

# An overview of the health status of migrants in France, in relation to their dietary practices

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## Abstract

*Objective:* To review studies on the morbidity, mortality and nutrition of migrant populations in France.

*Design:* A systematic search of the bibliographic database Medline, and direct contact with associations and institutions concerned with migrants' health.

*Results:* In France, as in other host countries, migrants belong to the lowest socio-economic strata. They have on average better health and lower mortality than the local-born population. Health benefits are particularly noticeable in Mediterranean men, especially for affluence-related diseases such as cancer and cardiovascular diseases. North African men smoke as heavily as the local-born of the same occupational categories, and yet their mortality rates from lung cancer are notably lower. Such a paradox may be the result of a synergy between different phenomena such as the selection of the fittest applicants for immigration and the maintenance of healthy lifestyles from the countries of origin. In contrast, migrant women do not enjoy the same health advantages, possibly because they are less likely to be selected on the basis of their health and because they are often non-working. Adult migrants from southern Europe and North Africa report dietary practices consistent with the typical Mediterranean diet, which is renowned for its positive effects on health.

*Conclusions:* The diet of Mediterranean adults living in France may partly explain the low rates of chronic diseases and high adult life expectancy observed in migrant men from northern Africa. Information about their diets might provide clues for the design of nutritional education campaigns aimed at low-income people.

**Keywords**  
Migration  
Health  
Mortality  
Food intake  
Mediterranean diet  
France

Migrants studies have long been popular in epidemiology, because they shed some light on the relative importance of the environment and genetic make-up of populations in shaping health disparities between countries<sup>1,2</sup>. Given their unfavourable social background in most countries, migrants are expected to be at higher risk of morbidity and mortality, particularly from obesity- and smoking-related disorders<sup>3,4</sup>, and yet numerous findings contradict this expectation<sup>5–7</sup>. The maintenance of traditional behaviours, such as healthier dietary habits and greater family support may protect migrants from the diseases related to affluence prevalent in their host countries<sup>8,9</sup>. In this paper, we address the possibility that such a paradox also exists in France, and we discuss the potential role of nutrition in explaining health disparities between migrants and local-born populations.

Although France is traditionally a country of immigration,

studies on health and health-related behaviours of migrants are to date scarce. The paucity of data might be related to the important methodological problems raised by migrants studies<sup>10</sup>. It has also been attributed to political reasons, i.e. concern that data on health risks and the costs of health care in migrants might be used to their detriment, and to conceptual reasons, whereby the differences between migrants and local-born populations would be mainly attributable to socio-economic differences<sup>11</sup>. The studies published on the morbidity and mortality of migrant populations in France are reviewed, as well as data on their dietary patterns and nutritional status. A systematic search of the bibliographic database Medline was completed by contacting associations, universities and institutions concerned with migrants' socio-economic conditions or health, because unreferenced reports constitute a great part of the available information on the subject.

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**Table 1** National data on morbidity of migrants in France

Ref. number	Study period, type of study and study size	Type of data, design and methods	Migrant groups and comparison group	Main results for migrants (i.e. statistically significant)
25	1988–1991 Population-based interview survey of a representative sample of households affiliated with the national social insurance scheme (29,266 individuals)	Disability and vital prognosis indicators, health care utilization, health insurance coverage, with age standardization	Foreigners or migrants naturalized French (together) vs. French people born in France	Better health status; lower health care utilization and lower health insurance coverage
29	1991–1992 Population-based interview survey of a representative sample of households (10,000 households)	Reported morbidity, health care utilization, tobacco consumption, body mass index, with adjustment for age and occupational status	Households whose heads were from North Africa vs. households whose heads were of French nationality	Fewer illnesses (–33% for men, and –16% for women). Protection from cardiovascular diseases for men (–68%). Increased prevalence of endocrine and metabolic diseases (+39%) and of obesity (RR = 2.21) for women
27	1978–1998 National AIDS register (46,973 AIDS cases, including 6571 cases among foreigners)	Mandatory notifications of AIDS cases by nationality related to population data, with age standardization	Eight groups of nationalities vs. French	Cumulative incidence rate twice as high among foreigners compared with French, with highest risks among sub-Saharan Africans and Haitians

### Origin and socio-demographic profile of migrant populations

Immigration has a long history in Europe, particularly in France. Massive population moves, from neighbouring countries or from former French colonies into France, occurred during times of economic expansion and post-war rebuilding (Second Empire, 1920s, 1960s) generally followed by a stabilization of population flow during periods of economic recession (end of the 19th century, 1930s, 1970s).

