher prevalence is noted among Saudi adult males<sup>6</sup> compared to their Bahraini<sup>7</sup> counterparts. Current cigarette smoking among Omani men is 23.5%<sup>8</sup>.

**Women** – The prevalence of smoking among adult females ranges between 1.6% and 12% in the GCC countries, the highest being in Kuwait<sup>4-10</sup>. Cigarette smoking has gained popularity among women in the Arabian Gulf<sup>11</sup> but waterpipe smoking is still considered a more socially acceptable behavior than any other type of smoking among women.

**Trends** – Both Kuwait and Bahrain have data on the prevalence of adult smoking in the 80s and 90s<sup>11-13</sup>. However, the definition used for a smoker varied in the studies of the two periods. Comparing regular smoking in Bahrain in the two periods has shown that there was a significant increase in the prevalence of regular smoking among women while the rates in men remained unchanged<sup>14</sup>. Moreover, the Kuwait data are suggestive of a rise in smoking in both men and women<sup>4, 12,13</sup>.

**2. Smoking Among Population Subgroups**

**Physicians** (Table 2) – Male physicians in Kuwait (45.3%) and the UAE (43.9%) have a higher prevalence of smoking than their counterparts in Saudi Arabia (38.5%) and Bahrain (26.6%)<sup>15-17</sup>. Female physicians in Kuwait (16.0%) and Saudi Arabia (15.8%) had higher rates than their colleagues in Bahrain (6.9%) and UAE (8.2%). However, there was a variation in the physician population in each study and the definition of smoker used.

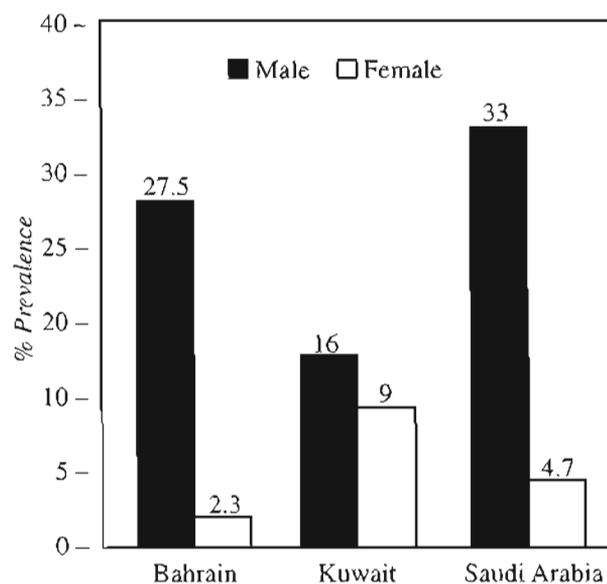
Table 2. Smoking among physicians in GCC countries

Country	Study period	Physicians' population	Prevalence		Source
			M	F	
Bahrain	1994	Primary Health Care			Hamadeh, 1997 <sup>a</sup>
Bahraini	22.7		6.3		
Non-Bahraini	28.6		7.7		
Total			26.6	6.9	
Kuwait	1990	Not Specified	45.3	16.0	Bener et al., 1993 <sup>b</sup>
Saudi Arabia	1987-1988	General Civil Health Facilities	38.0	16.0	Saeed et al., 1989 <sup>a</sup>
UAE	1991-1992	Not Specified	43.9	8.2	Bener et al., 1993 <sup>b</sup>

*a Smoker: Current daily and occasional smoker*  
*b Smoker: Daily cigarette smoker.*

**Medical Students** (Figure 1) – Smoking among male medical students in GCC countries is higher than that of the females. One third of male medical students in Riyadh, Saudi Arabia<sup>18</sup> are smokers, 27.5% in Bahrain<sup>19</sup> and 16.0% in Kuwait<sup>20</sup>. The highest prevalence of smoking among female future physicians is in Kuwait<sup>20</sup> (9.0%) followed by Saudi Arabia<sup>21</sup> (4.7%) and Bahrain<sup>19</sup> (2.3%). The definition of a smoker included occasional and daily smokers in all of the studies

except that of Saudi male medical students, which included daily smokers only.



Daily and occasional smoking except for males in Saudi Arabia which included daily smoking only

Figure 1. Prevalence of smoking among medical students in GCC countries

**Allied Medical Sciences Students** – In King Saud University, the prevalence of smoking among male allied medical students is 46.8% compared to 12.4% in females. One third of the Saudi male students and 14.3% of the Saudi female students smoke<sup>22</sup>. Of the male students in the Secondary Health Institutes in Riyadh City, 17.5% are smokers compared to 8% of their female counterparts<sup>23</sup>.

**Non-Medical Students** – Daily smoking among King Saud University male non-medical students<sup>24</sup> (37.0%) is slightly higher than that of their Kuwaiti counterparts in Kuwait<sup>25</sup> University (30.3%). However, the latter study included cigarette smoking only. Five percent of female non-medical students in King Saud University are daily smokers and 3.3% occasional<sup>21</sup>.

**School Students** – The prevalence of smoking among male secondary students appears to be on the increase in Bahrain and Kuwait. The prevalence of smoking increased from 14.8% in 1982 to 21.4% in 1989 and to 25.8% in 1996 in Bahrain<sup>26-28</sup>. Smoking prevalence rose from 24% in 1990 to 50% in 1991 among high school children aged 14-18 years in Kuwait<sup>3</sup>. In Riyadh, Saudi Arabia, 12.1% of male secondary students aged 12-18 years were occasional and daily cigarette smokers in 1984<sup>29</sup>. Ten years later, Felimban and Jarrallah, and Jarallah et al reported similar percentages (12.0%, 13.2%) in smoking of any kind of tobacco among intermediate and secondary male students in the same city<sup>30,31</sup>. However, the first study included occasional and daily smokers and the latter daily smokers only. The percent of Saudi nationals was probably higher in the earlier study, as 95% of the students had fathers working in the Saudi Armed Forces and were selected from one school<sup>29</sup> while 80% of the students in the latter studies were Saudi and the study populations were not selected from one school<sup>30,31</sup>. These factors might affect the conclusions that can be drawn in

that no change has occurred in the prevalence of smoking in that age group.

In Oman, 6.5% of secondary male students and 0.9% of their female counterparts are smokers. However, 6.7% and 1.2% of intermediate school male and female students are smokers<sup>32</sup>. The study fails to indicate the mode of administration of the questionnaire as in-person interviewing would have affected the prevalence of smoking by underestimating it in this age group.

Among current smokers, nearly twenty percent of the Omani<sup>32</sup> secondary male students smoked before the age of 13 years compared to half of their Saudi<sup>31</sup> and 37.6% of their Bahraini<sup>26</sup> counterparts.

## CIGARETTE CONSUMPTION

Annual adult cigarette per capita consumption is high in GCC countries. The UAE occupies the 7th rank with respect to annual cigarette consumption when compared with 127 other countries in 1990<sup>42</sup>. However, a 43% decline has been reported between 1986 and 1990 reaching 3218<sup>41</sup>.

Annual adult cigarette per capita consumption increased until the mid 80s in Bahrain and Kuwait and started to decline reaching 2017 in Bahrain<sup>42</sup> and 2280 in Kuwait<sup>3</sup> in the early 1990s. In contrast, annual adult cigarette consumption in Saudi Arabia has risen significantly since the early 70s, averaging to 2130 in 1990-1992<sup>3</sup>.

## MORTALITY FROM TOBACCO USE

Age-standardized death rates for lung cancers are relatively high in Kuwait<sup>3</sup> (35 for males and 15.3 for females per 100,000 during the period 1985-1989) and in Bahrain among nationals (26.7 for males and 9.4 for females per 100,000 during the period 1978-1982). The truncated standardized death rates (35-64 years) during the same period were 45.8 and 15.6 per 100,000 among the Bahrainis<sup>40</sup>.

## TOBACCO CONTROL MEASURES

Countries in the GCC collaborate in tobacco control measures. A series of resolutions has been adopted on smoking and health by the Secretariat General for the Council of Health Ministers since 1979 to date<sup>40,43</sup>. Both Bahrain (1994) and Kuwait (1995) have comprehensive tobacco control policies supported by an Antismoking law issued by the Amir of the country. Qatar has an Amiri decree concerning tobacco control in the Ministry of Health and its establishments while Saudi Arabia has a prime ministerial decree in this respect. Oman, however, has a voluntary law on sales of tobacco and tobacco products.

Both Bahrain and Oman have a national Antismoking Committee that has representatives from all ministries and other sectors. The Antismoking Committee helps in policy development and coordination of tobacco control measures. Moreover, Bahrain, Saudi Arabia and Kuwait have Antismoking Societies.

Imported tobacco and tobacco products to GCC countries should satisfy several conditions like maximum tar and nicotine content, carrying a health warning and production date. Countries vary in their policies concerning tobacco advertising, sponsoring of social events and distribution of

gifts promoting cigarette sales and restrictions on sales to minors. In the efforts to protect non-smokers, GCC countries vary in the number of places that smoking is prohibited<sup>3</sup>.

## CONCLUSION

Review of available documents on smoking shows variation in GCC countries by number and nature of studies done. Statistics on smoking are lacking in some of the countries. The majority of the studies are on the prevalence of smoking and few on tobacco consumption, smoking related diseases and mortality attributed to smoking.

It can be concluded that smoking is a problem in the GCC countries. The prevalence of smoking is high among adult Kuwaiti and Saudi males, male physicians, male medical and non-medical students and secondary male students. The prevalence of smoking among females is relatively low in the region with the exception of Kuwait. However, the indications that it is increasing among women and secondary male students implies that school students and women should be targetted in tobacco control efforts. Adult cigarette consumption is high in the region but has started to decline in some of the countries.

Commendable efforts have been made by the GCC countries in smoking control. Adoption of unified measures and passing of laws by the rulers of some of the countries reflect the importance of tobacco control to these governments.

Future studies in the region should include a uniform definition of a smoker to allow trend comparison and comparison between countries. Moreover, due to the transient and heterogenous nature of the expatriates in the different countries, analysis by nationality should be a must.

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## Nutritional Problems among Pregnant Women in the GCC Countries

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The aim of this paper is to highlight the nutrition status of pregnant women in the GCC countries. Iron deficiency anaemia is one of the main nutritional problems among pregnant women in the Gulf, with a prevalence ranging from 30% to 54%. Overweight and obesity are problems of concern in this group of women. It was estimated that 54%-70% of the women in this region were overweight and obese. On the other hand, underweight is prevalent among 3%-13% of the women. Gestational diabetes occurred in 5%-10% of pregnant women, which may be associated with significant pregnancy complications. Early age at marriage, multiple pregnancies, unsound food habits, traditional beliefs and attitudes, social change and lifestyle are the main factors associated with the nutritional status of pregnant women in the GCC countries. Recommendations to improve the nutritional status of pregnant women in the region were suggested.

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The recent rapid increase in the wealth of Arab Gulf Countries is well known. What is less well appreciated is that the nutritional well being of their population has not improved accordingly. Women of reproduction age, pregnant and lactating mothers, and children are most susceptible to the development of nutritional problems than other groups. The objective of this paper is to highlight the current situation of the nutrition of pregnant women in the GCC Countries.

### Iron Deficiency Anaemia

Studies in the Gulf countries demonstrated that iron deficiency anaemia is one of the main public health problems among pregnant women. Using haemoglobin level less than 11g/dl, the prevalence of anaemia ranged from 30% to 54% in these women (Table 1). The lowest prevalence was reported in Qatar, which is largely due to estimating the anaemia in the first trimester. The requirements for iron during the first trimester are relatively small, but rise considerably during the second and third trimester<sup>1</sup>. A study in Kuwait showed that the prevalence of anaemia was 21% during the first trimester, increasing to 38% and 45% during the second and third trimester, respectively<sup>2</sup>.

Using other blood parameters, iron deficiency anaemia among pregnant women was still high. In Saudi Arabia, Khoja et al<sup>3</sup> reported that 57% of pregnant women were anaemic, using transferrin saturation (< 16%). When serum ferritin (< 12 mg/ml) was determined for the same women, the prevalence of anemia was very close to that of transferrin saturation (54%).

Table 1. Prevalence of anaemia among pregnant women in the GCC Countries (Hb < 11g/dl)

Country	Sample size	% Anaemia	Reference
Bahrain	1200	54.0	15
	228	41.7	16
Kuwait	900	31.0	17
	1582	39.7	2
Oman	1000	54.0	18
	1310	48.5	19
Qatar	299	30.0	20
Saudi Arabia	272	25.6	21
	6539	31.9	22
	952	22.9	23
United Arab Emirates	274	44.0	24
	621	22.7	25

Iron deficiency anaemia can be caused by nutritional deficiencies, diseases, inadequate intake of usable iron and excessive blood loss<sup>4</sup>. The intake of food that inhibits iron absorption may also play a role in the prevalence of this anaemia. It is well documented that the consumption of tea inhibits the absorption of iron. Tea is widely consumed in this area particularly after a heavy lunch. The low consumption of food rich in vitamin C is another contributing

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factor. as this vitamin enhances the absorption of iron. Increase in the awareness of mothers towards the right food to be taken during pregnancy and lactation, fortification of some staple foods with iron, as well as iron supplementation, are the main activities to decrease the prevalence of iron deficiency anaemia.

### Obesity

Obesity among women is considered a new problem associated with affluence. Recent studies in the GCC countries<sup>5</sup> reported a high prevalence of overweight and obesity among women ranging from 54% to 70%. These percentages are higher than those reported in many developed countries. Epidemiological studies have indicated that obesity is a risk factor for several chronic diseases such as hypertension, diabetes, heart diseases and some types of cancer<sup>6</sup>.

The increased prevalence of overweight and obesity among Arab Gulf women has brought concern about the possible influence of these changes on pregnancy outcomes. During the past decade, the incidence of macrosomia (large infants weighing 4.0 kg or more at birth) has increased in the region. Maternal obesity may contribute to this incidence of high-birth weight babies. Maternal obesity and overnutrition sets up the cascading events of increased blood glucose that stimulates increased fetal insulin, resulting in abnormally increased lipogenesis and excessive adipose tissue deposit. Obese mothers as much as 150% overweight are at risk themselves for developing gestational diabetes, elevated blood pressure, and increased blood lipids<sup>7</sup>.

### Underweight

Although underweight is a less common problem in the Arab Gulf population than is overweight, it does occur in a small percentage. It was found that the prevalence of underweight among women in the Gulf ranged from 3% to 13%<sup>5,8</sup>. The underweight pregnant women presents special weight related problems and needs, especially of inadequate total weight gain during pregnancy and the pattern of the gain. Gestational weight gain, especially during the second and third trimesters is an important determinant of adequate fetal growth. For women who were underweight prior to pregnancy the greater the gain during pregnancy, the lower the neonatal mortality rate.

Underweight and low intake of essential nutrients are the main causes of low birth-weight (LBW) infants. The incidence of LBW in the GCC countries varies from country to country, with a range of 7% to 15%<sup>9</sup>.

### Gestational Diabetes Mellitus

Gestational diabetes appears during pregnancy in women who have no previous history of diabetes. Although studies on prevalence of gestational diabetes in the Gulf are scarce, indicators available from health records showed that the prevalence of this symptom is relatively high, varying from 5% to 10%. It is well documented that gestational diabetes is associated with significant pregnancy complications such as macrosomia, perinatal mortality and prematurity<sup>7</sup>.

## Some Factors Associated with Nutritional status of Pregnant Women in the GCC Countries:

### 1. Early age at Marriage

Early age at marriage is still one of the factors that is associated with some health problems during pregnancy among women in the GCC countries. This is particularly true in the rural and Beduin areas. Several studies showed that many women got married before 16 years of age<sup>8,10</sup>.

The hazards of teenage pregnancy are that it can cause maternal death and infants with low birth weight (LBW < 2.5 kg), which in turn affects infant survival. In Bahrain, it was demonstrated that mothers aged 15-19 years were more likely to deliver low-birth-weight infants (11%) than mothers in other age groups (7%)<sup>11</sup>.

In addition to teenage pregnancy, the risk of LBW increased with the first pregnancy. It was found that the incidence of LBW was 10.6% for Bahraini mothers who delivered for the first time compared with 6.3% for mothers who have one child or more<sup>11</sup>.

### 2. Multiple Pregnancies:

Multiple pregnancies without enough spacing between the pregnancies may cause several health and nutritional problem among both the women and their fetus. Statistics showed that the fertility rate of the Gulf mothers is relatively high (ranging from 4.6 per 1000 women aged 15-44 years in Bahrain to 7.1 in both Oman and Saudi Arabia). Multiple deliveries tend to lower the haemoglobin level in mothers, because closely spaced pregnancies deplete the iron stores of the mothers, especially when there is no iron supplementation during pregnancy<sup>12</sup>.

