

UPDATE IN CARDIOLOGY UPDATE IN CARDIOLOGY UPDATE IN CARDIOLOGY

TRENDS in NUTRITIONAL INTAKES and NUTRITION-RELATED
CARDIOVASCULAR DISEASE RISK FACTORS in LEBANON

The Need for Immediate Action

<http://www.lebanesemedicaljournal.org/articles/62-2/review4.pdf>

Lara NASREDDINE^{1,4*}, Farah NAJA^{1,4*}, Abba-Mehio SIBAI^{2,4}, Khalil HELOU³, Nada ADRA^{1,4}, Nahla HWALLA^{1,4}

Nasreddine L, Naja F, Sibai AM, Helou K, Adra N, Hwalla N. Trends in nutritional intakes and nutrition-related cardiovascular disease risk factors in Lebanon: The need for immediate action. *J Med Liban* 2014 ; 62 (2) : 83-91.

Nasreddine L, Naja F, Sibai AM, Helou K, Adra N, Hwalla N. Évolution temporelle des habitudes alimentaires, apports nutritionnels et facteurs de risque cardiovasculaires au Liban. *J Med Liban* 2014 ; 62 (2) : 83-91.

ABSTRACT • AIM : To examine the burden of cardiovascular disease (CVD) risk factors and their association with dietary variables in the Lebanese population while reviewing secular trends in the population's nutritional intakes and nutrition-related CVD risk factors.

METHODS : Data on CVD risk factors and food consumption patterns in Lebanon were collected from scholarly papers, including individual studies and systematic review articles. Electronic databases were searched using combinations of key terms.

RESULTS : The prevalence of obesity in Lebanon followed an alarming increasing trend over time, paralleled by an escalation in the prevalence of hypertension, diabetes and hyperlipidemia. Food consumption surveys illustrate an increasing trend in energy intake and the proportion of energy derived from fat and animal products, with a concomitant decrease in carbohydrates and cereals intakes.

CONCLUSION : The shift towards an atherogenic diet coupled with the alarming increase in nutrition-related cardiovascular risk factors suggest that the Lebanese population is at an increased risk for CVDs. This should alert to the importance of formulating multi-component intervention strategies at both the individual and population levels to halt the progression of nutrition-related diseases in the country, while highlighting the need for immediate public health efforts to promote the adoption of healthy dietary habits.

Keywords : diet, cardiovascular diseases, risk factors, nutrition transition, Lebanon

INTRODUCTION

Lebanon, like other countries of the Middle-East and North Africa Region (MENA), is currently witnessing a fast rate of development and modernization with concurrent shifts in diet, physical activity and body composition [1]. These changes provide an understanding of the multidimensional phenomenon of the nutrition transition, which is characterized by increased consumption of energy, fat (especially of animal origin), added sugars

RÉSUMÉ • OBJECTIFS : Examiner la prévalence des facteurs de risque cardiovasculaires, leur évolution temporelle ainsi que leurs associations avec les facteurs nutritionnels et les changements d'habitudes alimentaires au sein de la population libanaise.

MÉTHODES : Les données concernant les facteurs de risque cardiovasculaires et les données sur la consommation alimentaire au Liban ont été recueillies à partir des résultats d'études individuelles et de revues systématiques d'articles scientifiques publiés. La recherche des bases de données électroniques a été effectuée en combinant différents mots-clés.

RÉSULTATS : L'évolution temporelle de la prévalence des facteurs de risque cardiovasculaires au Liban souligne un accroissement considérable des taux d'obésité, accompagné d'un accroissement des taux d'hypertension, de diabète et d'hyperlipidémie. Les enquêtes de consommation alimentaire démontrent une transition nutritionnelle avec l'adoption de nouvelles habitudes alimentaires caractérisées par une augmentation de l'apport énergétique et de la consommation de matières grasses et animales et une diminution concomitante des apports en glucides et céréales.

CONCLUSION : L'adoption d'un régime alimentaire athérogène et l'augmentation considérable de la prévalence des facteurs de risque cardiovasculaires suggèrent que la population libanaise est à un risque accru de maladies cardiovasculaires. Ces résultats signalent l'importance de formuler des stratégies d'intervention multisectorielles, ciblant à la fois l'individu et la population, permettant d'arrêter la progression au Liban des maladies chroniques liées à la nutrition. De même, des efforts de santé publique visant à promouvoir l'adoption d'habitudes alimentaires saines doivent être immédiatement envisagés.

Mots-clés : régime alimentaire ; maladies cardiovasculaires ; facteurs de risque, transition nutritionnelle, Liban

and salty foods and decreased intakes of complex carbohydrates, dietary fiber, fruits and vegetables [2-3]. Amongst the contributors to the development of the nutrition transition, globalization, urbanization and mecha-

¹Department of Nutrition and Food Science, Faculty of Agricultural and Food Sciences, American University of Beirut (AUB), Lebanon;

²Dept of Epidemiology & Population Health, Faculty of Health Sciences, (AUB); ³Dept of Nutrition, Faculty of Pharmacy, Université Saint-Joseph, Beirut; ⁴Member of the Public Health & Nutrition (PHAN) Research Group at the American University of Beirut, Lebanon.

*These authors contributed equally to this work.

Correspondence: Nahla Hwalla, PhD RD.

e-mail: nahla@aub.edu.lb

Fax: +961 1 744 460

nization and their effects on income, lifestyle and food availability are considered the major factors [4].

Through its characteristic changes in food consumption and dietary patterns, the nutrition transition is a common modifiable cause of non-communicable diseases (NCDs) [5]. This is important to health policy planners in Lebanon as a rapid shift in morbidity and mortality towards much higher NCD rates has dominated the health profile of the Lebanese population. In particular, cardiovascular diseases (CVDs) are increasingly recognized as the leading cause of death in Lebanon, accounting for around 60% of all-cause mortality in persons aged 50 years and older [6].