According to the last published national census in 1990, 6.2% of the population in France are of foreign nationality ('foreigners') and 7.2% were born outside of France ('migrants' in the strict sense), being of foreign nationality or naturalized<sup>12</sup>. Migrant populations mainly originate from Mediterranean countries, with people from North Africa and southern Europe representing respectively 35% and 32% of the foreigners. In 1990, Portuguese (17.7%), Algerians (16.6%) and Moroccans (13.9%) formed the largest communities of foreigners, followed by Italians (7.8%), Spanish (6.7%) and Tunisians (4.7%). Three other groups have increased during the last 20 years: eastern Europeans (mainly Turks and Yugoslavians, amounting to 7%), sub-Saharan Africans (7%) and Southeast Asians (mainly refugees from Laos, Vietnam and Cambodia, amounting to 3%). Overall, the population of migrants is younger than the local-born population, with a difference in average age of 5 years for men and 8 years for women<sup>13</sup>. Although incoming migrants are now predominantly women and children, overall the migrant population is still composed mainly of men (55%)<sup>13</sup>. More than one-third of the migrants have settled in Paris and its suburbs<sup>14</sup>.

Migrants generally belong to the lowest socio-economic social classes of France<sup>11</sup>. Consequently, various aspects of their living conditions are affected by poverty and/or precariousness of employment<sup>15,16</sup>, housing<sup>14,17</sup>, marital status<sup>13</sup> and education<sup>18,19</sup>. Unknown numbers of migrants stay in France illegally or suffer from restrictions in social rights. Foreigners represent an important fraction (40%) of the homeless in Paris<sup>20</sup>.

### Health status of migrants in France

Twenty-four studies, which have included data on morbidity, mortality and/or nutrition of migrants, are reviewed in this section. The large population-based studies are summarized in Tables 1–3.

#### *Utilization of preventive health services*

Studies have shown that, even after adjustment for socio-economic factors, adult migrants<sup>21</sup> and their children<sup>22</sup> are less likely than the local-born population to engage in preventive medical measures. Pregnant women born in North Africa have less prenatal visits than women born in continental France, particularly if they do not speak French<sup>23,24</sup>. Foreigners have a lower health insurance coverage and a lower health care utilization than their French peers<sup>25</sup>. An insufficient awareness of health risks and a poor understanding of health messages, due to cultural or language barriers, might be involved in this low utilization of preventive care.

#### *Morbidity*

In free health centres, which attract the most deprived migrants, often without health insurance coverage and/or legal status (referred to as 'sans papiers'), the frequencies