### 3. Unsound Food Habits:

There are many unsound food habits during pregnancy which may affect the weight of infants. Few mothers are interested in improving their diet during pregnancy. In Bahrain, it was reported that only 31% of mothers consumed more fresh fruit during pregnancy<sup>13</sup>. As a result the intake of some nutrients may be affected. In Kuwait, Prakash et al<sup>14</sup> found that the intake of calcium, iron and vitamin C by pregnant mothers was below 75% of US recommended daily allowances (RDA), while among lactating mothers, all nutrients (except protein) were below the RDA.

### 4. Traditional Beliefs and Attitudes:

Traditional beliefs related to nutrition are an important risk factor in pregnancy. For example, in some areas in the Gulf, mothers decrease their intake during pregnancy believing that extra food will cause an over large baby, while others believe that they should eat for two. Many pregnant women believe that the intake of iron supplement may cause enlargement of the fetus and the subsequent difficult delivery or even abortion<sup>9</sup>.

### 5. Social Change and Lifestyle:

In general most of women in the GCC countries are unemployed and few of them practice exercise. These factors play an important role in increasing the risk of overweight and obesity. The availability of housemaids,

cars, television and sophisticated home appliances has decreased the physical activity of the women, and the sedentary lifestyle has become a norm. In addition the intake of fast foods and other food rich in fat has increased significantly. These factors lead to high increase in the weight of women during pregnancy.

#### CONCLUSIONS AND RECOMMENDATIONS:

The nutritional status of pregnant women in the GCC countries has not kept pace with the change in social, economic and health status in their countries. Nutritional disorders such as anaemia, overweight and obesity, underweight and diabetes mellitus are still common in pregnant women in the region. In order to improve the nutritional status of pregnant women in the GCC countries the following recommendations are suggested:

1. Health education through mass media should focus on the management of nutritional problems during pregnancy, and correction of unsound food habits and beliefs commonly wide spread in the community.
2. Introduce information on nutrition aspects for women in general and pregnant and lactating women in particular in school and college curricula.
3. Expand pre-marital counselling to include nutrition assessment and the counselling should be based on situation analysis.
4. Training health workers, especially community health nurses, in assessment and management of nutritional problems during pregnancy.
5. Carrying out research and studies on current nutrition problems of pregnant women in the GCC countries and socio-cultural factors associated with these problems.

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## Nutritional Problems of Infants and Young Children in the GCC Countries

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One of the most important health problems affecting infants and preschool children is malnutrition. In the first five years of life, a child is totally dependent upon food supplied by others. Human growth and development are affected by biological, cultural and environmental factors. Under-nutrition early in life has a great adverse effect on mental development and hence on the learning potential of the child.

The rapid changes in social and economic status in the GCC countries have an impact on food habits and nutritional status of infants and young children. Growth retardation, low birth weight, iron deficiency anaemia and vitamin D deficiency are still common nutritional problems in these countries. The aim of this paper is to highlight the current feeding practices and nutritional problems of infant and pre-school children in the GCC countries.

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Food selection and nutrition behaviour are influenced by many factors. These factors are internal, such as nutrition knowledge, attitude and personality characteristics, and external such as food availability, cost of food, advertising appeals and food popularity<sup>1,2</sup>. Cultural and socio-economic influences implicit in many of the above factors have also explicit effects on nutrition behaviour<sup>1-7</sup>. For example, the presence of expatriate maids with many families in the Arabian Gulf countries, which is one of the manifestations of the recent social and economic changes, was found to have effects on nutrition and food patterns of many families. In an investigation of the role of the maid on infant feeding in Kuwait<sup>8</sup>, it was found that the duration of breast feeding was diminished from 7.29 months in the absence of a maid to 5.43 months in her presence. In another study of food habits of mothers and children in two regions of Oman<sup>9</sup>, it was concluded that dietary patterns have changed dramatically during the past two decades towards unhealthy habits, such as increased consumption of food rich in fat, cholesterol, refined sugar and salt. This change in eating habits could have its share in increasing the rate of diet related chronic diseases. These changes may be considered as side effects of the rapid socio-economic changes in the Arabian Gulf region.

Due to the World-wide economical and technological developments which are affecting the lifestyle everywhere and due to the phenomenon of economic and social developments that are taking place in the Arabian Gulf countries, one has to realise that we can only monitor trends of changing habits rather than instilled habits. This realisation is important in designing ways and means of improving dietary patterns. Although this work is concerned with the nutritional status of infants and young children, we will occasionally consider some of the dietary habits of mothers.

### Breast Feeding Habits

The adverse effects of the early stopping of breast feeding are very well established and documented. In addition to growth and physiological development, breast feeding has immunological and psychological benefits for the infants. The patterns and trends of breast-feeding in Arabian Gulf countries have been the subject of many studies.

Although the patterns of breast feeding have demographic and temporal dependence within the Arabian Gulf countries and even within the same country or region of a country, there is a common tendency in all these countries towards shorter breast-feeding. Mixed and bottle feeding or exclusive bottle feeding have increased steeply.

Musaiger<sup>10,11</sup> reported that breast-feeding in the sixties extended for about two years in some Arabian Gulf countries; however the duration of breast-feeding had declined to a few months in the late eighties. In Bahrain, for example, the duration of breast-feeding dropped from two years in the 1960s to 11 months in the 1970s and to 8 months in the 1980s<sup>11,12</sup>. In the United Arab Emirates, it was found that the median duration of breast-feeding was 4.5, 5 and 9 months in urban high, urban average and rural groups, respectively<sup>13</sup>.

Mixed feeding is introduced early in the infants life. In a national survey in the United Arab Emirates, it was reported that 42% of mothers started bottle feeding at the age of one month of their infants, 21% at the age of two months, and 9% at the age of three months. This amounts to 72% of mothers giving their children a bottle at the age of three months or less<sup>13</sup>.

Kordy et al<sup>14</sup> found that the two major reasons for terminating

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breast-feeding in Saudi Arabia were pregnancy and insufficient milk. A minority of mothers (6.5%) were given advice about breast-feeding by nurses or doctors. In general the following factors were reported as reasons for early termination of breast-feeding in the Gulf region: illiteracy of mothers, lack of nutrition awareness, influence of sales promotion, the role of private doctors to promote infant formula, mother's employment, high family income which makes it possible for mothers to purchase baby foods, early introduction of supplementary foods, and unsound beliefs and attitudes towards breast-feeding and weaning of infants<sup>11</sup>.

Contemplating the above factors reveals that they are mostly socio-economic in nature. This should be affirmed by observing that the past two decades have witnessed dramatic economic and social changes and consequently a drastic change in infant feeding patterns. As a matter of fact the economic and social development, including urbanization and the un-dependency of newly formed families, have weakened the traditional mother - daughter educational channel which was the main source of educating young mothers.

Proper new learning sources should be substituted to complement the parents as a source of infant and nutrition knowledge. Khashoggi et al<sup>15</sup> conducted a study to assess the nutritional knowledge and attitude of female undergraduate students of King Abdulaziz University, Jeddah, Saudi Arabia. The findings revealed the main sources of nutrition knowledge were: parents (57%), school curriculum (42%), books and/or magazines (37%), text books (21%) mass media (18%) and friends and classmates (11%). This study shows that students who are young mothers or potential mothers are finding new sources to complement parents (particularly grandmothers of infants) as learning sources.

### Weaning Habits

It is only natural to assume that the same factors, drives and attitudes which bring bottle feeding early in infant lives, may play a parallel role in introducing weaning food at an early time. This is indeed confirmed by many studies<sup>9,11,16</sup>. One of these studies<sup>16</sup> carried out in five geographical regions of Oman, showed that 31% of mothers introduced weaning foods, mainly commercial foods, before the age of four months of infants' lives. It is also reported<sup>13</sup> that many mothers introduced honey, ghee and glucose water during the first days of infants' lives.

Early introduction of weaning foods has several adverse effects, which include: inducing an infants' preference against breast suckling, reducing the frequency of breast-feeding, termination of breast-feeding at an early stage, increasing the probability of infant infection emanating from unhygienic preparation of weaning foods or improper sterilisation techniques, and increasing the probability of malnutrition if weaning food is not correctly chosen.

The adverse effects of the last two factors are compounded by the ignorance of the proper selection and preparation of weaning food. This is particularly paramount in the case of illiterate mothers who cannot read labels and preparation instructions, or properly measure the ingredients of infant food. In a study carried out on young mothers at King Abdulaziz University<sup>1</sup>, it was found that only 3% of mothers

read food labels. The main reasons for not reading the labels were hurriedness (66.7%), language difficulties (41.7%), unclear information (17.7%) and feeling that it is not important (13.5%).

If college students are not willing or cannot read nutrition labels, one can imagine the difficult situation of a weaning child of an illiterate mother. Traditional learning of new mothers in this set-up by their mothers is not very effective as well, since the majority of baby food preparations are relatively recently introduced in the society. In addition, as mentioned before, the mother-daughter learning channel is impeded by the independence of new families.

### Nutrition Status

Due to improved economical conditions, severe cases of protein energy malnutrition are not expected to be dominant in the Arab Gulf countries<sup>10</sup>. However, the whole spectrum of nutritional status should be looked at and compared with the corresponding status in other countries.

### Low Birth Weight

A study<sup>17</sup> carried out in 1995 on newborn Kuwaiti infants showed that the mean birth weight in Kuwait was 3.50 Kg which compares favourably with many developed countries. The results of the study showed that maternal body weight, height and weight gain during pregnancy were positively correlated with birth weight. Mothers from high income families had heavier babies when compared with a low income group. On the other hand, educated and employed mothers were more liable to have slightly smaller babies when compared with illiterate or unemployed mothers.

The incidence of low birth weight (defined to be less than 2.5 Kg) among 3,485 live births in the three hospitals of Al-Ain City, United Arab Emirates, where almost all deliveries take place, during one year period (1992-1993) was found to be 8.4%<sup>18</sup>. It was found that mothers of low birth weight (LBW) infants are statistically significantly younger in age. It was also found that mothers occupation, maternal smoking, antenatal care, and lack of help in the home were associated with increased risk of LBW.

In another study<sup>19</sup> carried out on a total of 5280 babies delivered at King Khalid Hospital, Al-Kharj, Saudi Arabia, the percentage of LBW cases amounted to 6.5%. Throughout the Arabian Gulf countries, the reported incidence of LBW ranges from 6% to 8% which compares favourably with other developing countries. However, it is pointed out<sup>13</sup> that these rates were derived from hospitals' records which may give a biased conclusion. Factors mentioned to contribute to birth weight of infants include sex of the infant, geographical location, mothers' age and interval between births. Iron deficiency may also be a factor in LBW. It is also established that maternal malnutrition and ill health are causes of LBW<sup>10</sup>.

### Growth Pattern

Nutrition surveys in the past showed some mild and moderate degree of malnutrition in young children<sup>20</sup>. For example, in rural areas in Saudi Arabia it was found that 45% of preschool children aged 0-5 years had mild malnutrition, and 14.5% had moderate malnutrition based on weight for

age, and only 0.9% showed severe malnutrition. Al-Othaimen et al<sup>21</sup> investigated the nutritional status of the children surveyed over the past ten to fifteen years in Saudi Arabia. It was found that the weight for height and height for age of children up to 14 years can be compared favourably with international standards (WHO/NCHS).

A combination of height for age as an indicator of stunting, and weight for height as an indicator of wasting showed that a sizeable proportion (78.1%) of children aged 0-5 years in Saudi Arabia have normal or slightly above normal nutritional status. A small proportion of the children (1.4%) were below -2.0 standard deviation (SD) scores of the reference population for weight, for height, and for age. But it was found that overall, Saudi children are slightly shorter and thinner than their American counterpart. Nearly 20% of the children were below -2 SD scores of the reference population median<sup>22</sup>.

Reviewing the nutritional status of children in the Arabian Gulf countries, Musaiger<sup>12</sup> concluded that the growth pattern of pre-school children is close to the NCHS standard in the first 6-9 months of life, but falls dramatically afterwards, particularly in up-to-five years old children. It is argued that this may be due to stopping of breast-feeding, introduction of an unbalanced diet, and the susceptibility to infectious and diarrhoeal diseases during this period. The situation improves for children 6-9 years old.

However, the significance of the conclusions drawn from local or regional anthropometric data in comparison of foreign standards is dubious. For example, it was found<sup>23</sup> that the NCHS growth curves should be adjusted for local use for Saudi children. After analysing the anthropometric data of 1,168 children aged 1-60 months in Asir, Saudi Arabia, it was found that the lower limits for the expected normal on the growth curves should be shifted from the third percentile line to -3 SD line. Further studies in this direction are needed to find a suitable regional standard.

#### Micronutrient Deficiencies

Iron deficiency (based on haemoglobin levels) is prevalent in the region among pre-school children, teenage girls, pregnant women and lactating mothers. The prevalence of iron deficiency anaemia based on haemoglobin levels, ranges from 29.5% to 67% among pre-school children, 12.6% to 46% among school children, 13% to 58% among teenage girls and about 50% among pregnant mothers<sup>11</sup>. Karrar<sup>24</sup> reviewed the iron deficiency anaemia among school and pre-school children in several Gulf states. The following percentages were reported, Bahrain 21 to 42% Saudi Arabia 21 to 50% United Arab Emirates 28 to 43%. It is also reported that iron intakes of the infants below one year of age are significantly lower than standard<sup>21</sup>.

Probable factors contributing to iron deficiency anaemia in the region are: low intake of food rich in iron, intake of iron absorption inhibiting substances such as tannin (in tea or coffee), low intake of food rich in vitamin C which enhances iron absorption, and parasitic infection<sup>11</sup>.

In addition to iron deficiency, vitamin D deficiency has been reported in the Arabian Gulf countries. This is paradoxical in view of the abundant sunlight. Vitamin D deficiency has a role in the pathogenesis of rickets in infants with inadequate

vitamin status indicating that the disease has its origin in the perinatal period. Probable factors contributing to vitamin D deficiency in the region include: avoidance to sunlight exposure, lack of vitamin D in staple diet, an increase in ultraviolet light insulation due to atmospheric dust particles, and using unfortified powdered milk with vitamin D<sup>11</sup>. In addition to iron and vitamin D deficiencies, iodine deficiency has also been reported<sup>25</sup>.

#### Dental Caries

Dental caries is considered a diet-related disease associated with affluence. Alamoudi et al<sup>26</sup> examined the caries experience of children aged 6-9 years in Jeddah, Saudi Arabia. Overall, 1522 children were examined from six primary schools located in different areas of the city. Results showed that the mean of decayed, missing, or filled teeth (DMFT) is 4.23. The mean DMFT value excluding caries free children, however, was 5.7%. Only 26.1% of the children were caries free.

In another study<sup>27</sup> on 1,665 students from fourteen schools for boys and fourteen schools for girls in Al-Khobar, Saudi Arabia, it was found that only 12.5% of the students were caries free. The mean of DMFT for permanent teeth increased from 0.78 in the six and seven year olds to 4.59 in those who had reached sixteen and seventeen years of age. These findings should be compared with the World Health Organization (WHO) goals of "Health for all by 2000" which recommend a DMFT score of not more than 3.00, and 50% caries free for twelve year olds.

Dental care should be attended to from the early stages of a child's life. In that context it should be mentioned that prolonged breast-feeding is beneficial. In a study conducted in Kuwait, it was found that breast-fed children were significantly more likely to be caries free than those who were bottle-fed from birth<sup>28</sup>.

#### CONCLUSION

The GCC countries have experienced remarkable economic growth and noticeable social changes which have affected the nutritional status of the population including infants and young children. Severe protein-energy malnutrition has been drastically reduced. However, Micronutrient deficiency prevails. Affluence and newly acquired nutritional habits have resulted in reduction of breast-feeding periods and prevalences of dental caries. Measures to promote the nutritional status of children should be adopted.

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## Health and Nutritional Profile for Adolescent Girls in the GCC Countries

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Studies of adolescent girls in this region demonstrate a number of health and nutritional problems. Iron deficiency anaemia is the main problem among adolescents in all socio-economic groups. Also a major concern is inadequate energy intake leading to underweight among a relatively high percentage of these girls. At the same time the prevalence of obesity in adolescent girls has increased, suggesting a predisposing factor for chronic disease such as heart disease, diabetes and hypertension. One of the main reasons for the increasing prevalence of overweight and obesity among teenage girls are intake of foods high in energy and fat, lack of physical exercise and sedentary lifestyle. Such chronic diseases are the main causes of death in the region, and thus any programme to prevent and control these diseases should start with children and adolescents.

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Health and nutrition of adolescent girls has been neglected in health programmes in most Arab countries, where the girls become child caretakers well before they become mothers. Despite the significant improvement in educational and health services in these countries, the health and social status of adolescent girls have not improved consequently.