Recognizing the above, major resources are directed towards the promotion of prevention strategies – both primary and secondary. The role of nutrition in modulating major risk factors for CVDs (obesity, diabetes, hypertension, hyperlipidemia and the metabolic syndrome), and hence in the prevention of CVD is currently well-established [7-11]. Recent evidence shows that dietary factors such as vegetables, nuts, and “Mediterranean” dietary patterns play a strong protective role against CVDs while the intakes of trans-fatty acids and foods with high glycemic index are associated with a higher risk [12]. There is consistent evidence that high-fat meals have a detrimental effect on postprandial vascular function, an integrative marker of CVD risk [13]. More specifically, the types of dietary fat are also implicated in modulating the risk of CVDs, with saturated fatty acids (SFA) and dietary cholesterol being linked to increased levels of serum total cholesterol and LDL-C [12,14]. Conversely, replacing saturated fat with polyunsaturated fatty acids was associated with beneficial effects on lipid levels and thus on cardiovascular health [15-16].

The aim of this paper is to review the burden of CVD risk factors in Lebanon and their association with dietary behaviors as nutrition transition is unfolding in the country. It reports on the population’s nutritional intakes, the prevalence of diet-related CVD risk factors, and their trends over time. The paper builds on previous studies of the dietary and epidemiological changes among the Lebanese population and focuses on some unique nutritional issues, including the much higher level of fat intake in the diet, the high levels of obesity and other cardiovascular risk factors such as dyslipidemia and the metabolic syndrome.

METHODS

The methodology used in the present paper is similar to the one applied in our recent review on CVD risk factors and the nutrition transition in the MENA region [1]. Accordingly, we have gathered data, where available, from individual studies and systematic review articles that have reported on the burden of diet-related CVD risk factors in Lebanon. These include obesity, hypertension, diabetes, metabolic syndrome, abnormal blood lipids and lipoproteins, and dietary/nutritional intakes.

Electronic databases (MedLine, PubMed, Scopus, and Google Scholar) were searched using combinations of key terms (Lebanon and individual CVD risk factors). The reference lists were also reviewed to identify additional data sources. In addition, surveys and studies that reported on the country’s food consumption patterns and dietary habits were also reviewed. For this purpose, electronic databases (MedLine, PubMed, Scopus, and Google Scholar) were searched using combinations of key terms (Lebanon, diet, nutrition, consumption patterns; dietary intake; dietary patterns). The articles consulted for this paper included scholarly publications irrespective of the demographics (age and gender) of the population studied.

RESULTS

Overweight and obesity

Available data indicate that the prevalence of obesity in Lebanon has reached high levels approaching those reported from developed countries such as the USA and Europe, were 32.2 and 10-20%, respectively, of the adult population are reported as obese (Body mass index, BMI ≥ 30) [1,17-18]. Studies on adult men and women in Lebanon show that obesity prevalence rates have increased during the past decade from 17% in 1997 to 28.2% in 2009 [1,19], an increase that surpasses that reported from several developed countries during the past decade, including the US [20] (Table I). Assuming a linear trajectory in obesity rates over time, the prevalence of obesity among Lebanese adults is expected to approach 40% by the year 2020 (Figure 1). These findings carry important public health implications. Obesity is associated with increased mortality and morbidity from CVDs, with the adipose tissue being increasingly recognized as a key player in obesity-mediated CVD [8]. A collaborative analysis of data from almost 900 000 adults in 57 prospective studies indicated that each 5 kg/m² increase in BMI above the optimal range of 22.5-25 kg/m² was associated with a 30% increase in all-cause mortality (40% for vascular; 60-120% for diabetic, renal, and hepatic; 10% for neoplastic; and 20% for respiratory and for all other mortality) [21].

Of more concern is the high prevalence of pediatric overweight and obesity in the country. Based on a nationally representative survey conducted in 1997, the prevalence of overweight amongst 6- to 19-year-old children was estimated as 21.7% and obesity as 6.5% [22]. The highest levels of overweight and obesity were noted among adolescent boys (12-19 years), among whom 29.3% were either overweight or obese (BMI $\geq 85^{\text{th}}$ percentile for sex and age), which is of comparable magnitude to the levels reported from the US in the late 1990s (30.5%) [22-23]. Similar findings were also reported by Chakar and Slameh (2006) in a cross sectional study of adolescents in private Lebanese schools [24].

Parallel to the secular increase in the prevalence of adult obesity that Lebanon is witnessing, pediatric obesity is also following an alarming increasing trend over

TABLE I
PREVALENCE (%) of NUTRITION-RELATED CARDIOVASCULAR DISEASE RISK FACTORS in the ADULT LEBANESE POPULATION

Risk factor	Survey	Year	Sample size (n)	Age group (years)	Prevalence (%)
Obesity	Sibai <i>et al.</i> [19]	1997	1216	≥ 20	17.0
	Sibai <i>et al.</i> [1]	2009	2697	≥ 20	28.2
Diabetes	WHO Infobase [31]	1999	2846	25-65	11.6
	Thome <i>et al.</i> [36]	2004	2125	≥ 30	13.8
Hypertension	WHO Infobase [31]	1999	2846	25-65	22.8
	Sibai <i>et al.</i> [32]	2010	499	18-65	31.2
Hypercholesterolemia	WHO Infobase [31]	1999	2846	25-65	18.4
	Sibai <i>et al.</i> [32]	2003	499	18-65	36.9
High LDL-C	Sibai <i>et al.</i> [32]	2003	499	18-65	32.1
Low HDL-C	Sibai <i>et al.</i> [32]	2003	499	18-65	49.3
Hypertriglyceridemia	Sibai <i>et al.</i> [32]	2003	499	18-65	35.3
Metabolic Syndrome	Sibai <i>et al.</i> [32]	2003	499	18-65	25.4

