



REVIEW ARTICLE

Overview on main nutrition-related diseases in three countries from North Africa

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ABSTRACT

The aim of this review article is to give a holistic overview on the magnitude of nutrition-related diseases in the North African region and to outline major factors associated with the prevalence of these complications. A literature analysis was performed on PubMed and Google Scholar for data relating to nutrition-related diseases published between January 2007 and March 2017. The employed keywords were; “Algeria AND Morocco AND Tunisia AND Nutrition-Related diseases”. We focused firstly on the nutrition-related diseases associated to inadequate intake of nutrients and unhealthy dietary habits such as low birth weight, anemia and micronutrient deficiencies, thereafter, diseases associated with changes in lifestyle such as obesity, diabetes and cardiovascular disease are highlighted. Factors, contributing to nutritional issues, vary from one country to another. Low socioeconomic status, low educational levels, unhealthy eating habits, poverty, and ignorance are mainly responsible for both under and over nutrition problems. Despite their alarming rates, national strategies to combat these nutritional diseases do not exist or are ineffective in North African countries. Efforts are focused on therapeutic actions, however, the scarcity or the complete lack of preventive health care services, epidemiological surveys, nutritional surveillance and lack of nutritional assessment need to be considered. Continuous and accurate analyses of the evolving situation will allow setting up good tools, strategies and health intervention programs in North African countries.

Keywords: North African countries, nutrition-related diseases, overview, undernutrition, over-nutrition

Received: 29 April 2017 / Accepted: 23 June 2017 / Published: 28 June 2017

1 Introduction

The transition to modernity that accompanied the globalization is often associated with changes in food habits. This contributed to an upsurge in the frequency of nutrition-related diseases including both under- and over-nutrition. Indeed, regardless of region and countries, diet is rapidly passing from a traditional to a westernized pattern. This new public health burden is widely studied and poses a major challenge for the coming years [1-3].

The North African countries, belonging also to the Mediterranean basin, have been progressively losing their food pattern which was traditionally characterized by a high

consumption of olive oil, citrus, fresh and dried grapes. Furthermore, a variety of fresh fruits and vegetables, cereals, especially wheat and also legumes, that represent an extraordinary source of protein and essential amino acids; moderate consumption of fish, poultry, eggs, red meat (lamb and goat), and dairy products [4, 5]. The Mediterranean diet is the most studied food model at the level of evidence-based medicine. However, recently this region of multiple cultures and civilizations is progressively losing its food habits and is suffering drastic alterations [6].

Food price crisis, religious beliefs, inactivity, political and humanitarian crisis, ethnicity, and population growth rates,

are other serious issues that influence the nutritional status in the north African countries [7, 8].

During the last decades, the three countries of North Africa; Algeria, Tunisia, and Morocco are encountering an active epidemiological and nutritional transition. This has resulted in an increase in the incidence of some metabolic disorders as overweight and obesity and in the prevalence of comorbidities such as type 2 diabetes (T2D), cardiovascular diseases, and hypertension [9-11].

This paper aimed to highlight the magnitude of the nutrition-related diseases in Algeria, Tunisia, and Morocco, based on the literature review.

2 Methods

The search was performed on PubMed and Google Scholar and it concerned original and review papers, as well as reports on nutrition-related diseases in English language published from January 2007 to March 2017. The search covered three North African countries; Algeria, Tunisia, and Morocco.

The keywords used in the Search were: “Algeria AND Morocco AND Tunisia AND Nutrition-Related diseases”. The nutrition-related diseases covered low birth weight, under nutrition, anemia, overweight and obesity, cardiovascular diseases, and T2D. One hundred thirty-five papers were identified at the preliminary stage. The titles and abstracts were then reviewed carefully, according to the inclusion and exclusion criteria. These criteria were determined as follow:

- Only studies performed on nutrition-related diseases in human living in these three countries were included. This was done for prevalence of nutritional problems obtained through national studies or by results announced by official bodies, World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF);
- Small studies performed on specific town, small communities and people living as immigrants or refugees in these countries were excluded;
- Studies on animals or microorganisms (fungi, algae or bacteria) were all excluded.