UNICEF<sup>1</sup> reported that the concept of adolescence in the Arab World is relatively new, particularly where teenage girls are concerned. In the past, adolescence lay generally buried in the direct transition from childhood to adulthood, as girls married shortly after puberty. Nowadays, with increased education and delayed age at marriage, the needs and problems of young girls are becoming more obvious. Their physical and mental health has an impact not only on their own lives, but on the lives and well-being of their children and their families as well.

Information about the health and nutritional status of adolescent girls in the GCC countries is scarce. The current report highlights some health and nutrition indicators for adolescent girls in the GCC countries based on available data.

### Social and Demographic Factors associated with Health of Adolescent Girls

#### Age at Menarche

Age at menarche is affected by genetic and environmental factors. Low nutritional status has also a negative influence on age at menarche. People living in tropical countries mostly have a late menarche, mainly because their nutritional status is poor. However, well-off children in these areas have menarche at about the same age as children in Temperate areas<sup>2</sup>. The mean age at menarche in Arabian Gulf countries ranged from 12.9 years in Saudi Arabia to 13.3 years in Oman<sup>3,4</sup>. A recent study in Bahrain showed that educated

mothers (high economic group) were more likely to get menarche at an earlier age than illiterate mothers. In this study the mean age at menarche was also found to be about 13 years, and ranged from 9 to 19 years<sup>5</sup>. This average is slightly higher than that reported in Western countries. The nature and timing of the pubescent growth spurt and sexual maturation vary considerably among teenagers, but generally the adolescent female achieves physiological maturity about 4 years after menarche<sup>6</sup>.

#### Age at Marriage

Early age at marriage in one of the risk factors affecting the health status of mothers and their children. In Saudi Arabia, Bhatti et al<sup>7</sup> found that, in general, females got married around menarche (10-16 years). Abdul-jabar and Wong<sup>3</sup> showed a slight increase in the age at marriage among Saudi women, but they still got married when they were below 18 years of age. The average age at marriage was 18.3 years, and 14% of women were less than 15 years of age when married.

The National Nutrition Survey of Oman<sup>8</sup> reported that a high percentage of mothers in Oman got married at less than 15 years of age (41.4%). About 48.8% got married at 15-19 years of age, and only 9.8% got married at 20 years and above. There were differences in age at marriage among various geographical regions. This is mainly due to differences in socio-economic and cultural factors.

In Qatar, it was found that 29% of women got married before 16 years of age, 46% got married between 16 and 20 years of age and 25% got married after 20 years of age<sup>9</sup>.

In Bahrain the Central Statistics Organization (CSO)<sup>10</sup> demonstrated that a relatively high percentage (13%) of women who got married in 1989 were between 13 and 19 years of age. A recent study<sup>11</sup> showed that many Bahrainis

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got married at adolescent age and the mean age at marriage ranged from 14.2 to 22.8 years, with a general average of 18 years.

Compulsory enrolment of young girls in primary and intermediate schools is recommended to delay the age at marriage. Promotion of nonformal education programmes for adult females should be also encouraged.

### Early Pregnancy and Interval between Births

As many Gulf women get married at an adolescent age, they are more likely to get pregnant at an early age too. In Bahrain, it was found that 18% of mothers got their first pregnancy between 11 and 15 years old, and about 43% between 16 and 19 years old<sup>5</sup>. In Oman, it was reported that 16.5% of women got their first pregnancy at less than 15 years of age, 68.2% at 15-19 years and 15.3% at 20 years and above<sup>5</sup>. A recent study in Saudi Arabia showed similar patterns as about 45% of women got their first pregnancy at less than 20 years of age.

The hazards of teenage pregnancy are that it can cause maternal death and infants with low birth weight, which in turn affects child survival. Teenagers who become pregnant within less than 4 years after menarche are at high nutritional risk since they may have to meet their own needs for growth as well as the energy and nutrient demands of pregnancy. It also possible that pregnancy among these individuals may deplete their often limited nutritional reserves, which can compromise their own health and result in poor pregnancy outcome<sup>6</sup>.

It was found that adolescent Bahraini mothers aged 15-19 years were more likely to deliver low-birth-weight (LBW) than mothers in other age groups (7%). In addition to teenage pregnancy, the risk of LBW is increased with the first pregnancy, as it was reported that the incidence of LBW was 10.6% for Bahraini mothers who delivered for the first time compared with 6.3% for mothers who have one child or more<sup>12</sup>.

Interval between births is also a matter of concern. The recent data of Central Statistics Organization in Bahrain<sup>10</sup> showed that the majority (61%) of adolescent mothers (13-19 years) gave a space of less than 2 years between births, while the percentages were 32%, 18.7% and 15.3% for mothers aged 20-29, 30-39 and 40+ years, respectively. It was reported that Bahraini mothers were least likely to bear LBW babies when the interval between births was more than 2 years. As the interval between births increased the incidence of birth-weights more than 3.5 Kg increased<sup>12</sup>.

### Nutritional Problems

Adolescence, a period of rapid physical growth and increased nutritional requirements to support increase in body mass, makes adolescent girls vulnerable to nutritional problems because of several physiological and social factors<sup>6</sup>. Studies on the nutritional status of adolescent girls in Arabian Gulf countries are scarce. Some of the studies on nutrition of adolescent girls in this region will be briefly discussed.

### Growth and Development

In general, the nutritional status based on anthropometric

measurements of adolescent girls in the Gulf seems to be better than that of preschool or primary school children. In a cross-sectional study of school children aged 6-17 years in Kuwait, the children were found to be shorter than American children and tended to be heavier during adolescence, indicating a trend of obesity. There was no marked difference in fat and muscle areas between Kuwaiti adolescents and their American counterparts<sup>13</sup>.

A comprehensive study on growth patterns of adolescent girls was carried out on 433 girls aged 11 to 18 years from all geographical areas in Bahrain<sup>14</sup>. The median height fluctuates between 25th and 5th percentiles of NCHS standard for age 11 years. For age 12 years onwards, the median height fluctuates between 25th and 10th percentiles. The median weight fluctuates between the 50th and 10th percentiles.

A cross-sectional survey<sup>4</sup> was carried out on 683 school girls aged 11-18 years in Oman in order to assess their physical growth. Results showed that median height and weight of Omani girls fluctuates between 25th and 5th percentiles and 25th and 10th percentiles of the NCHS standard, respectively. In general, Omani girls are shorter and lighter than girls of similar age in other Arabian Gulf countries (Bahrain and Kuwait).

### Iron Deficiency Anaemia

Iron deficiency anaemia is considered one of the main nutritional problems among adolescent girls in the Gulf. In Kuwait, a cross-sectional study of 1208 school children aged 6-17 years was carried out to determine the prevalence of iron deficiency anaemia. Data revealed that anaemia was more prevalent among girls (26%) than boys (13%), but it was highly prevalent among younger boys (6-9 years) and adolescent girls compared with other age groups<sup>15</sup>. In Bahrain, Blair and Gregory<sup>16</sup> demonstrated that 24% of school girls aged 7-18 years had signs of iron deficiency based on transferrin saturation, and the anaemia was most prevalent among 15-18 year olds (42%). These findings confirm that teenage mothers in the Gulf are more at risk than older mothers.

### Dental Caries

The incidence of dental caries among adolescent girls in the Gulf is alarming. In Bahrain, Barne<sup>17</sup> showed that the decayed, missing or filled teeth (DMFT) index among 12 year old Bahraini girls was 1.0, while another survey<sup>18</sup> on adolescent girls aged 12 and 15 years indicated that the DMFT index has increased to 1.3 and 1.9 for these age groups, respectively. The prevalence of caries was 51% and 55% for the same age groups, respectively. In Saudi Arabia, it was estimated that 78% of children aged 13-15 years were in need of dental treatment<sup>19</sup>. A survey of dental health in school children in Kuwait showed that the total average of DMFT was 3.2<sup>20</sup>.

The frequency of consumption of sweets is of prime importance in the occurrence of dental caries. The intake of soft drinks, chocolates, sweets, cakes and other high sugar food between meals, especially by school girls has been associated with rising rates of dental caries. The high consumption of bottled water which contains low levels of flouride is another contributing factor to the occurrence of

dental caries in Bahrain. Prevention programmes should focus on the improvement of dietary habits and oral hygiene of school children, including adolescent girls.

### Obesity

Obesity in children and adolescents may be a predisposing factor for adult obesity<sup>21</sup>. Several studies have reported that obesity is a problem of concern in the Gulf countries<sup>22,23</sup>. It is well documented that obesity is a risk factor for many health problems such as cardiovascular disease, diabetes, arthritis, hypertension and some forms of cancer<sup>21</sup>. These diseases are the major causes of morbidity and mortality in Bahrain.

In some Gulf countries, the prevalence of obesity among adolescent girls is alarming. The work of Eid et al<sup>13</sup> has provided interesting findings on obesity among adolescent girls that 23.7% of girls aged 10-13 years were obese (based on weight/height), while the percentage was double at age 14-17 years (44.5%). In general, Kuwaiti adolescent girls have small muscle mass and low physical work capacity.

Using skinfold thickness technique it was found that 19% of Bahraini girls aged 6-18 years were obese<sup>16</sup>. A cross-sectional survey on school girls aged between 15 and 20 years showed that 17.4% of these girls were overweight or obese based on body mass index more than 25<sup>23</sup>.

An attempt was made to study some social and dietary factors associated with obesity among adolescent girls (15-20 years) in Bahrain<sup>23</sup>. The findings showed that obesity was higher among older girls (18-20 years), and girls with low family size, illiterate mothers or fathers and those with a family history of obesity. Girls who did not eat between meals, and those who ate 1 or 2 meals per day had a higher prevalence of obesity than those who ate between meals and ate 3 meals or more per day. The prevalence of obesity was also higher among girls who ate alone (21%) than those who ate with family (17%).

### CONCLUSION

Adolescent girls are a neglected target group in health programmes in Arabian Gulf countries as most of these programmes focus on the health of mothers and children. Adolescent girls in this region seem to have several social and health problems. First of all, a relatively high percentage of them get married before they reach 19 years old, and this affects the health of both mothers and children.

Studies of adolescent girls in this region demonstrate a number of health and nutritional problems. Iron deficiency is the main problem among adolescents in all socio-economic groups. Also a major concern is inadequate energy intake leading to underweight among a relatively high percentage of these girls. At the same time the prevalence of obesity in adolescent girls has increased, suggesting a predisposing factor for chronic diseases such as heart disease, diabetes and hypertension. One of the main reasons for the increasing the prevalence of overweight and obesity among teenage girls are intake of foods high in energy and fat, lack of physical exercise and sedentary life-style. Such chronic diseases are the main causes of death in the country, and thus any

programme to prevent and control these diseases should start with children and adolescents.

### RECOMMENDATIONS

In order to improve the health and nutrition status of adolescent girls in the Gulf, the following activities and programmes should be included in health and social plans:

1. Expanding mother and child health services to include more activities related to teenage girls.
2. Improving of school feeding activities to provide more nutritious foods to school girls such as fruit juices, milk and milk products, and fresh fruits, instead of carbonated beverages, sweets and corn-puffs.
3. Programmes to control iron deficiency anaemia should be given a high priority. Several measures should be taken into consideration when attacking this anaemia such as iron tablet supplementation for teenage pregnant girls, blood screening for adolescents girls, prevention and treatment of parasitic infection, iron fortification of some common foods, education to increase the intake of foods rich in iron and vitamin C, and reducing intake of foods which inhibit iron absorption such as tea and coffee.
4. Dietary intervention to modify food habits of adolescent girls. Excessive intake of foods rich in fat, sugar and salt, skipping meals, especially breakfast, high consumption of carbonated beverages and low intake of food rich in fiber such as fresh fruits and vegetables are all examples of unsound habits among these girls, which need to be corrected through health education, through mass media and school curricula.
5. Introducing information on prevention and control of nutritional and health problems in the school curriculum.
6. Encouraging exercise habits among both children and adolescents. Regular and frequent isotonic exercise can play an important role in the prevention and control of obesity, hyperlipidemia, hypertension and diabetes. School children and adolescents should be encouraged to adopt a life-style involving some forms of exercise. Health education on physical fitness must be introduced in schools. It is essential also to allocate sufficient time in school schedules for exercise activities<sup>21</sup>.
7. Professional training of health, social and community workers in prevention and management of health problems among adolescent girls.
8. Encouraging education of girls till at least secondary school to delay early marriage and pregnancy.
9. Carrying out further research and studies on factors associated with health and nutritional status of adolescent girls in this region.

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## Selected Risk Factors for Cardiovascular Disease among Saudi Men

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A total sample of 690 male Saudi faculty members of King Saud University were screened for blood parameters (total cholesterol TC, high density lipoprotein cholesterol HDL-C, low density lipoprotein cholesterol LDL-C, blood triglycerides (TG), blood sugar (BS)), and for systolic and diastolic blood pressure (SBP,DBP) in order to investigate the coronary heart disease risk factors (CHDRF) in a fairly sedentary affluent segment of the society. Mean values of these parameters were within normal ranges, however calculated mean body mass index (BMI,kg/m<sup>2</sup>) have indicated prevalence of overweight among the cohort. High blood pressure SBP > 160 mm Hg was not prevalent among younger participants age < 35, nor among normal weight BMI < 25. About 4.3% of the total population studied showed this elevation. However, 14.5% of the group were with a raised DBP (>90mm Hg). Similar percentages of those with elevations in blood lipids and glucose were observed. The importance of public awareness, at all socio-economic levels, in regard to the cardiovascular (CVD) risk factors, related lifestyle, and food consumption patterns are therefore recommended.

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Cardiovascular disease (CVD) is the main cause of death in Saudi Arabia and other Arab Gulf countries<sup>1</sup>. Epidemiological studies showed various potential risk factors predisposing an individual to CVD: these include the predictable modifiable variables such as dietary habits, lifestyle, elevated serum lipids, lipoproteins, hypertension, glucose intolerance, obesity, cigarette smoking and physical inactivity, and the unmodifiable factors such as gender and age<sup>2-5</sup>. The differential effects of blood pressure and body weight on the risk of CVD have long been established<sup>6</sup>. Obesity has been incriminated as a risk factor in several chronic disorders such as CVD, diabetes mellitus (DM) and hypertension (HT)<sup>7-11</sup>.

In the Arabian Gulf States the rapidly increasing wealth may have eliminated the manifestations of under-nutrition but at the same time, has resulted in what is termed as "malnutrition of affluence". Chronic disorders such as CVD, CHD, obesity, diabetes and certain types of cancer have become major causes of morbidity and mortality resulting from drastic changes in lifestyle and dietary habits of people of the region<sup>12</sup>.

However, in the affluent Gulf countries measures against clinical metabolic disorders have not been developed in a national programme. Most programmes are hospital-based and are restricted to treatment, rehabilitation and to a lesser extent dietary counselling. In some Gulf countries like Saudi Arabia, Kuwait and Bahrain, nutrition focal points have been stepped up towards foundation of preventive programme at national level, as yet not established, to combat such disorders primarily by public awareness and education in regard to potential risk factors.

The present paper aims to find out some of the risk factors for CVD among Saudi men working in King Saud University.

### METHODS

#### Participants

Six hundred and ninety (690) Saudi men who are staff members of King Saud University participated in the study.

The participants were invited by mail to visit a mobile research unit stationed at different sites of King Saud University. Each participant completed a standardised questionnaire. The questionnaire included demographic background, health history and lifestyle information.

#### Anthropometric measurements

Standing height without shoes was measured to the nearest 0.1 cm using a stadiometer attached to the weighing scale.

Body weight was measured with as few clothes as possible on a calibrated scale (10 x 0.5 kg, 260 x 116) (Dong Fang MC86. 00000275) accurate to 0.2 kg. Body mass index (BMI) was then calculated to find out the obesity among participants.

#### Biochemical measurements

All participants were requested to fast 12 hours before blood measurements. Total Cholesterol (TC), high density lipoprotein cholesterol (HDL), low density lipoprotein cholesterol (LDL), blood sugar (BS) and triglyceride (TG) were measured immediately at the screening sites using the Boehringer Mannheim Reflotron and the associated materials (2368802 Boehringer Mannheim GmbH). The Reflotron procedure consist of collecting blood from volunteers using finger tip puncture. An autoclix was used to puncture the tip of thumb, after sterilizing with a swab containing 70%

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isopropnol. Blood was then drawn using special ring caps reflotron 32 ul capillary tubes; it was then applied on the special test strip, and later inserted into the reflotron measuring chamber for the determination of blood parameters. Blood pressure was measured using digital blood pressure meter (UA-751). The average of three readings taken from a 10 minute resting participant was considered for each of systolic and diastolic blood pressure (SBP and DBP).

#### Statistical analysis

Data were analysed at the main computer centre at King Saud University. Means, standard deviations and Duncan groupings as well as Pearson's Correlation coefficients were used for statistical tests<sup>13</sup>.