time, as suggested by the recent findings of the Nutrition and Non-Communicable Disease Risk Factor Survey conducted between 2008 and 2009 (Sibai and Hwalla, unpublished data). This increase in pediatric obesity is of public health concern given that it is shown to track into adulthood [25] and to predict a broad range of adverse health effects including hypertension, type 2 diabetes, insulin resistance and the metabolic syndrome [26-27]. A recent systematic review documented strong evidence for a significantly increased carotid intima-media thickness, an indicator of early atherosclerotic lesion, in obese children and adolescents as compared to healthy controls [27]. Furthermore, childhood obesity has been also shown to be associated with a proinflammatory and prothrombotic state in children that have not yet reached puberty [28], and to thus significantly increase the risk of cardiovascular diseases.

Obesity is a complex multifactorial phenotype, but the adherence to a diet characterized by high intakes of refined carbohydrates, added sugars, fats, and animal-source foods has been associated with increased risk of

obesity [3]. A recent cross-sectional population-based survey (n = 2048 Lebanese adults) conducted by our research group revealed a positive association between obesity and the “Western” dietary pattern, characterized by the consumption of high fat fast foods, sweets and soda drinks [29]. Similarly, a study conducted on adults from rural areas in Lebanon showed that adherence to the Mediterranean diet is negatively associated with waist circumference (WC), and that a 2-point increase in the composite Mediterranean score is associated with a decrease in BMI of 0.51 and 0.78 kg/m² and a decrease in WC of 2.77 and 4.76 cm in men and women, respectively [30].

Hypertension

Parallel to the increasing trend in obesity prevalence, emerging data suggest a rising trend in the prevalence of hypertension over time in Lebanon, with its prevalence increasing by almost 1.5 folds in the past decades (from 22.8 to 31.2%) [31-32] (Table I). Assuming a linear trajectory over time, the prevalence of hypertension among

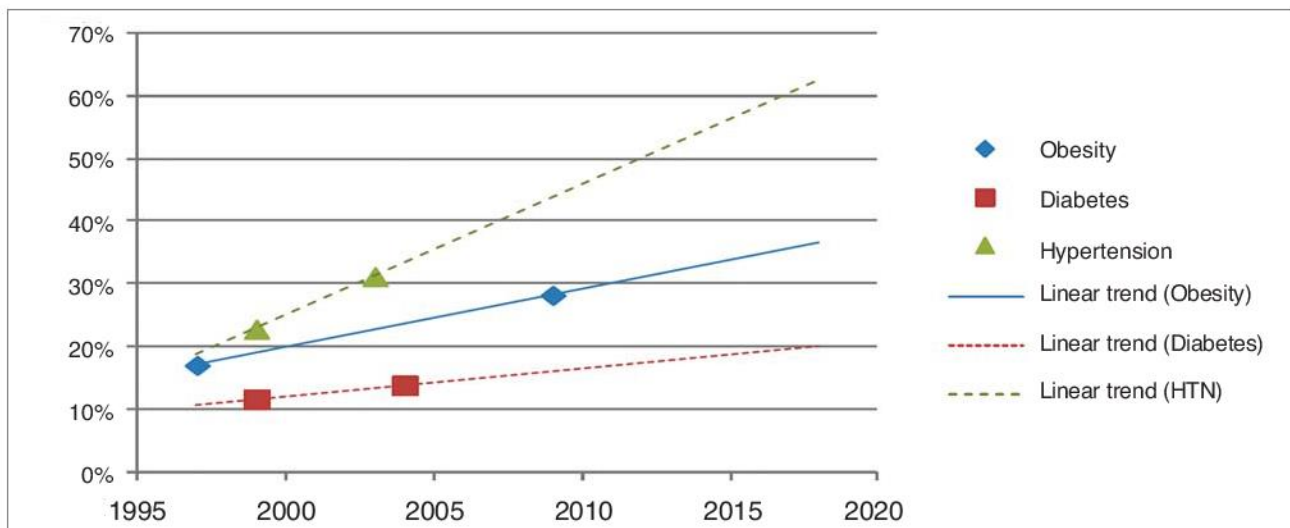


FIGURE 1. Secular linear trends in the prevalence (%) of obesity, diabetes and hypertension among Lebanese adults.

Lebanese adults is expected to exceed 50% by the year 2020 (Figure 1).

Obesity-related hypertension is increasingly recognized as a distinct hypertensive phenotype involving complex and interdependent mechanisms [33]. Overweight and obesity are associated with adipose tissue dysfunction, characterized by enlarged hypertrophied adipocytes, increased infiltration by macrophages and marked changes in the secretion of adipokines and free fatty acids [33]. This results in chronic vascular inflammation, oxidative stress, activation of the renin-angiotensin-aldosterone system and sympathetic overdrive, eventually leading to hypertension [33].

In addition to obesity, evidence from population-based studies document a link between several nutrients, minerals, food groups and dietary patterns and the risk of hypertension. In particular, evidence suggests that dietary sodium is associated with elevation of blood pressure [34]. Based on a recent national survey conducted in Lebanon (Hwalla *et al.*, unpublished data), 55% of Lebanese adults were found to exceed the maximal sodium intake level of 2300 mg/day as recommended by the Institute of Medicine [35], thus predisposing towards increased risk of hypertension and associated cardiovascular diseases such as stroke, left ventricular hypertrophy and coronary heart disease [9]. Also, similar to reports issued by the Center for Disease Control (CDC), processed foods are contributing the most to dietary salt intake in Lebanon, with bread being the highest contributor.