After this subsequent screening, we included 38 articles and reports from Google Scholar and 10 articles from PubMed in this review (Figure 1).

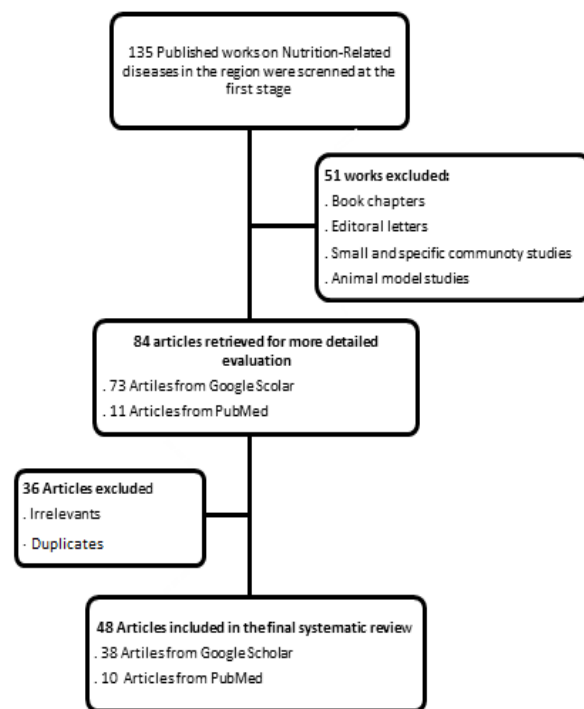


Figure 1. Flow chart of studies reviewed

3 Findings and Discussions

3.1 Undernutrition-related diseases

3.1.1 Low birth weight

The WHO defined low birth weight (LBW) as weight at birth less than 2.5 kg, with the measurement taken within the first hours of life. Worldwide, about 20.6 million infants are born each year with LBW, 16.5 % among them in developing countries and 7 % in developed countries [12]. The LBW is considered as one of the most important risk factors of infant mortality.

Comparing between the North African countries, Algeria had the lowest prevalence of LBW at 3.5 %, which is lower than those recorded in Morocco (7 %), and Tunisia (7 %) [12].

Despite the fact that data on risk factors associated with LBW in North African countries are lacking, female gender, low socioeconomic status, older mothers, and smaller interval between pregnancies could be considered as the main risk factors linked to low birth weight [13]. Malnutrition among pregnant mothers constitutes another important factor that contributes to this LBW. According to fares *et al.* [14], the LBW is associated with inadequate vitamin status of vitamin A, E, and D. However, in Algeria, Demmouche *et al.* [15]

reported a higher prevalence of LBW (less than 2500 gr) among anemic mother compared to non-anemic ones.

3.1.2 Nutrient deficiencies-related diseases

In developing countries, the double burden of malnutrition (under-nutrition and over-nutrition) is becoming a serious health crisis [16, 17]. The growing scourge of the under-nutrition (i.e., underweight, wasting, stunting, and micronutrients deficiencies) remains important problem in many developing countries, despite the remarkable improvement in nutrition status [18].

Currently, the prevalence of underweight is approximately 13.2% and ranged from 1 to 43.9 %. In Algeria and Morocco, the prevalence is about 3.7 % and 3.1 %, respectively; however, the rate of underweight in Tunisia is about 2.3 % [19].

Wasting, which is defined as a low weight for height, is critical malnutrition associated with inadequate food intake and especially low protein and energy intakes. Wasting is often observed when countries go through periods of food insecurity [20].

Chronic malnutrition can also lead to the stunting (low height for age) that might occur even in regions and households with apparent food security. In developing countries, the latest data regarding the prevalence of stunting are not always widely available. It is primarily micro-nutritional deficiencies and high occurrences of stunting that lead to the classification of countries' food security risk as "serious" as in Morocco (21.6 %) and Algeria (15.6 %) or "moderate" as in Tunisia (9 %) [21].