#### RESULTS

Means and standard deviations (SDS) for selected risk factors for CVD are presented in Table 1. The mean age was 40.2 years ( $\pm 5.8$ ). Weights of participants ranged from 50-135 kgs (mean  $\pm$ SD 78.9  $\pm$  12.5) while their heights varied from 1.56 m to 1.9 m with an average of 1.72  $\pm$  0.42 m. Mean calculated BMI (Kg/m<sup>2</sup>) was 26.7  $\pm$  5.8; BMI was divided into two categories <25 and >25 defined as normal, and overweight and/or obese, respectively. Similarly age was classified into <35 and  $\geq$ 35 years.

Table 1. Mean values and standard deviations of selected cardiovascular risk factors among Saudi men

Parameters	Mean (SD)
Age (yr)	40.2 $\pm$ 5.8
Weight (Kg)	78.9 $\pm$ 12.5
Height (m)	1.72 $\pm$ 0.42
BMI (Kg/m <sup>2</sup> )	26.7 $\pm$ 5.8
SBP (mm Hg)	127.4 $\pm$ 12.9
DBP (mm Hg)	82.1 $\pm$ 11.8
TC (mg/dl)	183.1 $\pm$ 41.4
HDL-C (mg/dl)	37.8 $\pm$ 10.1
LDL-C (mg/dl)	148.4 $\pm$ 16.8
TG (mg/dl)	156.4 $\pm$ 90.2
BS (mg/dl)	88.8 $\pm$ 28.4

Table 2. Means and standard deviations of risk factors in male staff of King Saud University by BMI and age

Risk Factors	BMI (Kg/m <sup>2</sup> )		P value	Age (yr)*		P value
	<25 No=150	$\geq$ 25 No=540		<35 No=265	$\geq$ 35 No=425	
SBP	122.8 $\pm$ 10.8	127.3 $\pm$ 14.9	NS	123.8 $\pm$ 10.7	128.0 $\pm$ 15.9	NS
DBP	79.2 $\pm$ 7.0	81.9 $\pm$ 13.9	NS	78.9 $\pm$ 8.2	82.9 $\pm$ 14.9	NS
TC	159.9 $\pm$ 37.6	188.4 $\pm$ 45.8	0.005	170.8 $\pm$ 40.3	189.4 $\pm$ 47.4	0.04
LDL-C	121.8 $\pm$ 26.8	142.6 $\pm$ 8.0	0.006	132.7 $\pm$ 23.7	153.7 $\pm$ 17.2	0.005
HDL-C	38.1 $\pm$ 14.2	35.0 $\pm$ 8.7	NS	38.1 $\pm$ 17.8	35.7 $\pm$ 9.2	NS
TG	115.2 $\pm$ 41.1	167.2 $\pm$ 102.7	0.02	131.1 $\pm$ 59.7	171.4 $\pm$ 109.3	0.01
BS	95.1 $\pm$ 21.2	100.2 $\pm$ 29.0	NS	95.45 $\pm$ 23.7	101.4 $\pm$ 29.5	NS

NS - Not statistically significant

Means and SD values of the blood indices by BMI and age are shown in Table 2. SBP, DBP and HDL and BS did not show any significant differences with increased BMI or advanced age, while TC, HDL and TG have had significant differences at P-values <0.005, <0.006 and <0.02 with BMI, respectively, and at P-values <0.04, <0.005 and <0.01 with

age difference, in the same order. However, there were insignificant increases of SBP, DBP and BS as a result of increased BMI and advanced age, and there was a decrease in HDL.

Percent prevalence by BMI and age of selected risk factors are presented in Table 3. Participants with BMI <25 and those with age <35 years did not show any pronounced elevation in SBP (>160 mm Hg), while 4.3%, 5.6% and 7.1% of the whole population, of those with BMI  $\geq$ 25 and of those aged  $\geq$ 35 years were having this elevation, respectively. The percentages of participants with borderline high systolic blood pressure (160>SBP>140 mm Hg) in the whole population, in BMI <25 group, in BMI  $\geq$ 25 group, in age <35 group and in the age  $\geq$ 35 group, were 8.7%, 6.7%, 9.3%, 9.4% and 8.2% respectively. The proportion of those with DBP >90 mm Hg showed a similar trend of increases with increasing BMI and advanced age, the only difference being that, in both BMI <25 and age <35 years groups some participants were having elevated (>90 mm Hg) DBP (10% and 7.5%) compared to none with SBP elevations in these groups.

TC >220 mg/dl (<5.2mmol/L) was observed in 15.2% of the whole population, in 6.7% of BMI <25 group and in 9.4% of age <35 years group compared to 17.6% in BMI  $\geq$ 25 and 18.8% in age  $\geq$ 35 years groups.

TG > 150 mg/dl exhibit a similar trend in respective groups, the percentage of those with elevated TG doubling in some groups (41.7% in BMI >25 groups Vs. 20% in BMI <25 group). Age  $\geq$ 35 years group had the highest percentage of those with elevated BS (>120 mg/dl) (14%) compared to 3.8% in age <35 years group. The proportion was 11.1% in BMI  $\geq$ 25 group compared to 6.7% in BMI <25 group.

In Table 4 the overall simple linear correlation coefficients between the selected variables (SBP, DBP, TC, TG and BS) and BMI and age are calculated. SBP and DBP were not significantly correlated with BMI while they were highly positively correlated to age ( $r=0.323$ ,  $P<0.0001$ ). TC, TG and BS were significantly positively inter related with BMI at P-values <0.05, <0.01 and 0.008 respectively. However, though TC and BS were significantly correlated with age at  $P<0.05$  and <0.03, respectively, TG was correlated with

age, indicating that in this group dietary patterns and fat intake together with BMI may have been the determinant factors in triglyceride levels.

#### DISCUSSION

About 4.3% of our whole population possibly having elevated blood pressure (SBP >160 mm Hg) and/or just can be called

Table 3. Percent prevalence of selected risk factors in male staff of King Saud University by BMI and age

Risk factor	Whole population No. 690		BMI				Age			
	No.	%	<25 No=150		≥25 No=540		<35 No=175		≥35 No=425	
			No.	%	No.	%	No.	%	No.	%
SPB (mm Hg)										
SBP>160	30	4.3	0	0.0	30	5.6	0	0.0	30	7.1
160>SBP>140	60	8.7	10	6.7	50	9.3	25	9.4	35	8.2
SBP<140	600	87.0	140	93.3	460	85.2	240	90.6	360	84.7
DBP (mm Hg)										
DBP>90	100	14.5	15	10.0	85	15.7	20	7.5	80	18.8
90>DBP>80	200	29.0	30	20.0	170	31.5	85	32.1	115	27.1
DBP<80	390	56.5	105	70.0	285	52.8	160	60.4	230	54.1
TC (mg/dl)										
TC<220	585	84.8	140	93.3	445	82.4	240	90.6	345	81.2
TC>220	105	15.2	10	6.7	95	17.6	25	9.4	80	18.8
TG (mg/dl)										
TG<150	580	84.1	120	80.0	315	58.3	195	73.6	240	56.5
TG>150	110	15.9	30	20.0	225	41.7	70	26.4	185	43.5
BS (mg/dl)										
BS<120	620	89.9	140	93.3	480	88.9	225	96.2	365	85.9
BS>120	70	10.1	10	6.7	60	11.1	10	3.8	60	14.1
SBP>160; DBP>90 mm Hg	30	4.3	-	-	-	-	-	-	-	-

Table 4. Simple correlation coefficients coronary risk factors with BMI and age in male staff of King Saud University

Risk factor	BMI		Age	
	r	P	r	P
SBP	0.1409	NS	0.3230	<0.0001
DBP	0.1139	NS	0.2031	<0.02
TC	0.1642	<0.05	0.1694	<0.04
TG	0.2159	<0.010	0.1466	<NS
BS	0.2251	<0.008	0.1808	<0.03

NS = Not significant

hypertensive since they were 14.5% subjects with DBP >90 mm Hg, also defined as hypertensive. As concluded from the results in Table 3, prevalence of high blood pressure (SBP>160 and DBP >80) increased with increasing BMI and advanced age. The percentage of those with high blood pressure in our study were considerably higher than those for males studied by Al-Nozha et al<sup>14</sup> in Riyadh region in a community based epidemiological study. However, their population included 45.3% of those age <15 yr, half of which were females. Another factor that might have accounted for this difference was that our participants were from an affluent high income sedentary group of the society. On the other hand 9.1% (greater than in our study, 4.3%) of the total Kingdom of Saudi Arabia population sample (19,598 persons, 57% females) screened in the national nutritional survey<sup>15</sup> were shown to have SBP >160 mm Hg while those with DBP >95 constituted 8.73% compared to 14.5% in our study group. Al-Shammari et al<sup>16</sup> have found high blood

pressure to be prevalent in 11% among 1005 attendants (aged <35 to >65 yr) of the family practice clinic of King Fahd Hospital screened for serum lipids and blood sugar. Al-Shagrawi and Al-Shayeb have found 1.2% and 4.1% male King Saud University students screened for total cholesterol, to have SBP >160 and DBP >90 mm Hg respectively<sup>17</sup>. Hakim et al<sup>18</sup> who have found hypertension prevalence in 16% of acute myocardial infarctions (AMI) in Saudi patients, concluded that this disease occurs mainly in middle aged and elderly males, however they stated that young males are also afflicted<sup>18</sup>. Hypertension prevalence in Saudis in Assir region at the primary health care (PHC) level was found to be 2.5% (SBP >160 and/or DBP >95 mm Hg)<sup>19</sup>. It is worth mentioning that people of this region are still unchanged, living in a traditional society and may be remarkably free of risk factors.

It has been stated that unusual DBP is positively related to the risks of stroke and of CVD, not only among those who might be considered "hypertensive" but also among those who would usually be considered normotensive, thus the lower the level through out the range (70-110 mm Hg) the lower the risk of these diseases<sup>20</sup>. Therefore the hypertension prevalence, and/or the borderline high blood pressure observed in the above mentioned and compared studies emphasises the need for an effective assessment of the epidemiological information, as a potential tool for the prevention of CVD at the earliest stages.

In the population study "evaluation of the nutritional status of the people of Saudi Arabia", 38.4%, 28.2% and 12.9% of the sample were having TG >150 mg/dl, TC >200 mg/dl (5.2 mmol/l) and BS >110 mg/dl respectively<sup>15</sup>. Similarly

in the attendants of King Fahd Hospital, diabetics, hypertensive, diabetics and hypertensive, overweight and/or obese, and those with other health problems with TC >250 mg/dl (5.2 mmol/l) were 13.2%, 10.8%, 14.1%, 10.6% and 7.1% respectively<sup>16</sup>. Surprisingly and at the same time the percentage of our participants were not complaining of the above mentioned diseases, yet their cholesterol elevation (>220 mg/dl (5.2 mmol/l) was higher than the percentages of the above diseased groups. However, those with elevations TG (15.9%), TC (15.2%) and BS (10.1%) in our study, were lower than their corresponding groups in the national nutritional study<sup>15</sup>.

Ahmed et al<sup>20</sup> have studied the incidence of coronary heart disease (CHD) risk factors in Saudis in Al-Madina Al-Munawwarah<sup>21</sup>. Their patients were with risk factors more frequently found than in controls (hypertension (HT) in 42%, diabetes mellitus in 41% and high TG in 32%). They concluded that in the Saudis they studied, hypertension, diabetes mellitus and smoking, were consistently associated with coronary heart disease (CHD). Of plasma lipids hypertriglyceridemia (a controversial independent risk factor)<sup>22,23</sup> was also consistently related to CHD whereas plasma levels of other lipids showed no such association. Desirable blood cholesterol level is defined as 200 mg/dl (5.2 mmol/l), and those from 200 to 239 mg/dl (5.2 - 6.2 mmol/l) as border-line. The cut-off point that defines high blood cholesterol (240 mg/dl (6.2 mmol/l) is the value above which risk for CHD rises more steeply<sup>24</sup>. It was suggested that relative risk of CHD conferred by an elevated cholesterol is weaker in elderly than in young or middle aged adults, yet a high cholesterol level leads to more CHD events in the elderly<sup>24</sup>. Thus a high percentage of our participants may have been threatened in both situations being middle-aged advancing towards old age, and moreover afflicted by other risk factors, (overweight and/or obesity, hypertriglyceridaemia and hyperglycemia).

Regardless of the prevalence of obesity among our study group, the presence of a remarkable percentage of overweights (78.1%) constitutes an alarming signal of the possible dangers of this disorder and its complications, viewed with the high vulnerability to CHD enacted by the socioeconomical and lifestyle factors.

Al-obaid et al<sup>24</sup> have found the CHD deaths in the Eastern Province of Saudi Arabia to be 26% (proportionate mortality rate (PMR) of the total deaths), and male CHD deaths to be 27% of total male deaths. Similarly, MUSAIGER and ABDULLA<sup>25</sup> found that diseases of the circulatory system were responsible for about 26.5% of the deaths in Bahrain with CHD and hypertension being the leading causes of these deaths. It has been reported that more than one third (37%) of the mortalities were due to CVD<sup>26</sup>.

It was said that using blood pressure to screen for persons at high risk of stroke would be quite effective, as 57% of the incidence of atherothrombotic brain infarction at Framingham arises in the 19% of the population having a systolic blood pressure of 160 mm Hg or greater. The statistics of hypertensive heart disease were also similar. Overall, 36.2% cases of CVD occurring in a 2 year period arise in the group of persons whose SBP >160 mm Hg<sup>27</sup>.

There is still however, greater need for better understanding of the dietary and other determinants of population blood

pressure levels. Likewise prevention of disease entails accurate identification, diagnosis evaluation of co-existing controllable risk factors such as raised TC, raised LDL and/or decreased level of HDL.

Prevention of CHD and CVD requires intervention as early in life as possible. Reduction of risk factors in middle age may be too late to achieve maximal, or indeed any, benefit in terms of progression of underlying disease. Thus emphasis should be to promote good dietary habits and lifestyle (eg. diet low in animal fat, less total fat, exercise etc.) and preventing bad habits (eg. smoking etc).

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# Food Frequency Intake and Lifestyle among Patients attending Out-Patient Clinics in Qatar: A Preliminary Study

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The objective of this study was to find out some risk factors that may be related to occurrence of chronic diseases among patients attending out-patient clinics in Qatar. All adult patients (20 years and over) attending the out-patient clinics in Hamad General Hospital for one week between 8 am and 12 pm were included. The total sample was 243 men and 214 women. The findings revealed that the daily consumption of fresh vegetables and fruits was low among both Qataris and non-Qataris. The proportion of current smokers was 28% in Qatari and 45% in non-Qatari men, while none of Qatari women reported smoking compared to 7.9% of non-Qatari women. The practising of exercise was relatively high compared to other Gulf countries, ranged from 33.7% to 51.6%. This is because of two reasons; Firstly, the high proportion of chronic diseases among the patients and therefore they may be advised by the physicians to practise exercise to control these diseases. Secondly, the unclear definition of exercise which lead to obtaining misleading answers. Watching television for a long time (more than 3 hours/day) was observed among both Qataris and non-Qataris. However, the Qataris were more likely to watch television for a long duration than non-Qataris. Further comprehensive studies are urgently needed to explore the main risk factors associated with chronic non-communicable diseases in Qatar.

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In Qatar, as in other Arab Gulf countries, where a rapid change in food habits and living standards has occurred over the past 30 years, chronic non-communicable diseases have emerged as the main causes of morbidity and mortality. Trends in leading causes of deaths in Qatar at present resemble those reported for developed countries, as 34% of total deaths were due to circulatory system diseases, and 12% were due to neoplasms<sup>1</sup>.

Risk factors for chronic non-communicable diseases in Qatar have not been well investigated. A study on risk factors for cardiovascular diseases among women attending health centers in Qatar showed that very few women were current smokers (3.2%), but 37.7% of married women have smoker husbands. Using Body Mass Index (BMI), 30% of women were overweight (BMI 25-29.9) and 33.6% were obese (BMI  $\geq$  30). Only 16% of women reported practising exercise regularly<sup>2</sup>.

The present preliminary study was carried out to explore the risk factors that may be associated with occurrence of chronic diseases and to find out the association of age, sex and nationality with these factors among patients attending out-patient clinics in Qatar.

## METHODS

Data of this study were obtained from patients attending

out-patient clinics attached to Hamad General Hospital in Qatar. This hospital is the only governmental hospital in Doha, the capital of Qatar. All patients aged 20 years and over who attended the out-patient clinics between 8 am and 12 pm for the period of one week were interviewed and included in the study. The total sample was 457 (243 male and 214 female). Non-response was not reported.