Diabetes

Even though the prevalence of diabetes among adults in Lebanon (13.8%) [36] appears to be lower than that reported from most other countries in the MENA region including Bahrain (25.5%), UAE (23.3%) and KSA (23.7%) [1], it was found to exceed the worldwide prevalence rates of diabetes among adults aged 20-79 years (6.4% in 2010) [37]. Available data also suggest that prevalence rates of diabetes are following an escalating trend over time in Lebanon, increasing from 11.6% in 1999 to 13.8% in 2004 [31, 36] (Table I). Moreover, given the well-established association between excess body fat, impaired glucose tolerance and type 2 diabetes (DM II), the increasing prevalence of obesity that the country is witnessing is expected to lead to further increases in the incidence and prevalence of diabetes in the Lebanese population in the future [38]. This is corroborated by a recent report suggesting that, worldwide, the greatest relative increase in the number of people with diabetes is expected to occur in countries of the Middle Eastern crescent [39]. Available data suggest that, assuming a linear trajectory in diabetes rates over time, the prevalence of diabetes among Lebanese adults is expected to approach 20% by the year 2020 (Figure 1).

Diabetes is a well-recognized risk factor for cardiovascular diseases [10], with the common conditions co-existing with diabetes (e.g., hypertension and dyslipidemia) acting as major risk factors for CVD, in addition

to diabetes itself conferring independent risk [10]. More importantly, there is compelling evidence that diabetes can be prevented or its onset delayed by lifestyle interventions, including dietary strategies [38]. Studies on the association between diabetes and dietary factors are lacking in Lebanon, however, strong evidence highlights a close link between nutrition, a modifiable risk factor, and the risk of DM II. Available evidence suggests that diets high in saturated fat, Trans fat, high glycemic index foods and low in fiber, fruits and vegetables and whole grains are positively associated with increased diabetes risk [38].

Blood lipids, lipoproteins and the metabolic syndrome

A study conducted on a random sample of Lebanese adults (n = 499) highlighted a high prevalence of dyslipidemia with 36.9% of adults being hypercholesterolemic, 35.3% hypertriglyceridemic, 32.1% having high LDL-levels and 49.3% having low HDL levels [32] (Table I). Available data also suggest an increasing trend in the prevalence of dyslipidemia, and in particular hypercholesterolemia, the prevalence of which was estimated at 18.4% in 1999 [31-32].

Based on the ATP III classification criteria, the prevalence of the metabolic syndrome (MS), a constellation of cardiometabolic risk factors, was estimated at 25.4% in Lebanese adults, a value which approaches that reported for US adults (27%) [40] and exceeds values reported from several European countries (11.5%) [41]. Abdominal obesity and low HDL-C were the factors that contributed the most to the overall prevalence of MS [32].

Of more concern is the high prevalence of MS documented among obese children and adolescents in Lebanon. Based on the modified Adult Treatment Panel III definition, the MS was identified in 26.4% of obese pre-pubertal children (n = 140) [42] and 24% of obese adolescents (n = 263) [43], thus exceeding prevalence rates reported among obese youth from several developed countries such as France (14.9%) [44], Italy (16.5%) [45] and Spain (18.0%) [46].

Even though the metabolic syndrome, as a disease category, faces substantial controversy, the diagnosis of the metabolic syndrome (MS) appears to identify substantial additional cardiovascular risk above and beyond its individual risk factors. Emerging evidence points to the presence of early functional, and morphologic, changes to the heart and blood vessels. These may be apparent in obese subjects with the MS as early as in childhood [42-43, 47]. The inflammatory response related to fat accumulation may influence cardiovascular risk through its involvement not only in body weight homeostasis, but also in coagulation, fibrinolysis, endothelial dysfunction, insulin resistance (IR) and atherosclerosis [8]. Moreover, there is evidence that oxidative stress may be a mechanistic link between several components of MS and CVD, through its role in inflammation and its ability to disrupt insulin-signaling. The crosstalk between impaired insulin-signaling and inflammatory pathways enhances both metabolic

insulin resistance and endothelial dysfunction, which synergize to predispose to CVD [8].

Available evidence suggests a close association between the MS and diets high saturated fat, Trans fat, sugars and low in dietary fiber, fruits and vegetables [48]. A cross-sectional study conducted on a random sample of Lebanese adults ($n = 323$) showed a significant association between a dietary pattern that is based on fast foods and desserts with the metabolic syndrome. Compared with participants in the lowest quintile of the Fast Food/Dessert pattern, those in the highest quintile had significantly higher odds for MS (OR: 3.13; 95% CI: 1.36-7.22) [49].

Food consumption changes in Lebanon paralleling CVD risk factors

Having clearly demonstrated in the sections above the alarming increases in various nutrition-related CVD risk factors over the last period, we find that this can be, in part, attributable to documented changes associated with eating habits and dietary practices. Based on two national surveys, the first conducted in 1997 and the second in 2009, energy intake amongst the Lebanese adult population was found to increase from 1789.5 kcal/day (Sibai *et al.*, unpublished data, 1997) to 2591 kcal/day (Hwalla *et al.*, unpublished data, 2009). Moreover, food consumption surveys conducted in the past decade have essentially documented a high intake of dietary fat, with its contribution to energy intake ranging between 36 and 39% [50-52], thus exceeding the WHO recommended value of 30% of total energy intake [53].