Almost in all the Arab countries, iron deficiency anemia is the most common type of anemia [22]. The main nutritional causes of iron deficiency, anemia is the low intakes of dietary iron, low intakes of vitamin C through low intakes of fruits and vegetables, which could enhance iron absorption and high food intakes of tannins and phytates that inhibit iron metabolism [23] (Table 1).

3.1.3 Vitamin D deficiency

Vitamin D is a fat-soluble vitamin which plays an essential role in bone health and bone growth [25]. Responses to vitamin D deficiency differ between children and adults. In children, vitamin D deficiency can cause rickets. However, in adults, myopathy, osteopenia, secondary hyperparathyroidism, and osteomalacia are major results of vitamin D deficit [26, 27].

Table 1. North African countries estimates of anemia prevalence in preschool-age children, pregnant women and non-pregnant women of reproductive age

	Preschool-age children (0-4.9 years) (%) [24]	Pregnant women (%) [24]	Non-pregnant women of reproductive age (%) [24]
Algeria	30.95	33.33	29.08
Morocco	31.48	37.20	29.93
Tunisia	21.65	32.14	24.80

3.1.4 Vitamin D deficiency

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It is well known that sunlight exposure is by far the essential source of vitamin D [28]. Thence, limited skin exposure to sunlight and seasonally variations are presumed to be important causes of vitamin D deficiency. In North African countries such Morocco, Algeria, Tunisia, Libya, and Egypt, seasonality in cutaneous vitamin D synthesis is often expected [29].

Studies, about vitamin D deficiency in North Africa region, are scarce and generally limited to Morocco and Tunisia. The prevalence of vitamin D insufficiency is high in Morocco. Results, from two hospital-based studies conducted in Rabat (capital of Morocco), revealed a low 25-(OH)-D level in the mid-adolescence [30, 31]. In Tunisian women, the findings were not different and insufficient levels were noted too [32]. Likewise, in Algeria and despite a sunny environment, vitamin D insufficiency is frequent in healthy Algerian children, as recorded by Djennane *et al.* [33].

3.1.5 Vitamin A deficiency

According to the WHO, the vitamin A deficiency, in developing countries, affects 250 million children. Inadequate dietary intake is the main cause of vitamin A deficiency. This type of vitamin deficiency is related to blindness, measles and severe diarrhea in developing countries. A Fluctuating consumption of food sources of preformed vitamin A such as dairy products, liver, eggs and cereal rich alimentation characterize the most affected countries [34].

Studies on the hypovitaminosis A prevalence are extremely rare in the region and/or do not give a representative idea on the real situation at the level of these countries.

3.1.6 Iodine deficiency disorders

The dietary intake of iodine is extremely required in thyroid hormone production. Deficiency in iodine causes endemic goiter (an enlargement of the thyroid gland), cretinism (mental retardation), intellectual impairments, growth retardation, neonatal hypothyroidism, and increased prevalence of pregnancy loss and infant mortality [35].

Iodine deficiency continues to be one of public health issues. It is available in approximately 40 % of the world's population. Overall, 11 out of 54 African countries with available data, including Ethiopia, Algeria, Sudan, Morocco, and Ghana, are iodine deficient [36]. Results showed that more than 40 % of Moroccan infants had thyroid hypofunction, a much higher rate than in the women [37].

Many regions in Morocco remain iodine deficient, despite the legislation in force since 1995 on the compensation of salt with iodine [37]. A household survey of iodized salt showed that, two decades after the adoption of the legislation, only a quarter of Moroccan households had any iodized salt. In the sentinel survey conducted by Zahidi *et al.* [37], about 25 % of households use iodized salt. Only 4.5 % of household met the recommended iodine concentration of 15 – 40 mg of iodine per kg of salt.

In Tunisia, a recent study published in 2016 evaluated iodine status in school-age children. The Universal Salt Iodization Program achieved its objectives two decades after its implantation. The national median iodine concentration of household salt was 22 mg/kg. However, important geographic disparities, in the coverage of adequately iodized salt, need to be more monitored [38].