**Table 2** National data on mortality of migrants in France

Ref. Number	Study period, type of study and study size	Type of data, design and methods	Migrant groups and comparison group	Main results for migrants (i.e. statistically significant)
30	1974–1975 Mortality statistics (study size unknown)	Age-specific death rates and causes of death	Foreigners (by country of origin) vs. French	Lower mortality from cardiovascular diseases, cancers and alcohol-related diseases, in males from Portugal and Algeria (recent migrations) but not from Italy or Poland, (ancient migrations). Higher mortality from work-related accidents in all migrant groups
24	1972 and 1981 Representative samples of births (mother + child) (10,419 births in 1972, 5285 births in 1981)	Prenatal care, neonatal pathology	Women born in North Africa, Portugal, or other countries (European or not) vs. French women born in metropolitan France	Higher stillbirth rate among foreign women, especially those born in North Africa
35	1980–1982 Mortality statistics (37,224 deaths)	Death rates and causes of death for 1–14 and 15–24 years old	Foreigners vs. French	Higher mortality for all causes in the two age groups and both sexes
31	1979–1985 Mortality statistics (3,822,811 deaths)	Cause-specific death rates. Poisson modelling with age, occupational status and place of residence	People born in a foreign country vs. people born in France	Lower mortality from all causes (–30%), more so among Mediterranean migrants than among eastern European, West African and Asian migrants
33	1979–1985 Mortality statistics (3,822,811 deaths including 816,096 deaths from cancer)	Deaths rates for cancer deaths by site. Poisson modelling with age, occupational status and place of residence	People born in Algeria, Morocco, Tunisia and Egypt vs. people born in France	Low risks for most cancer sites. High risks for certain cancers such as nasopharynx and bladder
34	1979–1991 Mortality statistics (more than 10,000 deaths)	Age-specific death rates, with adjustment for under-registration of deaths. Calculation of life expectancies. Poisson regression modelling of cause-specific death rates	Moroccans born in Morocco vs. France as a whole	Lower mortality and higher life expectancy at birth for Moroccan men. Slightly higher mortality of women. Protection from cardiovascular diseases in men (RR = 0.71), from cancer in men (RR = 0.68) and women (RR = 0.88). Increased risk for diabetes in women (RR = 2.49)

**Table 3** National data on diets of migrants in France

Ref. Number	Study period, type of study and study size	Type of data, design and methods	Migrant groups and comparison group	Main results for migrants (i.e. statistically significant)
46	1989 Population-based interview survey of a representative sample of households (9038 households)	Household budgets, with details concerning food expenditure. Indicators of living standards. Co-variance analysis with adjustment for household size, socio-economic status and income	Households whose heads were from North Africa or Portugal vs. households whose heads were French	Higher consumption of oil, potatoes, citrus fruits, bread and milk in both groups. Lower consumption of pork and alcohol among North Africans, and higher consumption of fish and wine among Portuguese
21	1986–1987 Population-based interview survey of a representative sample of households (13,147 individuals)	Alcohol consumption, tobacco use, food frequency questionnaire	Foreigners born in Spain/Portugal, Italy or North Africa vs. people born with French nationality	Lower consumption of dairy products and meat (OR = 0.4 for North Africans), higher consumption of starchy food and legumes (OR = 1.5 for North Africans). Lower consumption of alcohol and higher tobacco intake among North Africans

of psychiatric disorders, parasitism, tuberculosis, and infections by HIV and hepatitis C virus are particularly high among migrants<sup>25,26</sup>. Foreigners represent 14% of the cases of AIDS registered in France between 1978 and 1998; very high incidence rates are found for foreigners from sub-Saharan Africa<sup>27</sup>. The excessive risk in this community could be due to several factors: the high prevalence of HIV infection in the countries of origin, the existence of migration for medical reasons, and a low access to preventive and health care due to cultural and religious barriers, as well as to socio-economic and legal factors<sup>27,28</sup>.

The analysis of population-based data leads to quite a different picture. Migrants affiliated with the national social insurance scheme were shown to have on average a better health status than French individuals of the same age<sup>25</sup>. This general under-morbidity has been confirmed for members of households whose heads originated from North Africa, using the data from another national survey<sup>29</sup>. The most striking observation was an important (−68%) and significant favourable difference in the prevalence of reported cardiovascular diseases for men from North Africa compared with French men of the same age and occupation type. And yet, North African men were found to smoke as heavily as the local-born in the same occupational categories. Women from the same community were less advantaged in terms of their health in comparison with their French peers: the prevalence of obesity was twice as high, and they were at a significantly higher risk of being diabetic than French women<sup>29</sup>.