A food consumption survey conducted in 2001 in the capital Beirut [51], showed that 45.3% of urban Lebanese adults consume less than the recommended 400 g of fruits and vegetables [53] per day, while the intake of free sugar, as defined by the WHO, was found to contribute 11.4% to

daily energy intake, thus exceeding the maximal intake limit of 10% [53]. The aforementioned study also documented a low consumption of fish (19.7 g/day), with 73.6% of subjects consuming less than the recommended two servings of fish per week [54]. Worse, when compared to subjects aged 35 years and older, younger adults (25-34 years) had significantly higher intakes of soft drinks, pre-packed juices, alcoholic beverages, sugar and sugar derivatives, and significantly lower intakes of cooked vegetables and pulses [51]. In accordance with data reported from other parts of the world, these findings suggest that the younger population in Lebanon is at an increased risk of adopting the westernized dietary pattern characterized by increased energy-dense diets that are low in fiber, fruit and vegetables, and high in fats and sugars [51, 55]. This is not restricted to urban areas as rural regions in the country appear to be also experiencing the nutrition transition [56, 52]. A recent cross-sectional study conducted on 798 adults (40-60 years old) in rural areas of Lebanon documented a low adherence to the Mediterranean dietary pattern with the consumption of whole-grain cereals, legumes, olive oil and fish reported as "less frequent" compared to the consumption of refined cereals, liquid sweets, fats and oils and dairy products [30].

The data presented above are confirmed by several other studies conducted in the country which reported a shift in food consumption towards increased fat, milk and animal protein and a decrease in the intake of non-refined carbohydrates, in particular breads and cereals [55, 57]. The contribution of bread and other cereal products to daily energy intake was in fact reported to drop from 58 to 36% between 1964 and 1998 [57]. This was accompanied by a reduction in the contribution of carbohydrates to daily energy intake (Figure 2), which decreased from 66% to 57% between 1967 and 2001, with a concomitant increase in fat supply [58-59].

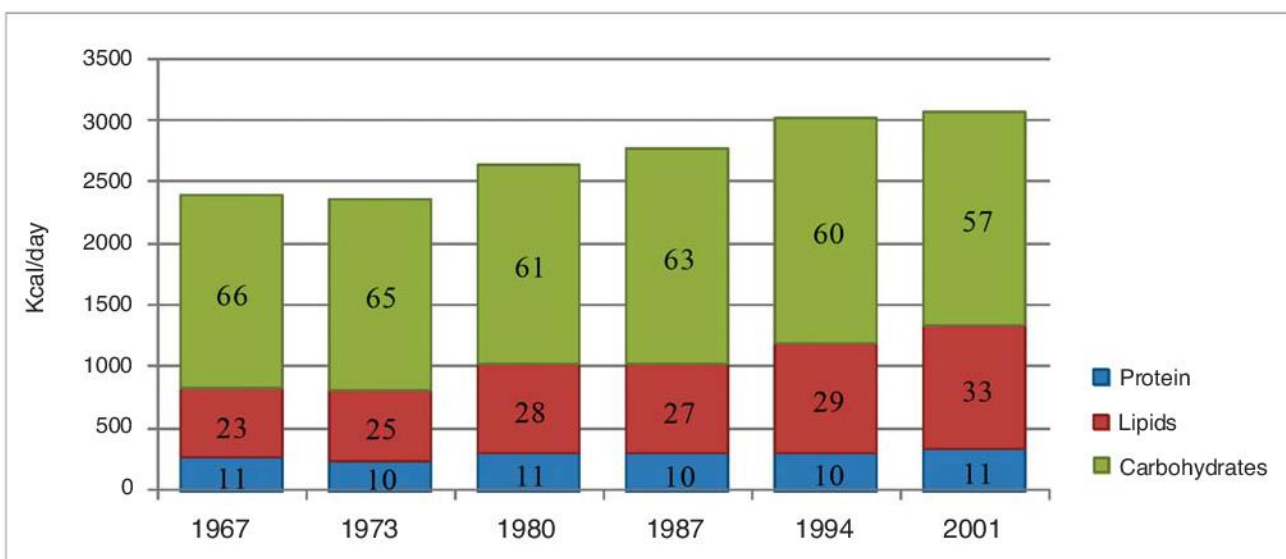


FIGURE 2. Secular trends in dietary energy supply and macronutrient distribution in Lebanon.
Source: Food and Agriculture Organization Statistical Database (FAOSTAT) [58-59]

The secular increase in energy intake, the rather high contribution of fat to daily energy intake, coupled to the low intake of whole grain cereals, fish and the relatively high percentage of people consuming less than the recommended amount of fruits and vegetables suggest that the Lebanese population is at increased risk of cardiovascular diseases, obesity and other NCDs.

CONCLUSIONS AND RECOMMENDATIONS

This review on CVD risk factors and dietary shifts in Lebanon addresses a broad range of public health challenges associated with the accelerated increase in energy-dense diets and adoption of unhealthy lifestyles.

Lebanon, like other countries of the MENA region, is witnessing rapid urbanization, economic growth, technical change and modernization [1]. All of this has brought about a significant change in dietary patterns towards unfavorable consumption choices and, subsequently, an alarming increase in nutrition-related diseases [1].

During the past 30-40 years, the intakes of energy, sugars and fats have increased considerably, with a parallel increase in the proportion of energy derived from animal-based products and a decrease in the contribution

of cereals and fruits to energy intake. These changes and the observed shifts in the Lebanese diet are likely to lead to higher intakes of saturated fat, refined carbohydrates and sugars and a lower intake of dietary fiber. It is probable that such a dietary pattern has contributed to the alarming escalating trend in the prevalence of obesity in the country. Although a disease in itself, obesity is considered an underlying and modifiable risk factor for CVDs [1]. As BMI increases, the risk of mortality from CVD increases for both men and women. It is increased by 20-40% at a BMI of 25.0 and by 2-3 times at a BMI greater than 30 [1,60]. Obesity also increases the cardiovascular risk through other mechanisms, including its comorbidity with hypertension, diabetes and unfavorable blood lipids [8], all of which appear to be following an increasing trend in their prevalence and burden among the Lebanese population.