The patients were interviewed by health workers using a pretested questionnaire. Information on socio-demographic background of the patients, frequency intake of specific foods and lifestyle patterns were collected.

Marital status was classified as currently un-married and currently married. Employment status was grouped into unemployed (include housewife), and employed. Any person who consumed one or more cigarettes a day was considered as current smoker, while non-smokers are those who do not smoke or former smokers.

Data were analysed using Epi-Info programme<sup>3</sup>. Chi-Square was used to test the statistical association between demographic variables and lifestyle patterns.

## RESULTS AND DISCUSSION

The demographic characteristics of patients attending out-patient clinics are presented in Table 1. The majority of patients were married and the proportion was higher among

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men than women. The association between marital status and sex was statistically significant for both Qataris ( $p<0.05$ ) and non-Qataris ( $p<0.000$ ). Of patients, 74% and 94.6% of Qatari and non-Qatari men were employed, whereas the percentages among women were 20.8% and 31.5%, respectively. The high percentage of employment in non-Qataris is expected, as these represent the expatriates who came to Qatar for better paid jobs, and they are mostly Arabs and Asians.

Table 1. Demographic characteristics of adults attending out-patient clinics in Qatar by sex and nationality

Characteristics	Qatari		Non-Qatari	
	Male (150)	Female (125)	Male (93)	Female (89)
Marital Status				
Currently single	15.3	24.8*	3.2	24.7*
Currently married	84.7	75.2	96.8	75.3
Employment				
Unemployed	25.3	79.2**	5.4	68.5**
Employed	74.7	20.8	94.6	31.5
Education level				
Illiterate	28.7	30.4	29.1	18.4*
Primary	12.7	8.8	8.6	9.0
Intermediate	17.3	16.0	16.1	9.0
Secondary	31.3	25.6	14.0	32.6
University	10.0	19.2	32.2	30.0

\*  $<0.05$  \*\* $<0.000$

Interestingly, the percentage of illiteracy among Qataris and non-Qataris was the same, but for women, the Qataris had a significantly higher proportion of illiteracy compared to non-Qataris (30.4% and 18.4%, respectively). The relatively high percentage of illiteracy among non-Qatari men may be due to low socio-economic status of non-Qataris, especially the labours who came from the Indian-sub continent, and working in low social occupations.

Table 2. Food frequency intake by adult Qatari patients attending out-patient clinics in Qatar

Food	Sex	Rarely or				P. Value
		Daily %	4-6/wk %	1-3/wk %	None %	
Vegetables	M	11.3	64.7	22.7	1.3	0.000
	F	4.8	42.4	49.6	3.2	
Fruits	M	14.0	58.0	26.7	1.3	0.000
	F	10.4	34.4	44.8	10.4	
Red Meat	M	7.3	60.7	31.3	0.7	0.000
	F	0.0	45.6	43.2	11.2	
Chicken	M	4.7	60.0	33.3	2.0	N.S
	F	4.8	71.2	27.3	4.8	
Fish	M	12.0	36.0	47.3	4.7	0.000
	F	1.6	38.4	44.0	16.0	
Pulses	M	3.3	44.7	42.7	9.3	0.000
	F	1.6	10.4	39.2	48.8	
Brown Bread	M	2.0	33.3	44.0	20.7	0.000
	F	5.6	6.4	26.4	61.6	

The daily consumption of fresh vegetables and fruits was low among Qataris. About 11% of men and 5% of women consumed fresh vegetables daily. The corresponding figures for fresh fruits were 14% and 10%, respectively. Additionally, a relatively high percentage of Qataris rarely or never consumed fresh fruits (10%), as shown in Table 2. Similar

findings were reported for non-Qataris, but the proportion of men who consumed fresh vegetables and fruits was higher (24.7% and 16.1%, respectively), as presented in Table 3. These results are alarming as fresh vegetables and fruits are a good source of many vitamins and minerals, as well as dietary fiber. It is recommended that an adult should consume at least two to four servings of fruits and a similar number of servings of vegetables per day. In general, the consumption of foods rich in dietary fiber such as vegetables, fruits, legumes and brown bread is low in both nationalities. The association between the intake of high-fiber foods, and occurrence of some chronic non-communicable diseases is well documented<sup>4</sup>. A case-control study in Bahrain showed that patients with myocardial infarction tended to consume fresh fruits and vegetables less frequently per week than community control subjects<sup>5</sup>.

Table 3. Food frequency intake by adult non-Qatari patients attending out-patient clinics in Qatar

Food	Sex	Daily %	Rarely or			P. Value
			4-6/wk %	1-3/wk %	None %	
Vegetables	M	24.7	23.7	50.5	1.1	0.000
	F	3.4	50.6	38.1	7.9	
Fruits	M	16.1	21.5	58.1	4.3	0.000
	F	4.5	52.8	34.8	7.9	
Red Meat	M	8.6	41.9	46.2	3.3	0.000
	F	1.1	48.3	40.5	10.1	
Chicken	M	6.5	33.3	58.0	2.2	N.S
	F	1.0	15.9	64.1	1.0	
Fish	M	19.4	36.6	41.9	2.1	0.000
	F	1.1	50.6	28.1	20.2	
Pulses	M	16.1	26.9	41.9	15.1	0.000
	F	2.2	58.5	25.8	13.5	
Brown Bread	M	6.5	43.0	31.1	19.4	0.000
	F	2.2	39.4	14.6	43.8	

Women were less likely to consume red meat and fish than men, in both Qataris and non-Qataris. This finding is in contrast with that reported by Musaiger and Abuirmeileh<sup>6</sup> in the United Arab Emirates, as the proportion of intake of meat and fish was almost equal among native men and women.

Smoking is one of the risk factors for several chronic diseases. The prevalence of smoking in the Gulf countries has increased more steeply but from a higher level in men than among women<sup>7</sup>. The proportion of current cigarette smokers was higher among non-Qatari (45%) than Qatari men (28%),

Table 4. Age specific and overall proportion (%) of smoking and practising exercise by sex and nationality in adults attending out-patient clinics in Qatar

Age (yrs)	Nationality	% smoking		% practising exercise	
		Male	Female	Male	Female
20-39	Qatari	32.1	0.0	42.3	46.3
	Non-Qatari	55.0	5.6	45.0	38.0
40+	Qatari	23.9	0.0	40.8	25.7
	Non-Qatari	37.0	12.9	55.5	29.0
Total	Qatari	28.0	0.0	41.3	36.8
	Non-Qatari	45.2	7.9	51.6	33.7

whereas none of the Qatari women reported smoking cigarette, compared to 7.9% of non-Qatari women who were current smokers (Table 4). It is important to mention that many Qatari women smoke water-pipes, as this practice is socially accepted in the Arab Gulf countries. However, those women do not consider such habits as smoking cigarettes, and therefore they did not report smoking water-pipes.

The percentage of smoking among Qatari men in this study was close to that reported among adult men in Bahrain, 32%<sup>8</sup>, the United Arab Emirates, 28%<sup>9</sup>, and Oman, 27%<sup>10</sup>.

There is some evidence that regular physical activity protects against coronary heart diseases, hypertension, stroke, osteoporosis and possibly non-insulin-dependent diabetes<sup>11</sup>. Practising exercise was relatively high in this study, compared to other studies in the Arab Gulf countries<sup>8</sup>. This is because most of the patients had chronic diseases such as a diabetes, hypertension and heart diseases (not shown in table), and were probably advised to practise exercise to control these chronic diseases. However, many people are confused by the word exercise, as they consider that any physical activity is a kind of exercise. It is highly recommended that the question of exercise should be examined in detail to get precise information on exercise habits in the Arab Gulf communities.

The link between watching television and occurrence of over-weight has become more evident<sup>2</sup>. This is due to the long duration for watching television per day and the types of food consumed during watching. The majority of Qatari and non-Qatari adults watched television more than three hours per day. However, Qataris were more likely to watch television for a longer duration than non-Qataris. About 19% of Qatari men watched television more than four hours a day, compared to 40% in women; the corresponding figure

for non-Qataris were 27% and 32%, respectively. The difference in watching television between Qatari men and women was statistically significant (Table 5).

## CONCLUSION

In conclusion, this preliminary study revealed that risk factors for chronic non-communicable diseases such as low intake of high fiber foods, smoking and sedentary lifestyle are prevalent among patients attending out-patients clinics in Qatar. It is highly recommended, therefore, to carry-out in depth studies on the prevalence of diet-related non communicable diseases and the risk factors associated with these diseases. At the same time, programmes to prevent and control such diseases should be established as soon as possible.

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Table 5. Hours of watching the television by adults attending out-patient clinics in Qatar

Nationality & sex	None or rarely		Hours of watching television/day						P value
	No.	%	1-2		3-4		5+		
			No	%	No	%	No	%	
Qatari									
Male	5	3.4	41	27.1	76	50.6	28	18.9	
Female	12	9.9	27	21.5	35	28.1	51	40.5	0.000
Non-Qatari									
Male	7	7.3	32	34.4	29	31.2	25	27.1	
Female	8	9.0	33	37.1	19	21.4	29	32.5	NS

## Obesity, Physical Activity and Prevalence of Diabetes in Bahraini Arab Native Population

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A cross-sectional population-based study of 2128 residents aged 40-69 years was carried out in 1995 to determine the prevalence of diabetes and the association of obesity and physical activity with this disease. Subjects were invited to the clinic for interview, physical and laboratory examination. Venous blood samples were taken fasting and 2 hours after a 75 g oral glucose load. Using the 1985 WHO criteria, the overall prevalence rate of diabetes and impaired glucose tolerance (IGT) were 30% and 18%, respectively. In the age group 50-59 years prevalence was 29% in men and 35% in women. Mean body mass index (BMI) was 27.3 kg/m<sup>2</sup> in men and 28 kg/m<sup>2</sup> in women. Only 13% of men and 1% of women walked at least 4 km/day. BMI was positively related to education and inversely related to physical activity. On average, subjects with diabetes were older, had higher monthly incomes and positive family history of diabetes. They also had higher mean BMI, waist-to-hip ratio (WHR), waist-to-height ratio (WHTR). Multiple logistic regression analysis shows that age, BMI (or WHR, WHTR), and less physical activity are independent risk factors of NIDDM. The prevalence of diabetes in Bahrain is increasing with economic development and changes from traditional to modernized lifestyle. Therefore, Bahraini people should attempt to retain certain features of their traditional lifestyle (physical activity, healthy eating, and moderate body weight).

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Epidemiological studies in the Arab populations have demonstrated high prevalence rates of diabetes mellitus<sup>1-5</sup>.

Non-insulin-dependent-diabetes mellitus is a cause for growing public health concern in both developed and developing countries. In many countries, diabetes is now a leading cause of death, disability and high health care cost<sup>6-8</sup>. Various genetic, environmental and lifestyle factors influence diabetes aetiology and prognosis. Important differences in the frequency of diabetes and its complications have been reported between countries, ethnic and cultural groups<sup>9,10</sup>.

Health services utilisation data of primary and secondary care for diabetes over a current 15-year duration in Bahrain show enlargement use of in-hospital patients. The in-hospital data review in 1992 has shown high admission rates of adult diabetics to the medical ward in Salmaniya Medical Centre, the main general hospital in Bahrain<sup>11</sup>. This study aimed to determine the prevalence of diabetes in Bahraini natives and associations with risk factors. The specific hypothesis to be tested was that diabetes and other metabolic complications of obesity would account for high diabetes rates in this population. No survey has been conducted before which represents the whole Bahraini native population and this led us to commence the present survey.

### METHODS

The sample was designed as a single-stage, stratified, systemic

random sample. The subjects were selected according to the latest National Census of Bahrain in 1991<sup>12</sup>. The sampling fraction has been set to a round value of 1/20, using this sampling fraction. The first individual was selected randomly and then every 19th individual in the census list was selected.

The census list was sorted by region, block number, sex and age group.

All urban and rural areas of Bahrain were represented in eleven regions. A random sample of 2000 Bahraini native men aged 40-59 years and 2000 Bahraini native women aged 50-69 years in the year 1995 were selected. A stratified simple random selection of subjects, ensured that the age and sex distribution of sample was reflected. A probability sample was obtained in accordance with recommendations for sample surveys of health in developing countries<sup>13</sup>. The calculation of sample size was based on the precision required for the prevalence estimate. The exact 95% confidence limits for various rates and sizes of random samples, are based on the effects of sampling variability; the error is inversely proportional to the square root of sample size, so that doubling the sample size reduces the limits by about 30%.

The names of all "usual residents", men aged 40-59 and women aged 50-69 years were recorded. At the time of the survey, written and verbal information had been given to each household concerning the reasons for the survey and

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what it might entail for each individual. There were specific "motivators" for the survey who had the primary responsibility for liaison and for issuing invitations and re-invitations. As well as initial contact at the time of the census, each community region was contacted several days before the arrival of the survey team in that area. Additionally, all individuals were given an invitation letter (with instructions for fasting) within 2-3 days of their appointment. Subjects on diet or tablets for diabetes were not asked to fast. The newspaper, radio and television announcements and posters through the Health Education Department in the Ministry of Health were recruited for help in this survey. Subjects who required an official letter for their employer requesting the latter's co-operation in allowing the person time off from work to attend the survey were given.

The extent to which non-responders were sought depend on the overall response rate, but normally involved at least one re-invitation while the survey team remained in the area. Appropriate survey sites were selected for each region in Bahrain and all health centres in Bahrain were recruited. Weight and height were recorded with the subjects wearing light clothing and without shoes. Accurate balance scales were used and weight was recorded to the nearest 0.1 kilogram. Height was recorded to the nearest centimeter, rounding up if midway, using a measuring rod.

The same person who recorded the height and weight in the same room recorded the waist and hip measurement. One layer of light clothing over underwear was acceptable. The observer kneeled or sat at an appropriate height in front of the subject, who breathed quietly and normally. A dressmaker's measuring tape was used, taking care that it was applied horizontally. Waist girth should be measured at the midpoint between the iliac crest and the lower margin of the ribs. An approximate indicator of this level may be ascertained by asking the subject to bend sideways. Hip girth was recorded as the maximum circumference around the buttocks posteriorly and indicated anteriorly by the symphysis pubis. Measures were made to the nearest 0.5 centimeter and repeated following both initial recordings. If there was variation greater than 2 cm between duplicate

readings then a third was taken and recorded alongside the second.

Blood samples were taken after an over-night fast of 12-16 hours on the second visit to the clinic. Venous blood was taken for estimating plasma glucose, plasma cholesterol, and plasma triglyceride concentrations. Then 75 g glucose dissolved in 300 ml water was drunk in two or five minutes and the venous blood glucose concentration was re-estimated two hours later.

During the interval, the subjects were asked about their health using a pretested questionnaire. They were asked about their family history of diabetes and physical activity. Physical activity was assessed by asking about walking distance on average week-days and weekend days and divided into three categories: < one kilometer (km), 1-3 ≥ 4km. Cycling was also assessed by asking about cycling distance on average weekdays and weekend days and divided into three categories: < one kilometer (km), 1-3 and ≥ 4 km.

Diabetes and impaired glucose tolerance were defined according to the 1985 World Health Organisation Criteria<sup>14</sup> for epidemiological studies, and were as follows:

1. NIDDM: FPG ≥ 140 mg/dl (7.8 mmol/l) or 2-hr plasma glucose >200 mg/dl (11.1 mmol/l), or history of physician-diagnosed diabetes.
2. And IGT: FPG <140mg/dl (7.8 mmol/l) and 2-hr plasma glucose 140-199 mg/dl (7.8-11.1 mmol/l).
3. A history of physician-diagnosed diabetes, with or without current use of hypoglycaemic agents, will be differentiated newly diagnosed and previously known NIDDM.
4. Non-diabetic (normal): All those who not meet the above criteria for either NIDDM or IGT will be classified as having normal glucose tolerance.

The obesity was defined by body mass index (BMI) calculation as weight/height<sup>2</sup> (Kg/m<sup>2</sup>). Overweight were defined as a body mass index ≥ 25 in men and women and obesity as a body mass index of ≥ 30 in both men and women.

Table 1. Age and sex specific prevalence of diabetes mellitus\* and IGT

Age-group	N	Not diabetic				Diabetic				Total prevalence	
		Normo-glycemic No	%	IGT No	%	New cases No	%	Old cases No	%	No	%
<b>MEN</b>											
40-49 years	668	404	60	111	17	71	11	82	12	153	23
50-59 years	506	276	55	80	16	46	9	104	20	150	29
Total	1174	680	58	191	16	117	10	186	16	303	26
<b>WOMEN</b>											
50-59 years	458	207	45	89	19	49	11	113	25	162	35
60-69 years	370	148	40	83	23	45	12	94	25	139	37
Total	828	355	43	172	21	94	11	207	35	301	36
<b>GRANT TOTAL</b>	2002	1035	52	363	18	211	11	393	20	604	30

\*Diabetes defined by World Health Organization diagnostic criteria: New: Fasting plasma glucose FPG 7.8 mmol/l Or 2 hr plasma glucose 11.1 mmol/l. Previous: A history of physician-diagnosed diabetes, with or without current use of hypoglycemic agents. Not diabetic: IGT: FPG 7.8 mmol/l and 2-hr plasma glucose 7.8-11.1 mmol/l. Normo-glycaemic: FPG<6.1 mmol/l and 75g OGTT<11.2 mmol/l.