### **Mortality**

The first study on migrant mortality in France showed that the death rates of migrants were unexpectedly low: not only better than the national average, but also better than rates specific to their occupational categories<sup>30</sup>. These findings were subsequently confirmed by an analysis of the mortality data of 35–64 year old adults living in France in 1979–1985, which showed a global and important (−30%) reduction in the mortality rate of migrants compared with local-born adults of similar age, occupational status and place of residence<sup>31</sup>. This profile was consistent with morbidity data, since the extent of under-mortality was particularly important for men from Portugal and North Africa, and for causes of death such as cancers of the digestive tract<sup>32,33</sup> and cardiovascular diseases<sup>34</sup>. Even after correction for under-registration of deaths, Moroccan men living in France had lower death rates than those in Morocco and also than French nationals, with a life expectancy at birth estimated at 73.7 years, vs. 71.3 for the country as a whole<sup>34</sup>. In contrast, Moroccan women, although in a better position than in their homeland, gained less from migration than men, with a life expectancy at birth estimated as 78.8 years vs. a national figure of 79.4.

Conversely, migrants from eastern European countries

were found to suffer from higher death rates from cardiovascular diseases and diseases of the respiratory and digestive systems, and migrants from West Africa, India, Pakistan and Southeast Asia had higher death rates from infectious and parasitic diseases<sup>31</sup>. Lastly, two mortality studies carried out in the 1980s are worth mentioning: one found a higher mortality from all causes of deaths in 1–24 year old migrants<sup>35</sup>; the other found a higher stillbirth rate among foreign women, especially those born in North Africa<sup>24</sup>. These two findings, however, were not adjusted for socio-economic status.

### **Dietary practices of migrants in France**

#### ***The Mediterranean diet***

The MONICA study at the European level<sup>36</sup>, the Seven Countries Study<sup>37</sup> and statistics from the WHO and the OECD<sup>38</sup> at the international level have shown that populations from the Mediterranean countries (Italy, Portugal, France, Yugoslavia, Greece and Spain) present the lowest death rates from ischaemic heart disease. On one hand, these data are consistent with the protective effects of olive oil<sup>39</sup>, wine or alcohol<sup>38</sup>, and of antioxidants such as vitamin E<sup>36</sup> and flavonoids<sup>40</sup>. On the other hand, they point to saturated fats<sup>37</sup> and animal foods (excluding fish)<sup>41</sup> as important determinants of mortality by cardiovascular diseases. These ecological observations have also shown inverse relationships between fibre intake and mortality from colorectal cancer<sup>42</sup>, and between carbohydrate intake and total mortality<sup>43</sup>.

As the typical diet found in southern Europe may contribute to low rates of chronic diseases and high adult life expectancy, it has been proposed as a model for healthy eating: abundant consumption of cereals, vegetables and fruits, low consumption of dairy products and red meat, use of olive oil as the principal added fat, and wine in moderation<sup>44</sup>. Less is known about dietary habits in Mediterranean regions other than southern Europe. A recent study suggests, however, that a pattern consisting of a low proportion of energy from fats (15%), a high proportion of energy from carbohydrates (67%) and a high polyunsaturated to saturated fatty acids ratio (1.04) exists in North African countries<sup>45</sup>. Another aspect of their dietary practices was that the energy intake was as high among women as men, while in western countries it is consistently lower<sup>45</sup>.

#### ***Food consumption***

In France, the large nutritional surveys carried out to date were either restricted to French people or did not separate native people from migrants or foreigners. Some dietary studies have been conducted, however, on specific groups of migrants. The most relevant and comprehensive of these used data from a French national survey of individuals more than 18 years of age living in private households. It was conducted between 1986 and 1987<sup>21</sup>.