The observed gradual and consistent shift towards an atherogenic diet coupled to the alarming increase in diet-related cardiovascular risk factors carry significant public health implications at the national level. Of more concern is the increasing trend in obesity among Lebanese children and adolescents, given that childhood obesity is known to track into adulthood and to predict a wide

TABLE II

RECOMMENDATIONS FOR CARDIOVASCULAR DISEASE PREVENTION: PATIENT AND POPULATION-CENTERED APPROACHES

CARDIOVASCULAR DISEASE PREVENTION	
Patient-centered approach [11]	Population-centered approach [62]
<p>Physicians can facilitate behavioral change by</p> <ul style="list-style-type: none"> ➤ Ensuring the patient understands the relationship between lifestyle and disease ➤ Gaining commitment to lifestyle change ➤ Involving the patient in identifying risk factors to change ➤ Exploring potential barriers to change ➤ Reinforcing the patient's efforts to change ➤ Using a multimodal team approach involving experts in behavioral medicine and nutrition ➤ Individualizing, if possible, intervention programs. <p>Physicians can recommend healthy food choices by</p> <ul style="list-style-type: none"> ➤ Advising patients about food choices that are associated with a lower CVD risk. ➤ Advising high risk persons to receive expert dietary advice, if feasible ➤ Encouraging patient to: <ul style="list-style-type: none"> ➤ Consume a wide variety of foods ➤ Consume fruits, vegetables, whole grain cereals, fish, lean meat, low fat dairy products ➤ Balance energy intake with energy expenditure ➤ Replace saturated fat with mono- and polyunsaturated fat (vegetables and marine) ➤ Limiting sodium intake from all sources ➤ Limit intake of free sugars. 	<p>Development of comprehensive health strategies at the national level, based on</p> <ul style="list-style-type: none"> ➤ Development of a multicomponent, population- based CVD prevention programme ➤ Monitoring the dietary intake for all population groups ➤ Monitoring the prevalence and incidence of CVDs and associated risk factors ➤ Identification of policy goals for the development of an evidence-based national framework for action ➤ Promoting policies which are likely to encourage healthy eating ➤ Creation of local and national conditions which support a reduction in the amount of saturated and Trans fat in foods ➤ Restriction of marketing, advertising and promotion of foods and drinks high in fat, salt or sugar ➤ Empowering local planning authorities to restrict permission for take-aways and other food retail outlets in specific areas, such as within walking distance from schools. ➤ Development of culture-specific food-based dietary guidelines aiming at decreasing the consumption of saturated fat, Trans fat, sugar and salt ➤ Establishing and implementing clear nutritional labeling regulations and legislation ➤ Monitoring the outcomes of policy and programmes in follow-up studies.

array of adverse health effects, including the metabolic syndrome and increased cardiovascular risk.

Taken together, these findings should alert to the importance of formulating policies and strategies to halt the progression of diet-related NCDs, and particularly CVDs, in the country, and highlight an urgent need for immediate actions that channel public health efforts into the promotion of a healthy lifestyle [1]. Clearly, one of the principle risk factors that can be modified through behavioral changes is an unhealthy diet [1]. The North Karelia project in Finland was able to reduce the burden of CVD by 70% through the promotion of good nutrition and the implementation of food policies [61]. Table II summarizes a set of recommendations for interventions focusing on changes at the individual as well as the population level, within the context of cardiovascular disease prevention [11,62].

Physicians and health care practitioners can play an important role in moderating the prevalence of cardiovascular risk factors through facilitating lifestyle changes, encouraging the adoption of healthy dietary habits and assisting patients in identifying barriers to behavior change [11]. In addition, nutritional education on the importance of a healthy diet at the population level and developing policies to facilitate the availability of healthy foods could reduce the rapid increasing trend in obesity and other chronic diseases. As suggested for the MENA region [1], population-wide community-based intervention programs that involve multisectoral partnerships and that are responsive to the socio-cultural norms of the Lebanese population must be put in place [1,61]. Strategies that address CVDs need to be put in place in order to develop an evidence-based national framework for action against CVD, to increase the public and professional awareness of the burden of CVDs and associated risk factors, to improve local and national surveillance of CVDs, to enhance the training of physicians and public health practitioners, and to adopt specific programs of proven effectiveness to prevent and control CVDs and their major risk factors [1].