**RESULTS**

**Prevalence of Diabetes**

The crude prevalence rates for diabetes and IGT were 30% and 18% respectively. The age-specific prevalence rates of diabetes and IGT are presented in Table 1. In the age group 50-59 years, the prevalence of diabetes in women was 35% higher than in men (29%). Prevalence of IGT was also higher in women (19%) than in men (16%).

Comparison has been made between the prevalence of diabetes in this survey and the prevalence in other populations after age-adjusting to the age distribution of the Bahraini men and women in this survey. All prevalence rates of diabetes presented in Table 2 are based on surveys using oral glucose tolerance tests and WHO diagnostic criteria. The lowest prevalence rates (<4%) were seen in Chinese people, both among men and women. Moderate prevalence rates (5-10%) were seen in black American men. High prevalence rates (11-20%) were seen in Arab Omani men, American Mexican native men and black American women. Very high prevalence rates were seen in Arab Bahraini women and Arab Omani women, 35% and 24% respectively. The rates in Bahrain are higher than in other high-risk populations such as Omanis and Mauritius Indians, and are exceeded only by the prevalence rates of more than 50% observed in Pima and Papago American natives of Arizona.

**Table 2. Age-adjusted\* prevalence(%) of diabetes mellitus in Bahrain compared with selected study populations**

Ethnic group	Age-Specific				Age-adjusted 40-59 yrs
	40-44 yrs	45-49 yrs	50-54 yrs	55-59 yrs	
<b>MEN</b>					
Chinese (Da Qing)	0.9	1.1	1.7	3.5	1.9
Americans (Black)	10.3	13.1	6.6	10.9	10.3
(Mexican)	13.9	18.5	8.4	30.8	19.0
Indians (Mauritius)	13.2	24.3	26.4	23.5	21.6
Arab (Oman)	16.6	15.1	16.7	26.4	19.2
(Bahrain)	17.6	27.4	24.7	31.9	24.4
Pima/Papago (Native Americans)	55.9	62.1	51.5	59.0	57.4
	Age-specific				Age-adjusted 50-69 yrs
	50-54 yrs	55-59 yrs	60-64 yrs	65-69 yrs	
<b>WOMEN</b>					
Chinese (Da Qing)	3.6	3.1	3.0	4.6	3.5
Americans (Black)	6.6	30.0	16.9	22.2	20.1
(Mexican)	17.4	36.5	26.1	50.6	34.6
Indians (Mauritius)	14.9	18.8	35.3	34.7	25.3
Arab (Oman)	20.2	24.3	18.8	31.6	23.8
(Bahrain)	30.3	36.9	36.8	36.1	35.1
Pima/Papago (Native Americans)	55.1	73.3	70.0	63.3	66.2

\* All these rates were adjusted according to the Bahraini native population of this survey

**Association of obesity with diabetes**

The mean BMI in diabetic men was 28 ± 4.7 and in non-diabetic was 27 ± 4.7 (p<0.001), while that in women were 29 ± 5.8 and 27 ± 5.5 in diabetic and non-diabetics respectively (p<0.001). Abdominal obesity was associated with diabetes

in both men and women (Table 3). The mean WHR in diabetic men was 0.98 ± 0.09 and 0.95 ± 0.07 in non-diabetic men (P<0.001). In women the differences in mean waist-hip ratio between diabetic and non-diabetic participants were not significant, however waist-height, ratio (WHTR) was higher in diabetic and non-diabetic participants in both men and women. The mean WHTR in diabetic women was 0.64 ± 0.08 and 0.61 ± 0.08 in non-diabetic women (p<0.001).

**Table 3. Characteristics of variables in men aged 40-59 years with and without diabetes**

MEN	Not diabetic (n=892)	Diabetic (n=303)	P value
Number surveyed			
Mean (SD) age (year)	49±5.7	50±5.6	<0.001
<b>Clinical examination date</b>			
Mean (SD) weight (Kg)	75.1±14.1	77.9±13.7	<0.004*
Mean (SD) waist (cm)	93.9±11.7	98.1±12.0	<0.001*
Mean (SD) hips (cm)	98.0±11.0	100.0±11.7	<0.008*
Mean (SD) BMI (Kg/m <sup>2</sup> )	27±4.7	28±4.7	<0.001*
Mean (SD) WHR	0.95±0.07	0.98±0.09	<0.001*
Mean (SD) WHTR	0.56±0.06	0.58±0.07	<0.001*
<b>WOMEN</b>			
Number surveyed	(n=540)	(n=293)	
Mean (SD) age (year)	59±5.3	60±5.3	0.361
<b>Clinical examination date</b>			
Mean (SD) height (cm)	153.9±6.0	153.5±5.3	0.39*
Mean (SD) weight (Kg)	64.2±14.3	69.5±15.5	<0.001*
Mean (SD) waist (cm)	94.3±11.9	98.8±12.9	<0.001*
Mean (SD) hips (cm)	99.7±12.4	103.9±13.0	<0.001*
Mean (SD) BMI (Kg/m <sup>2</sup> )	27±5.5	29±5.8	<0.001*
Mean (SD) WHR	0.94±0.08	0.95±0.08	0.150 <sup>†</sup>
Mean (SD) WHTR	0.61±0.08	0.64±0.08	<0.001*

\* P value based on t test for difference between two means P value based on chi square and odds ratio for difference between two proportions

The relationship of diabetes to body mass index and waist-hip ratio was examined in logistic regression analyses (Table 4). In men both body mass index and waist-hip ratio were strongly predictive of diabetes. In women, body mass index was a far stronger predictor of diabetes than waist-hip ratio.

**Table 4. Logistic regression of obesity as a risk factor for diabetes by gender**

Risk factor	Men		Women			
	OR*	P	95% CI**	OR	P	95% CI
<b>BMI groups</b>						
<20 Kg/m <sup>2</sup>	1.0		(Reference)	1.0		(Reference)
20-24.9 Kg/m <sup>2</sup>	1.4	0.349	0.66,3.10	1.9	0.114	0.85,4.37
25-29.9 Kg/m <sup>2</sup>	1.8	0.114	0.86,3.92	3.3	0.004	1.47,7.30
30-39.9 Kg/m <sup>2</sup>	2.4	0.027	1.10,5.17	4.3	<0.001	1.92,9.66
40+ Kg/m <sup>2</sup>	3.3	0.056	0.96,11.9	8.8	<0.001	3.00,26.1
<b>Waist-hip ratio</b>						
<0.85	1.0		(Reference)	1.0		(Reference)
0.85-0.89	1.6	0.334	0.61,4.18	1.4	0.251	0.79,2.44
0.90-0.94	2.8	0.024	1.14,6.85	1.5	0.149	0.86,2.55
0.95-0.99	2.9	0.020	1.18,6.95	1.7	0.060	0.97,2.82
1.00-1.04	3.1	0.015	1.24,7.66	1.4	0.218	0.80,2.58
>1.04	4.5	0.001	1.80,11.6	1.8	0.051	0.99,3.29

\* OR = Odds ratio \*\* CI = Confidence interval

### Association of physical activity with diabetes

The distance walked and cycling per average weekday was presented in Tables 5 and 6. The majority of people in Bahrain walk less than one kilometer on average weekdays. The men were more active than women. Only 6% of women aged 50-59 years were active by walking at least one km/day. The majority of people in Bahrain do not cycle; only 6% of men aged 40-49 years old were cycling and 9% of those aged 50-59 years old. Only 7 women reported were cycling.

**Table 5. Number and percentage of Bahraini men and women walking distance/km on average week days**

No of km walking	MEN				WOMEN			
	40-49 yrs		50-59 yrs		50-59 yrs		60-69 yrs	
	No	%	No	%	No	%	No	%
<1 km	423	63	340	68	437	93	362	95
1.3 km	150	22	103	20	26	6	14	4
4 and above	98	15	59	12	5	1	2	1
<b>Total</b>	<b>671</b>	<b>100</b>	<b>502</b>	<b>100</b>	<b>468</b>	<b>100</b>	<b>378</b>	<b>100</b>

**Table 6. Number and percentage of Bahraini men cycling distance/km on average week days**

Cycling	Age group			
	40-49 years		50-59 years	
	No	%	No	%
Yes	42	6	43	9
No	629	94	460	91
<b>Total</b>	<b>671</b>	<b>100</b>	<b>503</b>	<b>100</b>

### DISCUSSION

This is the first cross-sectional survey in Bahrain on the prevalence of diabetes mellitus based on blood parameters and associated risk factors in Bahraini natives. The overall diabetes prevalence (30%) in adults confirms that Bahrainis have extraordinary rates of diabetes. The main finding is the extremely high prevalence of diabetes in the Bahraini native population. Although there are variations in rates of diabetes by ethnic origin, even in the groups at lower risk the prevalence is among the highest in the world. Diabetes mellitus is present in 26% of men aged 40-59 years and 36% of women aged 50-69 years. When prevalence rates for the same age group (50-59 years) are compared, women had higher rates (35%) than men (29%). This sex difference in diabetes prevalence was removed by adjusting for BMI.

Prevalence of IGT (19% in women and 16% in men aged 50-59 years) was approximately two fold higher than the prevalence of newly diagnosed NIDDM in this study. This is in accordance with previously published studies of high-risk populations<sup>15-18</sup>. IGT is a relatively new clinical category, and its clinical significance is still under study. Several follow-up studies in middle-aged and younger populations have indicated that 50% of IGT subjects revert to normal glucose tolerance, 25% remain permanently glucose intolerant, and <25% progress to diabetes<sup>19-21</sup>. However, middle aged subjects with IGT have an approximately fourfold risk for developing diabetes compared with

normoglycaemic subjects<sup>17,20</sup>. It has been suggested that high prevalence of IGT in relation to prevalence of NIDDM is an indicator that prevalence of NIDDM is increasing<sup>22</sup>. This would be consistent with the increase in hospital admissions for diabetes during the last 20 years and with the changes of socioeconomic status and life-style which have led to high prevalence rates of obesity and to low physical activity.

Based on the present survey data, about 35% of those with diabetes aged 40-69 years in Bahrain are undiagnosed. For comparison, 48% of all cases of diabetes in the USA and about one-third of all cases in England in this age group are undiagnosed<sup>7,23</sup>.

Average body mass index, and prevalence of obesity (defined as BMI >30) were high in the Bahraini population, and higher in women (37%) than in men (22%). The prevalence of obesity and the average body mass index were lower than reported in surveys of population samples in Saudi Arabia<sup>1</sup> and Kuwait<sup>24</sup>, but similar to a study in United Arab Emirates<sup>2</sup>, where a community based survey among a Bedouin-derived population found that 27% of all urban residents aged 30-64 years old were obese (BMI ≥ 30).

In adult Kuwaitis<sup>24</sup> the mean BMI (± standard deviation) was 28.3 (± 5.3), the prevalence of overweight was found to be 70% (BMI ≥ 25) and the prevalence of obesity was 36% (BMI ≥ 30). Prevalence of obesity was higher among women than men.

In a study of Saudi Arabian women attending 15 health centres in urban and rural areas in the Riyadh region<sup>25</sup> whose mean age was 32.2 ± 11.7 years, the mean BMI was 29.2 ± 7.0 kgm<sup>2</sup>. Only 26% of subjects were ideal weight (BMI <25 kg m<sup>2</sup>), while 27% were overweight (BMI 25-29.9 kgm<sup>2</sup>), 42% were moderately obese (BMI 30-40 kgm<sup>2</sup>) and 5% were morbidly obese (BMI > 40kgm<sup>2</sup>).

Historical studies<sup>26,27</sup> suggest that the high rates of obesity in the Arabian Peninsula are a relatively recent phenomenon.

It has been hypothesized that native Arabs have a genetic predisposition to overweight in an environment of abundant food and decreased energy expenditure. Continuing high fat intakes in combination with low physical activity may contribute to the increasing prevalence of obesity.

Obesity is the most important determinant of risk of NIDDM within populations. Central obesity, as measured by the waist girth, the waist/hip ratio or the waist/height ratio, has generally been found to show stronger associations than body mass index with diabetes<sup>28</sup>.

Several epidemiological studies have shown associations between WHT and prevalence of diabetes, independent of BMI<sup>10,21</sup>. In Bahrainis, prevalence of diabetes was strongly related to waist girth and waist-height ratio in both men and women.

Waist-hip girth ratio was related to diabetes in men but not in women: as both waist and hip girth were associated with glucose intolerance. The reason for this is not clear; it may be that waist-hip girth ratio does not reliably discriminate women with central obesity from women with peripheral obesity in this population. It is notable that the average waist-hip ratios in women in this population were far higher

than in other populations.

Levels of physical activity in the population were generally low, especially in women. In populations where physical activity levels are very low, questions about physical inactivity - such as time spent sitting at work or watching television - may be more useful measures of energy expenditure than questions about physical activity. Low physical activity is likely to predispose to NIDDM through its effect on obesity, and possibly also through effects on insulin sensitivity that are not mediated through effects on obesity. Physical activity has been advocated<sup>29</sup> for primary prevention of NIDDM, but randomised trials to establish the specific intensities and duration that are protective are not available. The inverse association of physical activity with obesity is consistent with a protective effect on NIDDM.

## CONCLUSION

These data indicate that BMI, abdominally distributed fat, and physical inactivity are important independent risk factors for both IGT and NIDDM in Bahrain. Attributable risk factors from Mauritius suggest that population wide modification of levels of these risk factors could potentially result in substantially lower occurrence of NIDDM (and IGT). Such interventions should be attempted in high-risk populations. The prevalence of diabetes in Bahrain is increasing with economic development and changes from traditional to modernised lifestyle, especially where people have a lower level of education and socioeconomic development. Therefore, Bahraini people should attempt to retain certain features of their traditional lifestyle (physical activity, healthy eating, and moderate body weight). Increased knowledge of risk factors for diabetes may help to prevent a further rapid increase in the prevalence of diabetes in Bahrain.

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## Prevalences and Correlates of Diabetes, Obesity, and Hyperlipidemia in the United Arab Emirates (UAE)

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Associated with the rapid socioeconomic development during the last three decades, coronary heart disease (CHD) has emerged as a major cause of mortality in the UAE. Yet the prevalences and correlates of CHD risk factors including diabetes, obesity, and hyperlipidemia have not been studied in depth in any UAE population. We examined 358 apparently healthy office-based male employees of the Abu Dhabi oil industry for these three conditions. These men, aged 35-49 years, belonged to one of six ethnic groups: South Asian, Peninsular Arab, Shawam, Egyptian, Afro-Arab and European. Of all studied men, 10% had diabetes and 18% had glucose intolerance, 51% of the men were grade 1 overweight (body mass index (BMI): 25.00-29.99) and 18% were grade 2 (BMI:30.00-39.99) or grade 3 (BMI > 40.00) overweight. 31% of the men had a waist-hip ratio of 1:0. Borderline high levels (200-239 mg/dL) and high level (>240 mg/dL) of total blood cholesterol were detected in 35% and 39% of the men, respectively. The prevalences of the three studied CHD risk factors were associated with selected sociodemographic (age, ethnicity, level of education, and professional status) and lifestyle (current cigarette smoking and leisure-time physical activity) variables. The high prevalences of diabetes, obesity, and hyperlipidemia in this group of apparently healthy men emphasise the urgent need for effective interventions and further in depth research in this population and other comparable populations in the UAE.

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Associated with the rapid socioeconomic development and lifestyle changes during the past three decades, cardiovascular disease (CVD) has emerged as a leading cause of mortality in the United Arab Emirates (UAE)<sup>1</sup>. Therefore the need for CVD risk reduction in the UAE cannot be over-emphasised. The epidemiologic features of CVD risk factors have been studied extensively in the United States and Western Europe. Unfortunately, findings of these studies of CVD risk factors may not be directly applicable to the populations of other areas including the UAE<sup>2</sup>.

Therefore, before plans and programmes for CVD risk reduction in the UAE can be formulated and implemented, the epidemiology of CVD risk factors will have to be studied well. Currently, little is known about the prevalences and correlates of the major CVD risk factors in any population group in the UAE. This study was an attempt to fill partly this major knowledge gap.