Over nutrition-related complications

People living in North Africa, as part of developing countries, are particularly at risk of nutritional transition that has rapidly become a growing public health burden [39].

Accelerated urbanization and altered dietary patterns have caused a progressive increase in over-nutrition related complications such as overweight and obesity, hypertension, diabetes, and cardiovascular diseases. More industrial foods have been replacing the traditional Mediterranean diet [40, 41]. Although, despite widespread poverty in most North African cities, the easier access to high fat and refined sugar content foods is becoming more common in both urban and rural population [42].

3.1.7 Overweight and obesity

Recently, most evidences, from several studies, have indicated that overweight and obesity are major public health issues in North African countries [39]. However, obesity prevention has not been recognized as a main public health burden priority in this region. It is the necessity to prioritize action in order to prevent overweight and obesity as crucial first step [43].

a. Prevalence in school children and adolescents

Several published studies, about the prevalence of overweight and obesity among school age children and adolescents, performed in North African region, are not nationally representative. Furthermore, many available data did not consider the pre and puberty stage when selecting the age range (i.e., 6 to 18 years) which has a significant influence on weight gain and physiological modifications [44].

Statistics indicate that the prevalence of overweight and obesity among school children is alarming in North African countries. Highest prevalence of obesity among primary age school children is reported in Tunisia (9.1 %) [45]. Furthermore, in pre and adolescents, obesity is more frequent in Tunisia (5.7 %) [46], followed by Algeria (4.1 %) [47] and Morocco (3.6 %) [48].

b. Prevalence in adult population

The prosperity recorded in recent decades, such as easier lifestyles, in terms of transport development, urbanization, improved living conditions, easy access to foods high in fat and sugar among the urban poor, and rural populations. As well as the spread of fast-food western style and greater opportunities for sedentary lifestyles. Therefore, these factors created an “obesogenic environment” around the North African countries [39, 49].

In the southern Mediterranean countries, an increasing trend over time in the prevalence of obesity, was observed, especially in females than in males and in urban people than in rural ones. This could be related to some cultural values. Up to now, in many developing countries, female fatness is a cultural symbol of beauty, healthiness, fertility and prosperity [39]. In their study on Moroccan women, Jafri *et al.* [50] concluded that increasing obesity prevalence was associated with low educational levels and an increasingly sedentary modern lifestyle.

The highest prevalence of obesity was observed in Tunisian adults (37 % in females and 13.3 % in males) [51] (Table 2), followed by Algeria (30.1 % in females and 9.1 % in males) [48] and then Morocco (23.2 % in both genders) [52].

3.1.8 Cardiovascular diseases

Cardiovascular diseases (CVDs) are the most prevalent cause of mortality among people of working age, which may significantly affect the economic development of nations through loss of incomes and the high cost of medical care [53, 54]. In North African countries, reliable and complete data about mortality correlated to CVDs are

An epidemiologic assessment in Tunisia and Algeria, through TAHINA project, found a similar high prevalence of hypertension of about 30% in these countries [10].

In their study, Nejjari *et al.* [57] reported that the frequency of hypertension was 45.4% in a studied population from

Table 2: Prevalence of overweight and obesity among North African residents

Authors, year	Country	Population	Regions or Cities	Prevalence	
				Overweight	Obese
Taleb <i>et al.</i> [49]	Algeria	4-13 years 21618	Tebessa	6.38% (2007)	1.80% (2007)
Musaiger <i>et al.</i> [47]	Seven Arab Countries (Algeria)	15-18 years 459 Algerian/4698	Algiers	9.3%	4.1%
Atek <i>et al.</i> [51]	Algeria	35-70 years 2741 Female 2004 Male	16 Wilaya	36.4% 32.2%	30.1% 9.1%
Abdelkafi <i>et al.</i> [45]	Tunisia	4-6 years 1334	Monastir	11.6%	9.1%
Musaiger <i>et al.</i> [46]	Seven Arab Countries (Tunisia)	15-18 years 803 Tunisian/6447	-	15.8% (IOTF*)	5.7% (IOTF)
Atek <i>et al.</i> [51]	Tunisia	35-70 years 2964 Female 2379 Male	7 Administrative regions	34.1% 38.4%	37.0% 13.3%
Manyanga <i>et al.</i> [48]	Seven Countries (Morocco)	11-17 years 5756 Moroccan /23496	-	16.6%	3.6%
Benghanem Gharbi <i>et al.</i> [52]	Morocco	26-70 years 10524	Khemisset El Jadida	-	23.2%