REFERENCES

- Sibai AM, Nasreddine L, Mokdad AH, Adra N, Tabet M, Hwalla N. Nutrition transition and cardiovascular disease risk factors in the MENA countries: Reviewing the evidence. *Ann Nutr Metab* 2010; 57: 193-203.
- Moreno LA, Sarría A, Popkin BM. The nutrition transition in Spain: a European Mediterranean country. *Eur J Clin Nutr* 2002; 56 (10): 992-1003.
- Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. *Nutr Rev* 2012; 70: 3-21.
- Atinmo T, Mirmiran P, Oyewole OE, Belahsen R, Serramajem L. Breaking the poverty/malnutrition cycle in Africa and the Middle East. *Nutr Rev* 2009; 67 (Suppl 1): S40-S46.
- Hawkes C. Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases. *Global Health* 2006; 2: 1-18.
- Sibai A, Fletcher A, Hills M, Campbell O. Non-communicable disease mortality rates using the verbal autopsy in a cohort of middle-aged and older populations in Beirut during wartime, 1983-1993. *J Epidemiol Community Health* 2001; 55: 271-6.
- Sharrett AR, Ballantyne CM, Coady SA et al. Coronary heart disease prediction from lipoprotein cholesterol levels, triglycerides, lipoprotein (a), apolipoproteins A-I and B, and HDL density subfractions: The Atherosclerosis Risk in Communities (ARIC) Study. *Circulation* 2001; 104: 1108-13.
- Vazzana N, Santilli F, Sestili S, Cucurullo C, Davi G. Determinants of increased cardiovascular disease in obesity and metabolic syndrome. *Curr Med Chem* 2011; 18 (34): 5267-80.
- He FJ, MacGregor GA. Reducing population salt intake worldwide: from evidence to implementation. *Prog Cardiovasc Dis* 2010; 52 (5): 363-82.
- American Diabetes Association. Standards of medical care in diabetes - 2012. *Diabetes Care* 2012; 35 (Suppl 1): S4-S10.
- Graham I, Atar D, Borch-Johnsen K et al. European guidelines on cardiovascular disease prevention in clinical practice: executive summary. Fourth Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease prevention in clinical practice (constituted by representatives of nine societies and by invited experts). *Eur J Cardiovasc Prev Rehabil* 2007; 14 (Suppl 2): E1-E40.
- Mente A, de Koning L, Shannon HS, Anand SS. A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. *Arch Intern Med* 2009; 169 (7): 659-69.
- Vafeiadou K, Weech M, Sharma V et al. A review of the evidence for the effects of total dietary fat, saturated, monounsaturated and n-6 polyunsaturated fatty acids on vascular function, endothelial progenitor cells and microparticles. *Br J Nutr* 2012; 107 (3): 303-24.
- Schaefer EJ. Lipoproteins, nutrition, and heart disease. *Am J Clin Nutr* 2002; 75: 191-212.
- Astrup A, Dyerberg J, Elwood P et al. The role of reducing intakes of saturated fat in the prevention of cardiovascular disease: where does the evidence stand in 2010? *Am J Clin Nutr* 2011; 93: 684-8.
- Mensink RP, Zock PL, Kester AD, Katan MB. Effects of dietary fatty acids and carbohydrates on the ratio of serum total to HDL cholesterol and on serum lipids and apolipoproteins: a meta-analysis of 60 controlled trials. *Am J Clin Nutr* 2003; 77: 1146-55.
- Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA* 2006; 295: 1549-55.
- Seidell J. Obesity, insulin resistance and diabetes – a worldwide epidemic. *Br J Nutr* 2000; 83 (Suppl 1): S5-S8.
- Sibai AM, Hwalla N, Adra N, Rahal B. Prevalence and covariates of obesity in Lebanon: findings from the first epidemiological study. *Obes Res* 2003; 11 (11): 1353-61.
- Finucane MM, Stevens GA, Cowan M et al. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. *Lancet* 2011; 377: 557-67.
- Prospective Studies Collaboration, Whitlock G,