The aims of this study were to estimate the prevalences of selected CVD risk factors (diabetes mellitus, impaired glucose tolerance (IGT), obesity defined by body mass index (BMI) and by waist-to-hip circumference ratio (WHR), and elevated blood cholesterol) and to examine the associations of these prevalences with selected sociodemographic and lifestyle characteristics in a group of apparently healthy adult males in the UAE. Of all sociodemographic

characteristics studied, we were particularly interested in ethnicity because of the multiethnic composition of the UAE population.

### METHODS

#### Study subject selection

Our study subjects, aged 35-49 years, were office-based male employees in a group of petroleum companies in Abu Dhabi, the capital of the UAE. We studied an occupational group rather than a community-based sample because of resource and logistic constraints. During May 1995 through January 1996, altogether 575 men were invited individually in writing through their departmental heads to attend a CVD risk factor screening centre set up for this study. Although only apparently healthy men without known diabetes, hypertension, hyperlipidemia, and prior episodes of myocardial ischemia were eligible for inclusion in our study, all volunteers responding to the invitation were screened and then counselled and referred as appropriate.

#### Data collection

Each participant was advised to attend the CVD risk factor screening centre on a prescheduled day between 8 am and 9.30 am after an overnight 12 hour fast. Sociodemographic and lifestyle data were collected using questionnaires, some of which were self-administered and other interviewer-

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administered. Height, weight, waist circumference and hip circumference of each subject were measured by a single well-trained individual using standard equipment and procedures according to detailed protocols<sup>3</sup>.

A fasting venous blood sample was taken from all subjects.

Then, to test for oral glucose tolerance, a drink composed of 75g anhydrous glucose in 120 ml of 'Fortical' (Cow & Gate, Trowbridge, UK) was given to subjects without known or newly detected diabetes. From these individuals, a second venous blood sample was taken two hours after the glucose drink. Blood samples were separated within 20 minutes and stored at 4°C for glucose level measurement within 6 hours by the glucose oxidase method in an Astra 8 analyser (Beckman, USA) using Beckman reagents. Parts of the fasting samples were also stored at 70°C for total cholesterol level measurement within 24 hours by cholesterol oxidase (Boehringer) automated enzymatic colorimetry.

**Definitions**

We classified each subject into one of six ethnic groups based on his country of birth and parental origin. These six groups showing the predominant nationalities in parentheses were: Peninsular Arab (Emirati, Omani), South Asian (Indian, Pakistani), Afro-Arab (Sudanese, Somali), Egyptian, Shawan (Palestinian) and European (British). Subjects with fasting blood glucose level > 7.8 mmol/l or 2 hour blood glucose level > 11.1 mmol/l were classified as diabetics. Those with fasting blood glucose level < 7.8 mmol/l and 2 hour blood glucose level 7.8-11.1 mmol/l were classified as having IGT. Elevated blood cholesterol was defined as a fasting value

of > 200 mg/dl. An individual was considered obese if his BMI was > 24.99 Kg/m<sup>2</sup> and his WHR was >1.0. Because of the small numbers involved, for some analyses, we combined diabetes and IGT into a single group labelled 'abnormal glucose tolerance'.

**Data analysis**

Associations of diabetes, IGT, obesity defined by BMI and by WHR, and elevated blood cholesterol with the studied sociodemographic and lifestyle factors were examined univariately by cross-tabulations and multivariately by logistic regression analysis. Adjusted odds ratio (OR) point estimates, their 95% confidence intervals (CIs), and associated two-sided p-values were obtained through the multivariate logistic regression analyses. A p-value was considered significant if it was < 0.05. The Stata Statistical Software (Stata Corp, College Station, Texas, USA) was used for data analysis.

**RESULTS AND DISCUSSION**

Based on the employee health clinical data, of all 575 invited subjects, an estimated 458 were considered eligible for enrollment in this study. Of all eligible subjects, 361 (78.8%) actually volunteered to participate in the study. In the analyses for this paper, we included 358 subjects as the remaining 3 did not belong to any of the six main ethnic groups considered.

Overall, of our study subjects, 10% had diabetes, 18% had IGT, 68% had obesity defined by BMI, 31% had obesity defined by WHR, and 74% had elevated blood cholesterol.

**Table 1. Prevalences of diabetes, impaired glucose tolerance (IGT), obesity defined by body mass index (BMI) and by waist-to-hip circumference ratio (WHR), and elevated blood cholesterol among the 358 study subjects, by sociodemographic and lifestyle characteristics, Abu Dhabi, UAE, 1995-96**

Characteristics	Abnormal glucose tolerance (%)			Obesity (%)			Elevated Cholesterol %
	No	IGT	Diabetes	Total	BMI	WHR	
<b>Age (years)</b>							
35-39	115	16	6	22	64	26	66
40-44	115	17	15	32	74	32	70
45-49	128	21	9	30	67	33	84
<b>Ethnicity</b>							
South Asian	126	24	12	36	52	29	74
Peninsular Arab	67	22	16	38	78	39	72
Shawam	82	20	9	19	83	40	66
Egyptian	29	17	0	17	86	35	78
Afro-Arab	27	19	7	26	56	7	85
European	28	7	4	11	71	7	86
<b>Education level</b>							
Pre-university	32	19	22	41	50	31	72
University	326	18	9	127	70	30	74
<b>Occupation</b>							
Manager	164	17	7	24	76	32	75
Other	194	20	12	32	61	29	73
<b>Current smoker</b>							
No	270	20	9	29	68	32	73
Yes	88	14	14	28	68	26	77
<b>Leisure-time physical activity</b>							
None	119	19	14	33	71	35	73
Light	127	23	10	33	66	39	72
Medium	71	13	7	20	70	20	77
Heavy	41	12	5	17	61	12	76

The details of the socioeconomic and lifestyle characteristics of the 358 study subjects and the univariate associations of these characteristics with the prevalences of abnormal glucose tolerance, obesity defined by BMI and by WHR, and elevated blood cholesterol are presented in Table 1.

The highest prevalence of abnormal glucose tolerance (IGT + Diabetes) was among Peninsular Arab (38%) followed by South Asians (36%). Obesity measured by BMI was the highest among Egyptians (86%) and lowest among South Asians (52%). Elevated cholesterol ranged from 66% among Shawan to 86% among Europeans. In general, university education men had a lower proportion of diabetes, but a higher proportion of obesity (based on BMI) than pre-university men. Similar trends were observed in Manager compared to other occupations. With the exception of obesity based on WHR, there was no difference between current smokers and non-smokers in proportion of abnormal glucose balance, obesity (based on BMI) and elevated cholesterol. The men who practised heavy physical activity had a lower proportion of diabetes and obesity, than those who practised light and medium and those who did not practise physical activity.

The prevalence of IGT among Peninsular Arab in this study (16%) was higher than that reported for adult men in Saudi Arabia (10%)<sup>4</sup>. Diabetes measured by blood sugar was relatively higher in our sample compared to those reported in other Gulf countries for native population. However, the prevalence of diabetes among Emirati men of Bedouin origin was significantly lower than our findings for Peninsular Arab (5.8% vs 16%)<sup>5</sup>. Several factors contributed to the differences in proportion of diabetes in the Arab Gulf

Table 2: Multivariate logistic regression analysis of the associations between abnormal glucose tolerance and selected characteristics of the study subjects, Abu Dhabi, UAE, 1995-96

Characteristic	aOR	95% CI	P
Age (Ref: 35-39)			
40-44	1.86	0.99-3.49	<u>0.054</u>
45-49	1.84	0.99-3.43	<u>0.055</u>
Ethnicity (Ref: South Asian)			
Peninsular Arab	1.15	0.57-2.34	0.694
Shawam	0.37	0.17-0.78	<u>0.009</u>
Egyptian	0.31	0.10-0.96	<u>0.042</u>
Afro-Arab	0.62	0.23-1.66	0.343
European	0.26	0.07-1.01	<u>0.052</u>
Education (Ref: Pre-University)			
University	0.75	0.33-1.70	0.494
Profession (Ref: Manager)			
Other	1.15	0.64-2.05	0.644
Current smoker (Ref: None)			
Yes	1.05	0.58-1.88	0.882
Physical activity (Ref: None)			
Light	0.90	0.51-1.60	0.729
Medium	0.49	0.23-1.02	0.057
Heavy	0.61	0.23-1.59	0.308
Overweight			
BMI (Ref: <25)	1.42	0.80-2.50	0.229
WHR (Ref: <1.0)	1.36	0.79-2.34	0.269

Notes: aOR = adjusted odds ratio, CI = confidence interval, Significant p-values are shown in underscored bold

population such as age, ethnicity, exercise, overweight and food habits.

Multivariate logistic regression analysis of the association between abnormal glucose tolerance and selected characteristics of men studied is shown in Table 2. A significant association was found between abnormal glucose tolerance and age and ethnicity. Those who practise medium physical activity had a significant lower risk to have an abnormal glucose tolerance than those who did not practice any physical activity.

Table 3: Multivariate logistic regression analysis of the associations between obesity defined as body mass index (BMI) >24.99 Kg/m<sup>2</sup> and selected characteristics of the study subjects, Abu Dhabi, UAE, 1995-96

Characteristic	*OR	**95% CI	P
Age (Ref: 35-39)			
40-44	1.43	0.76-2.67	0.267
45-49	1.05	0.58-1.91	0.877
Ethnicity (Ref: South Asian)			
Peninsular Arab	3.06	1.44-6.54	<u>0.004</u>
Shawam	4.14	1.96-8.75	<u>0.000</u>
Egyptian	4.62	1.40-15.21	<u>0.012</u>
Afro-Arab	1.41	0.58-3.41	0.447
European	2.83	1.00-7.99	<u>0.050</u>
Education (Ref: Pre-University)			
University	1.93	0.83-4.50	0.127
Profession (Ref: Manager)			
Other	0.93	0.51-1.69	0.810
Current smoker (Ref: None)			
Yes	0.91	0.50-1.63	0.741
Physical activity (Ref: None)			
Light	0.82	0.44-1.50	0.512
Medium	1.07	0.52-2.18	0.853
Heavy	0.68	0.29-1.57	0.365
Overweight			
WHR (Ref: <1.0)	3.31	1.77-6.18	<u>0.000</u>

Notes: \*OR = adjusted odds ratio, \*\*CI = confidence interval, Significant p-values are shown in underscored bold

Ethnicity and overweight using WHR were found to be significantly associated with obesity defined by BMI > 24.9, using multivariate logistic regression. The risk to be overweight was lower among those who practise light and heavy physical activity (Table 3). However, when WHR was used as indicator for overweight, only medium and heavy physical activity had a significant association with WHR, as well as overweight measured by BMI. Afro-Arab and European had a significant association with overweight defined as WHR > 1.00. Although the risk for overweight (WHR > 1.00) was lower among university education and current smokers, the association was not statistically significant (Table 4).

Obesity, either measured by BMI or WHR is known as a risk factor for several chronic non-communicable diseases. The prevalence of overweight and obesity in Arab Gulf countries was high. Among men it ranged from 50%-60% using BMI > 24.9 as a cut-off<sup>6</sup>. This means that programmes to prevent and control overweight among both men and women are urgently needed. The programme should include school children and adolescents, as overweight and obesity usually occurs in early life.

**Table 4: Multivariate logistic regression analysis of the associations between obesity defined as waist-to-hip circumference ratio (WHR) >1.00 and selected characteristics of the study subjects, Abu Dhabi, UAE, 1995-96**

Characteristic	aOR	95% CI	P
Age (Ref: 35-39)			
40-44	1.19	0.63-2.25	0.599
45-49	1.44	0.77-2.70	0.253
Ethnicity (Ref: South Asian)			
Peninsular Arab	1.13	0.54-2.35	0.751
Shawam	1.18	0.59-2.36	0.637
Egyptian	0.83	0.31-2.19	0.702
Afro-Arab	0.14	0.03-0.64	<u>0.012</u>
European	0.15	0.03-0.72	<u>0.018</u>
Education (Ref: Pre-University)			
University	0.82	0.33-2.03	0.672
Profession (Ref: Manager)			
Other	0.78	0.44-1.38	0.391
Current smoker (Ref: None)			
Yes	0.64	0.35-1.16	0.139
Physical activity (Ref: None)			
Light	1.19	0.67-2.11	0.564
Medium	0.40	0.19-0.83	<u>0.015</u>
Heavy	0.27	0.09-0.80	<u>0.018</u>
Overweight			
BMI (Ref: <25)	3.57	1.89-6.73	<u>0.000</u>

Notes: aOR = adjusted odds ratio, CI = confidence interval, Significant p-values are shown in underscored bold

Elevated blood cholesterol was only significant among older men (45-49 years), using multivariate logistic regression analysis. The risk to have elevated blood cholesterol level was higher among Afro-Arab and European (Table 5).

Studies on elevated blood cholesterol in the Arab Gulf countries are scarce. A national survey on the prevalence of some risk factors for heart disease in Saudi Arabia showed that the prevalence of hypercholesterolemia (> 5.2 mmol/L) among adult men was 17.5%<sup>4</sup>. This percentage is significantly lower than our findings for all ethnic origin men, which may indicate that our sample is not representative for adult men for each ethnic group.

### CONCLUSION

In conclusion, in this group of apparently healthy male office-based employees aged 35-49 years, diabetes, IGT, obesity defined by BMI and by WHR, and elevated blood cholesterol were found to be widespread. If these findings are applicable to other similar population groups in the UAE, then we have a major and massive public health problem to address. Therefore, community-based surveys of CVD risk factors are urgently needed in the UAE. The similarities and differences among different ethnic

**Table 5. Multivariate logistic regression analysis of the associations between elevated blood cholesterol and selected characteristics of the study subjects, Abu Dhabi, UAE, 1995-96**

Characteristic	aOR	95% CI	P
Age (Ref: 35-39)			
40-44	1.23	0.69-2.22	0.482
45-49	2.80	1.47-5.32	<u>0.002</u>
Ethnicity (Ref: South Asian)			
Peninsular Arab	0.91	0.43-1.95	0.812
Shawam	0.61	0.31-1.23	0.169
Egyptian	1.08	0.36-3.21	0.893
Afro-Arab	2.15	0.67-6.93	0.201
European	2.03	0.57-7.17	0.274
Education (Ref: Pre-University)			
University	1.19	0.49-2.87	0.697
Profession (Ref: Manager)			
Other	1.07	0.59-1.95	0.816
Current smoker (Ref: None)			
Yes	1.56	0.86-2.85	0.146
Physical activity (Ref: None)			
Light	0.94	0.52-1.70	0.828
Medium	1.18	0.57-2.45	0.647
Heavy	1.33	0.55-3.22	0.523
Overweight			
BMI (Ref: <25)	1.19	0.68-2.10	0.540
WHR (Ref: <1.0)	1.19	0.67-2.11	0.555

Notes: aOR = adjusted odds ratio, CI = confidence interval, Significant p-values are shown in underscored bold

groups as to the prevalences of the studied CVD risk factors need to be investigated in depth. Findings of such studies should guide the planning of appropriate and effective interventions.

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## Developing and Implementing Science-based Dietary Guidelines

G Harvey Anderson, PhD\*

Dietary changes is occurring in both developed and developing countries, but with different consequences. Many developing countries are going through a rapid transition from "undernutrition" to "overnutrition". Thus health policies need to address malnutrition and chronic disease at the same time. Dietary guidelines cannot simply be imported because there are contrast among countries in the origin of nutritional problems. It is important that the origins of nutritional problems be clearly understood within each country prior to the development of dietary guidelines. This requires application of the best scientific knowledge and input from all groups that can contribute to the decision making prices within a country. These groups include government, health professionals and the food industry. It is only through cooperation among these groups that the most effective allocation of resources will be achieved and that the guidelines will be communicated within an appropriate sociocultural context.

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Solving nutritional problems at a societal level requires cooperation among government, health professionals, researchers and the food industry. Food guidance and nutrition policies must take into account sound, current, and scientific knowledge. To have impact, however, they must also have the support of all sectors that have a role in their implementation. These food and nutrition policies cannot be simply imported by a country, but require development within. Each country is going through its own nutrition transition.

### Nutrition Transition

Dietary change is occurring in both developed and developing countries, but with different consequences. In developed countries the primary focus is on chronic diseases stemming from "overnutrition", and the role of the diet in addressing them. In developing countries with an increase in the standard of living, people are able to purchase a greater variety of foods and shift from a dependence on grains, with a consequent improvement in nutrient intake. Such dietary change decreases the incidence of nutrition-deficiency diseases. But, as malnutrition decreases, "overnutrition" and the resultant chronic diseases tend to increase. Thus, health policies need to address malnutrition and chronic disease at the same time.

Diet and disease pattern will continue to change. It is predicted that deaths from communicable, perinatal, maternal and nutritional conditions will decrease by one-third, globally, between 1990 and 2020<sup>1</sup>. Deaths from non-communicable diseases, including heart disease and depression, will increase two-fold, as will deaths from injuries (accidents). By 2020, tobacco is expected to cause more premature deaths and disability than any other single factor. As birth rate falls, the number of adults relative to children increases, and the

commonest health problems become those of adults, not children. This fact must be kept in mind as countries develop public health priorities and deal with the nutrition transition.