(*) IOTF: International Obesity Task

not available; this could raise concerns about the potential development of CVD epidemic in this region (Morocco, Algeria, Tunisia, Libya and Mauritania). A good understanding of the current levels of CVD risk factors like hypertension and hypercholesterolemia in the region is lacking.

North African countries are undergoing a real epidemiological transition accompanied by increasing urbanization and rapid nutritional changes, whereby overall life expectancy is increasing. However, the risk of cardiovascular disease is increasing too. This will drive a sharp increase in the future burden of cardiovascular diseases and their combined risk factors as dyslipidemia and hypertension [55, 56].

According to ETHNA study [57], hypertension is highly prevalent and may be ineffectively treated in North Africa.

Algeria, Tunisia and Morocco. After adjusting for age and sex, the overall prevalence of hypertension was 26.9 %. The age was the mean factor of hypertension increase. However, hypertension was more encountered in rural areas comparing to urban ones and in illiterate comparing to educated individuals [57].

3.1.9 Type 2 diabetes

Diabetes mellitus, which is considered as a group of metabolic and hormone disorders resulting from defects in insulin secretion, insulin action or both and characterized by high glycaemia, has become a major cause of death in people under the age of 60. Along with rapid urbanization and economic growth, North African countries are experiencing titanic dietary changes favoring increased caloric consumption [58].

As for overweight and obesity, many factors fuel the emerging epidemic of T2D in the North African nations.

Drastic dietary changes, are going from predominantly typical Mediterranean diet characterized mostly by consuming fish, milk, fresh vegetables, and fruit, whole wheat bread and lamb meat to consuming processed foods rich in high saturated fats and refined carbohydrate coupled with a low dietary fiber intake [59].

The International Diabetes Federation (IDF) estimates suggest that by 2040, the number of people with impaired glucose tolerance will increase to 482 million, which is equivalent to 7.8 % of the adult population that will be at a real risk of progressing to T2D later in their life [60].

Ben Romdhane *et al.* [61] reported that the prevalence of T2D in Tunisia was 15.1% in adults aged 35 – 70 years old. This prevalence is twice higher in urban area.

Evidences from several studies suggest that the prevalence of T2D in Algeria has significantly increased from 6.8 % in 1990 to 16.23 % in 2005 among 35 – 70 years old [62]. In 2013, the IDF estimated the national prevalence of diabetes in Algeria at 6.63 % [63]. However, in 2015, the estimated prevalence of T2D in Morocco was 7.7 % in 20 – 79 years old according to the IDF [60].

4 Conclusion

Over the last few decades, North African countries have experienced dramatic changes in health and nutritional transition. The nutritional transition summarizes both issues caused by under and over nutrition. Low birth weight, iron deficiency anemia, hypertension, overweight and obesity, T2D and CVD, represent the most common nutritional difficulties in all these countries. The increase in prevalence of these nutrition-related diseases is primarily being influenced by environmental factors, nutritional transition, and westernization of the lifestyle. The adopted strategies based on therapeutic reduction of these burdens are misguided concepts. We should convince much more the policy makers and improve their awareness and understanding of the interrelationship between health, life styles, nutrition, social, economic and political factors, in order to develop multi-sectorial programs. Planning of such programs should be carried out respecting the local context of each country, based on situation and resources concept, political and social model, and the population growth rates.

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Cite this article as: Diaf, M., & Khaled, M.B., (2017). Overview on main nutrition-related diseases in three countries from North Africa. *The North African Journal of Food and Nutrition Research*, 1 (1): 20-29. <https://doi.org/10.51745/najfnr.1.1.20-29>

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