- Lewington S et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet* 2009; 373: 1083-96.
22. Hwalla N, Sibai AM, Adra N. Adolescent obesity and physical activity. *World Rev Nutr Diet* 2005; 94: 42-50.
 23. Kuczmarski RJ, Ogden CL, Guo SS et al. 2000 CDC growth charts for the United States: Methods and development. *Vital Health Stat* 2002; 11: 1-190.
 24. Chakar H, Salameh PR. Adolescent obesity in Lebanese private schools. *Eur J Public Health* 2006; 16 (6): 648-51.
 25. Singh JK, Kogan MD, Van Dyck PC, Siahpush M. Racial/ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: Analyzing independent and joint associations. *Ann Epidemiol* 2008; 18: 682-95.
 26. Orsi CM, Hale DE, Lynch JL. Pediatric obesity epidemiology. *Curr Opin Endocrinol Diabetes Obes* 2011; 18: 14-22.
 27. Lamotte C, Iliescu C, Libersa C, Gottrand F. Increased intima-media thickness of the carotid artery in childhood: a systematic review of observational studies. *Eur J Pediatr* 2011; 170 (6): 719-29.
 28. Mauras N, Delgiorno C, Kollman C et al. Obesity without established comorbidities of the metabolic syndrome is associated with a proinflammatory and prothrombotic state, even before the onset of puberty in children. *J Clin Endocrinol Metab* 2010; 95: 1060-8.
 29. Naja F, Nasreddine L, Itani L et al. Dietary patterns and their association with obesity and sociodemographic factors in a national sample of Lebanese adults. *Public Health Nutr* 2011; 14 (9): 1570-8.
 30. Issa C, Darmon N, Salameh P, Maillot M, Batal M, Lairon D. A Mediterranean diet pattern with low consumption of liquid sweets and refined cereals is negatively associated with adiposity in adults from rural Lebanon. *Int J Obes (Lond)* 2011; 35 (2): 251-8.
 31. World Health Organization Global InfoBase, NCD Indicators [Internet]. Geneva: World Health Organization. c1990- [cited 2012 Mar 10]. Available from <http://apps.who.int/infobase/Indicators.aspx?ISO35dza>
 32. Sibai A, Obeid O, Batal M, Adra N, El Khoury D, Hwalla N. Prevalence of metabolic syndrome in Lebanese adult population: findings from the first epidemiological study. *CVD Prev Control* 2008; 3: 83-90.
 33. Dorresteijn JA, Visseren FL, Spiering W. Mechanisms linking obesity to hypertension. *Obes Rev* 2012; 13 (1): 17-26.
 34. Srinath Reddy K, Katan MB. Diet, nutrition and the prevention of hypertension and cardiovascular diseases. *Public Health Nutr* 2004; 7 (1A): 167-86.
 35. Institute of Medicine: Dietary reference intakes for water, potassium, sodium chloride, and sulfate, 1st ed., Washington, DC: The National Academies Press, 2005.
 36. Tohme RA, Jurjus AR, Estephan A. The prevalence of hypertension and its association with other cardiovascular disease risk factors in a representative sample of the Lebanese population. *J Hum Hypertens* 2005; 19 (11): 861-8.
 37. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010; 87 (1): 4-14.
 38. Salas-Salvadó J, Martínez-González MÁ, Bulló M, Ros E. The role of diet in the prevention of type 2 diabetes. *Nutr Metab Cardiovasc Dis* 2011; 21 (Suppl 2): B32-B48.
 39. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004; 27: 1047-53.
 40. Ford ES, Giles WH, Mokdad AH. Increasing prevalence of the metabolic syndrome among US adults. *Diabetes Care* 2004; 27: 2444-9.
 41. Hu G, Qiao Q, Tuomilehto J, Balkau B, Borch-Johnsen K, Pyorala K. Prevalence of the metabolic syndrome and its relation to all-cause and cardiovascular mortality in non-diabetic European men and women. *Arch Intern Med* 2004; 164: 1066-76.
 42. Nasreddine L, Ouaijan K, Mansour M, Adra N, Sinno D, Hwalla N. Metabolic syndrome and insulin resistance in obese pre-pubertal children in Lebanon: A primary health concern. *Ann Nutr Metab* 2010; 57 (2): 135-42.
 43. Nasreddine L, Naja F, Tabet M et al. Obesity is associated with insulin resistance and components of the metabolic syndrome in Lebanese adolescents. *Ann Hum Biol* 2012; 39: 122-8.
 44. Druet C, Dabbas M, Baltakse V et al. Insulin resistance and the metabolic syndrome in obese French children. *Clin Endocrinol* 2006; 64: 672-8.
 45. Caranti DA, Lazzer S, Dâmaso AR et al. Prevalence and risk factors of metabolic syndrome in Brazilian and Italian obese adolescents: a comparison study. *Int J Clin Pract* 2008; 62: 1526-32.
 46. López-Capapé M, Alonso M, Colino E, Mustieles C, Corbatón J, Barrio R. Frequency of the metabolic syndrome in obese Spanish pediatric population. *Eur J Endocrinol* 2006; 155: 313-19.
 47. Toledo-Corral CM, Ventura EE, Hodis HN et al. Persistence of the metabolic syndrome and its influence on carotid artery intima media thickness in overweight Latino children. *Atherosclerosis* 2009; 206: 594-8.
 48. Grundy SM, Cleeman JI, Daniels SR et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. *Circulation* 2005; 112 (17): 2735-52.
 49. Naja F, Nasreddine L, Chamieh MC et al. Association between dietary patterns and the metabolic syndrome among Lebanese adults. *Eur J Nutr* 2011 Dec 23; 52: 97-105.
 50. Iskandar MM. Diet and physical activity as determinants of non-communicable disease risk factors in Lebanon [master's thesis]. [Beirut]: American University of Beirut; 2004. 125 p.
 51. Nasreddine L, Hwalla N, Sibai A, Hamzé M, Parent-Massin D. Food consumption patterns in an adult urban population in Beirut, Lebanon. *Public Health Nutr* 2006; 9 (2): 194-203.
 52. Rechmany RK. Food consumption patterns and dietary exposure to organophosphorous pesticide residues in an adult semi-rural population in Lebanon [master's thesis]. [Beirut]: American University of Beirut; 2008, 182 p.
 53. Joint WHO/FAO Expert Consultation. Diet, Nutrition and the Prevention of Chronic Diseases. Geneva: World Health Organization, 2003, 150 p. Technical Report Series No. 916.
 54. American Heart Association Nutrition Committee, Lichtenstein AH, Appel LJ. Diet and lifestyle recom-

- mendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation* 2006; 114 (1): 82-96.
55. Baba NH. Dietary intake and nutrition related disorders in Lebanon. *Nutr Health* 2000; 14 (1): 33-40.
 56. Batal M, Hunter E. Traditional Lebanese recipes based on wild plants: an answer to diet simplification? *Food Nutr Bull* 2007; 28 (Suppl 2): S303-S311.
 57. Hwalla N, Tannous Dit El-Khoury D. Lebanese traditional diets and health effects. In: De Meester F, Watson RR, editors. *Wild-Type Food in Health Promotion and Disease Prevention*, 1st edition. Totowa (NJ): Human Press Inc., 2008: 493-8.
 58. Food and Agriculture Organization of the United Nations. Nutrition country profile, Lebanese Republic [Internet]. Italy: FAO; 2007-cited [2012 Apr 9] Available from: <ftp://ftp.fao.org/ag/agn/nutrition/ncp/lbn.pdf>
 59. Food and Agriculture Organization Statistical Database (FAOSTAT) Supply Utilization Accounts and Food Balances Domain: Food Balance Sheets. Available from: <http://faostat.fao.org/site/368/default.aspx#ancor> (accessed March 2012).
 60. Adams KF, Schatzkin A, Harris TB et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *N Engl J Med* 2006; 355: 763-78.
 61. Puska P, Pirjo P, Ulla U. Influencing public nutrition for non communicable disease prevention: from community intervention to national programme – experiences from Finland. *Public Health Nutr* 2002; 5: 245-51.
 62. National Institute for Health and Clinical Excellence. NICE public health guidance 25 - Prevention of cardiovascular disease: quick reference guide [Internet]. London: National Institute for Health and Clinical Excellence; 2010 - [cited 2012 Apr 9]. Available from : <http://www.nice.org.uk/nicemedia/live/13024/49274/49274.pdf>.