### Dietary Guidelines

Science-based dietary guidelines are generally expressed in scientific terms, with quantitative recommendations on nutrients and food components. They are based on the best available scientific evidence of associations between diet and health, evidence that is available worldwide. They are appropriate for use by policy makers, health professionals and the food industry. However, most people need science-based dietary guidelines translated into food-based dietary guidelines that specify foods and serving sizes. Because of the importance of dietary practices in nutrition-related diseases, it is important that food-based guidelines be developed for specific countries. Such guidance must communicate within a socio-cultural context to be effective.

As well, the origin of chronic disease must be understood within each country during the development of food-based dietary guidelines and prior to setting public health priorities. The importance of a wide consultative process in developing science-based and food-based dietary guidelines has been emphasized in a recent FAO/WHO consultation report<sup>2</sup>.

### Science-based Dietary Guidelines

Dietary guidelines are advisory statement about diet for the population, and are aimed at prevention of diet-related diseases. They provide advice about components of foods (eg. fat, salt and fibre) that are important public health issues. These guidelines are science-based in that they are based on scientifically derived associations between diet and disease and recognize that to infer causality in associations between diet and chronic disease, six empirical criteria must be met. They are: strength of the association, dose-

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response relationship, temporally correct association, consistency of association, specificity of association and biological plausibility<sup>3</sup>.

Strength of association is usually expressed as the ratio of disease rates for people exposed to the hypothesized risk factor to those not exposed. The existence of a dose-response relationship in which greater exposure brings greater risk strengthens the inference that the association is causal. If the observed association is causal, exposure to the putative risk factor must precede the onset of disease by at least the duration of disease induction and latency. For consistency of the association, one expects to find the hypothesized association in a variety of studies, in more than one study population and when more than one method is used. The specificity of the association describes the degree to which one factor predicts the frequency or the magnitude of the disease. Finally, biological plausibility require that the putatively causal association fit existing biologic or medical knowledge. This association is very hard to find with chronic disease, given their complex nature.

The first national dietary guideline appeared in Scandinavia

Table 1. Canada's guidelines for healthy eating 1991

Enjoy a VARIETY of foods
Emphasise cereals, breads other grain products, vegetables and fruits.
Choose lower-fat dairy products, leaner meats and foods prepared with little or no fat.
Achieve and maintain a healthy body weight by enjoying regular physical activity and healthy eating.
Limit salt, alcohol and caffeine.

Source: Reference 11

in 1968<sup>4</sup>. Canada's first authoritative statement emerged in 1976, and the first edition for the United States appeared in 1977. By the early 1980s, government-generated dietary guidelines were common place in affluent countries. Dietary guidelines produced between 1981 and 1989 in 17 industrialized and developing countries were summarized by a World Health Organization study group in 1990<sup>5</sup>.

The nutrition recommendations for Canadians<sup>6</sup> now suggest that the goal of healthy body weight be achieved by a combination of healthy eating and physical activity. This important change recognizes that the increase in obesity in the Canadian population is more likely due to low levels of physical activity rather than to any specific food or dietary patterns. They no longer recommend a reduction in free sugar intake (Table 1). This change arose from evaluations showing that intake of added sugars (10-12% of energy) were consistent with the selection of healthy diets<sup>7,8</sup>.

The nutrition recommendations for Canadians now suggest that the goal to reduce fat to 30% or less of energy be gradually implemented so that it is achieved by the time adulthood is reached<sup>9</sup>.

The recent Dietary Guidelines for Americans<sup>10</sup> emphasise the maintenance of healthy body weights, but also include the notion that energy balance is determined both by food intake and physical activity. They continue to recommend that fat provide no more than 30% of dietary energy, but instead of saying that this recommendation applies to all above two years of age, they now suggest reaching the goal by the time the child is five years of age. They recommend that sugars be used in moderation, but also state that current intakes of sugars are not associated with chronic disease, except for dental caries. The rationale for the changes occurring from 1990 to 1995 is shown in Table 2.

Dietary guidelines are expected to change with new knowledge. Fortunately, the changes are not of sufficient

Table 2. Comparison of the 1990 and 1995 Dietary Guidelines for Americans

1990 guidelines	1995 guidelines	Rationale for proposed change
1. Eat a variety of foods	1. Eat a variety of foods	No change
2. Maintain healthy weight	2. Balance the food you eat with physical activity. Maintain or improve your weight.	New emphasis on energy balance
3. Choose a diet low in fat, saturated fat and cholesterol	3. Choose a diet low in fat, saturated fat and cholesterol	No change in wording. Moved down from third to fourth in 1995.
4. Choose a diet with plenty of vegetables, fruits and grain products	4. Choose a diet with plenty of grain products, vegetables and fruits	Increased focus on plant foods, consistent with Food Guide Pyramid. Moved up from fourth to third in 1995.
5. Use sugars only in moderation	5. Choose a diet moderate in sugars	Remove negative connotation of "only" focus on total diet.
6. Use salt and sodium only in moderation	6. Choose a diet moderate in salt and sodium.	Emphasise that foods themselves are the source of most dietary sodium.
7. If you drink alcoholic beverages do so in moderation.	7. If you drink alcoholic beverages do so in moderation.	No change

Source: Reference 12

magnitude to threaten the credibility of dietary guidelines. But because changes in knowledge are inevitable, committees given the responsibility of developing guidelines must pay close attention to the criteria for evaluating information on the diet-health relationship.

### **Food-based Dietary Guidelines**

Food-based dietary guidelines (FBDG) are needed, because consumers focus on foods, not nutrients, in choosing what to eat<sup>13</sup>. They must provide individuals with guidance to prevent both nutrient deficiencies and chronic disease. The development of FBDG is not a simple matter. It should be informed by public health issues (the science-based dietary guidelines); the social, economic, agricultural and environmental factors affecting food availability; and eating patterns and food patterns (not numerical goals). FBDG should provide positive messages encouraging enjoyment of appropriate dietary intakes while acknowledging that a wide range of dietary patterns can be consistent with good health<sup>2</sup>.

Eight steps are suggested for developing FBDG: (1) form a working group of representatives of agriculture, health, food science, nutritional science, consumers, food industry, communications and anthropology; (2) gather information on nutrition-related diseases, food availability, and food intake patterns in the country; (3) identify, through full discussion, a set of major nutrition-related health problems for which dietary guidelines could be useful; (4) evaluate the general food production and supply situation through consideration of current practices, subsidies and other governmental policies and problems, to see if FBDG can be implemented under the present situation; (5) prepare a set of draft food-based guidelines, followed by background statements for each guideline and circulate them to all working-group members; (6) pilot test the wording of the guideline statements with consumer groups; revise and check; (7) finalise the background statements and send them to special-interest groups in the country (and possibly internationally) for comment. Once again, meet to consider changes, in view of the responses, and put together a draft of the final report; (8) conclude the draft, adopt, publish and disseminate the final report, and finally begin implementation<sup>2</sup>.

Clearly, each country developing FBDG will have to spend considerable effort, organization, and time. The same process could logically be applied to the development of all nutrition and food policies. If these steps are taken, the outcome of the deliberations is more likely to be effectively implemented by the food industry and nutrition educators.

Food guides are an example of FBDG. Both Canada and the US have developed new Food guides that incorporate their national science-based dietary guidelines. In the past, the Food guides have concentrated on expressing a dietary pattern that would provide the individual with the essential nutrients in recommended amounts. The new Food guides recommended a dietary pattern aimed not only at meeting the requirements for essential nutrients, but also at preventing chronic disease. Both the Canadian and American Food Guides are centered on food groups and both have a new category: foods that include sugars, fats and oils.

Food guides should be a national product. To illustrate, even though the foods available to Canadians and Americans are similar, one can look at the differences in the countries food guides. The Canadian Food Guide<sup>6</sup> incorporates the four food groups in a rainbow design. Meat and alternatives are arranged along the small, inner arc. Next come the milk products, then vegetables and fruits and finally grain products along the large, outer arc. The design gives the visual cue that the greatest quantity of food should be selected from the grains group. A category of "Other Foods" is identified as not part of any food group, and includes foods that are mostly fats and oils, mostly sugar, high fat or high salt snack foods, beverages, herbs, spices and condiments. The guide acknowledges that "These foods can be used in making meals and snacks and are often eaten with foods from the four food groups", but recommends that they be consumed in moderation. Instructions on using the Food guide include advice on reducing fat; no mention is made of sugar.

The US food guide<sup>10</sup> is in the form of a pyramid, showing five food groups, with the grain group at the base. The vegetable group and the fruit group share the next level of the pyramid and on top of these are the milk group and the meat group, again sharing equally the next level in the pyramid. The visual impression is that one should consume less of those foods higher up the pyramid. At the very top is the category of fats, oils and sweets. The consumer is advised that "These foods supply calories, but little or no vitamins and minerals".

The scientific basis for the food guides has changed over the past twenty years and the new Food Guides capture these changes. For example, evidence that excess fat intake is a problem in both Canada and the US has become more convincing, although there is no total agreement on the need to apply fat reduction goals to children. In Canada, it is recommended that fat intake be reduced gradually to 30% or less of energy by the time adulthood is reached. By contrast, the US recommends that this goal be achieved earlier, by children of five years of age or older.

In earlier guidelines and food-based dietary guidance, added sugar was viewed negatively. It has been recognised, however, that this guidance was based on an incomplete understanding of sugar intakes and of the relationship between sugar intake and health. Best estimates show that the intake of sweeteners, primarily carbohydrate sweeteners such as sucrose and high-fructose corn syrup, averages 10-12% of the dietary energy and is consistent with healthy diets. Several recent reviews have concluded that other than the contribution of sugars to dental caries, there is no evidence that sugars at the levels currently consumed are the cause of sugar intolerance, diabetes mellitus, high blood lipids, cardiovascular disease, hypertension, hyperactivity in children, obesity or nutrient-deficient diets<sup>8,14,15</sup>.

Food-based dietary guidelines must focus on creating healthier diets and not create "good food/bad food" categories. As yet, science does not support a reductionist approach to inclusion and exclusion of specific foods.

To solve nutritional problems and implement FBDG, effective partnerships are needed among industry, government and academia. As emphasised by the FAO/WHO consultation group that met in 1995 to evaluate development of FBDG,

each country should engage in planning, with all the main partners: government, academic institutions, and industry. A call for increased collaboration among these three partners in solving nutrition problems was recognised at the International Conference on Nutrition through the World Declaration on Nutrition which was adopted unanimously by 159 governments<sup>16</sup>. The role of industry in connecting micronutrient deficiencies was also recognised at the Ottawa forum held in 1995<sup>17</sup>. This recent recognition of the role of the food industry as an essential partner in solving nutritional problems requires understanding and consideration by the government and academic sectors.

### The Role of the Food Industry in Nutrition Transition

The food industry contributes to the economic advancement of a country. It can be a key partner with government and health professionals in improving nutritional status, acting as a resource in both the development and the translation of dietary goals and policies<sup>18,19</sup>. The food industry is estimated to have accounted for fifty percent of the economic advancement of England since the Industrial Revolution. It has delivered improved nutrition as well as wealth<sup>20</sup>.

The food industry contributes to economic development by increasing the productivity of agricultural crops, decreasing losses and wastage, increasing food availability, reducing seasonality, making high-nutritive-value foods available, and providing employment and higher incomes<sup>21</sup>. Marketing strategies may help to achieve nutritional goals, because they include providing nutrition information on labels. Informative labels support nutrition educators' attempts to make people more aware of the importance of nutritional quality and food safety<sup>21</sup>. In addition, marketing strategies create distribution channels for food commodities<sup>22</sup>.

Multinational companies contribute to the advancement of the food industry sector of developing countries through several activities. They (a) bring modern applications of food technology, including biotechnology; (b) bring internationally recognised standards in the areas of food toxicology and safety; and (c) participate in, and respond to, the development of dietary guidelines and regulations. In developing countries, however, multinational companies often have difficulty in finding the necessary quantity and quality of raw materials, including the human resources needed to manage the food system. Often their ventures depend on future development and require large investments to secure raw materials, train personnel, work with government food and drug authorities, and develop markets.

The food industry is an essential partner with government and health professionals in changing dietary patterns and achieving dietary goals. Its effectiveness is enhanced if government provides the educational and regulatory framework that will influence consumers to create and pay for health-supporting products the industry produces. For the most part, the industry is consumer driven, responsive to the purchasing power and health knowledge of the population.

Given the right support, the food industry is a major force in changing the composition of the food supply, as illustrated by its response to the goal of reducing fat consumption, from 40% of energy toward the dietary goal of 30% of

energy in the North American population. In 1995, 80% of the new food products were fat reduced. The fat substitute Olestra has been approved by the United States Food and Drug Administration and the use of such products will likely lead to a reduction in fat intake<sup>14,23</sup>. Another example is the food industry's response to the recommendation that North Americans increase fibre intake. Many food products with enhanced fibre content have been developed. Recently in the United States, the government has approved a health claim that oat fibre consumed in ready-to-eat breakfast cereal can lead to a decrease in blood lipid levels and, presumably, cardiovascular disease. Currently, a great deal of interest is being expressed in functional foods sometimes called nutraceuticals. These are foods that have been modified to have biological or physiological (functional) effects that exceed those related to nutrition, in terms of providing energy and essential nutrients<sup>7</sup>.

In developing countries, the serious problem of nutrient-deficiency diseases remains. Yet, the food industry has the ability to add essential nutrients to food products that are commonly consumed. It has been well proven that the food industry can respond in this way to the health needs of a nation and can be an effective partner with government in the process<sup>24</sup>.

In developed countries, over the last 40-50 years, food fortification has played a major role in eliminating several nutritional deficiencies. Fortification does not require changes in the diet, hence it can be implemented and sustained over a long period. Further, it can be a cost-effective means of reducing micronutrient malnutrition<sup>24</sup>.

Developing countries have been slow to embrace the food industry as a partner in solving micronutrient malnutrition. Thus, the forum on Food Fortification<sup>25</sup> held in Ottawa, Canada in 1995 emphasised the importance of public-private sector collaboration to eliminate micronutrient malnutrition. The report notes that "Collaboration involves both sides taking ownership of the issue and searching for solutions together. Advocacy to eliminate micronutrient malnutrition cannot simply be targeted to industry but must also originate from industry".

A number of ways for industry to contribute to collaborative activities were suggested, including clear advocacy of industry needs to government; assistance to public sector in assessment of national needs; participation in education, research and health assessment; assistance in market research and promotional materials; development of business-to-business channels to transfer technology; development of joint ventures among fortificant and pre-mix suppliers and food processors; provision of training and methodologies for quality assurance programmes; creation of "Industry Best Practices" code for production and marketing of fortified products; development of special investment criteria for fortified products; and collaboration to expand current market niches for fortified foods.

Several reasons have been given for the difficulty that developing countries have solving nutrition problems<sup>22</sup>. First, where education has been overlooked, there is a high level of illiteracy. Illiteracy greatly limits the efficiency of people producing food, and hinders their ability to improve diets. Second, there is too little emphasis on the training of

food scientists and nutritionists. Third, political systems often change and public health policies get inconsistent attention.

Developing countries that fail to emphasise the training of food scientists, nutritionists, and dietitians and do not harness the capabilities of the multinational food industry will continue to struggle in vain to achieve health goals for their populations<sup>26</sup>. As noted, the benefits to be derived from food fortification have not been realised. For the future, the advances in and application of biotechnology have potential to be overlooked, leaving behind the very countries that could benefit the most. Biotechnology should be given a top priority in many developing countries, because it can improve raw material as well as improved and new plants or animals through genetic engineering<sup>22</sup>. Increased indigenous capacity in biotechnology would help a developing country move from its status of recipient to that of active player in the global arena and marketplace<sup>27</sup>. Unfortunately, mechanisms that promote and facilitate technology transfer either do not exist or are poorly developed, and economic, legal and social barriers prevent university-industry cooperation. Little communication between research establishments and the applied sector has been noted<sup>28</sup>.

The ability of the food industry to assist with economic development and the improvement of a population's health is clear. For this reason, the food industry should be included as a partner with government scientists, academics and health professionals in developing and implementing food and nutrition policies and dietary guidelines.

## CONCLUSION

**To cope with modernisation and the appearance of chronic disease while addressing nutrient deficiencies requires effective partnership among government, health professionals, academia, and the food industry. Science-based dietary guidelines are essential to the improvement of the health of a nation's people, but they must be communicated through FBDG that take into account public health issues, the social economic, agricultural and environmental factors affecting food availability, and eating patterns within a country. And they must be developed by all partners.**

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