**Table 4** Overview of potential biases in studies of the mortality of migrants

Type of bias	Mortality estimation	Impact of bias correction
Under-estimation of the migrants' population size	Over-estimation of mortality	Would reinforce migrants' advantage
Migration for medical reasons	Over-estimation of mortality	Would reinforce migrants' advantage
Selection of healthy migrants ('healthy migrant effect')	Under-estimation of mortality (relative to country of origin)	Would reduce migrants' advantage
Under-registration of deaths due to return to home country of severely diseased migrants ('salmon bias')	Under-estimation of mortality	Would reduce migrants' advantage

The dietary habits of three groups of migrants (Italy, Spain and Portugal, North Africa) were compared with those of French nationals. The findings, after adjustment for age, occupation and place of residence, included evidence for: a lower consumption of meat and dairy products; a higher consumption of cereals and legumes; a greater consumption of fruits (except in North African men and Iberian women); and a higher consumption of fish among Iberian migrants of both sexes. Consistently with the typical Mediterranean diet, Portuguese and North African families have been shown to consume significantly more oil, notably olive oil, potatoes and citrus fruits than French families of similar socio-economic level<sup>46</sup>.

Such dietary patterns differ from the eating behaviour of low-income French people who consume less meat and dairy products than people of higher income, but also less fruits<sup>47</sup>. The data confirm the persistence of specific ethnic or cultural dietary behaviours shown in previous studies of families from Portugal<sup>48</sup>, Asia<sup>49</sup> and North Africa<sup>50</sup>. These might be rooted in the historical and geographical origins of the migrants. Food prescriptions or proscriptions, such as the rejection of pork and the preference for lamb in North African families or, conversely, the rejection of lamb and the preference for pork in Asiatic families, play a unifying role in the community<sup>49</sup>. In Moslem populations, alcohol prohibition is less respected than pork prohibition, indicating that adherence to some practices is probably based more on cultural than religious factors<sup>18</sup>.

The progressive loss of traditional patterns of eating, known as the 'nutrition transition', has affected various countries during the last decades<sup>51</sup>, including Mediterranean ones<sup>52</sup>. The transition may be more rapid in migrants, due to the large differences existing between their imported habits and the predominant lifestyles in their new environments. In France, as in other European countries<sup>53</sup>, changes to the original culinary cultures are perceptible and are greater among the second generation of migrants<sup>49,50,54</sup>. Breakfasts and snacks are the most acculturated meals, while dinner remains closer to their cultural dietary background. By asserting their preference for simplified dishes or foods, such as pasta, pizzas, fried potatoes and chips, roast chicken and dairy products, children born and schooled in France are mainly responsible for the transition.

### **Nutritional status**

The nutrient intake of migrants living in France has not been investigated so far. There are some data, however, on their nutritional status, particularly that of children. Most data originate from health centres and are not adjusted for socio-economic factors. Children from North African families are at risk of vitamin D deficiency, even after 10 years of age<sup>55</sup>, notably if they do not come back to their country of origin for holidays<sup>56</sup>. Iron<sup>57,58</sup> and iodine<sup>59</sup> deficiencies are highly prevalent in migrant children, particularly in families from sub-Saharan Africa. Anaemia is also more frequent in migrant women than in metropolitan French women at term in pregnancy<sup>60</sup>. Both women<sup>29</sup> and pre-school girls<sup>61</sup> of North African origin have a high risk of being obese.

### **Interpretation of the morbidity and mortality profiles of migrants in relation to their diet**

#### ***The migrant mortality paradox***

Based mainly on mortality data, the health status of Mediterranean migrants in France unexpectedly turns out to be somewhat better than that of the local-born population. This paradox is not particular to France, but has also been described in the United States for Latinos<sup>7,9</sup>, in Germany for Turks<sup>62</sup> and in Sweden<sup>63</sup>, England<sup>64</sup> and Australia<sup>32,65</sup> for southern Europeans. Conversely, migrants from eastern Europe living in France experience a higher mortality than the local-born population<sup>31</sup>. In England and Wales, standardized mortality ratios for deaths from all causes are close to the national average for migrants born in southern Asia (Indians), higher for Scotland- and Ireland-born migrants, and lower for Caribbean-born migrants<sup>5</sup>. More or less unfavourable lifestyle habits (for instance, high consumption of alcohol by eastern Europeans in France and high use of tobacco by Scottish and Irish immigrants in England) and duration of residence in the host countries, with progressive acculturation of migrant communities, may account for these differences.

Various biases, summarized in Table 4, may limit the validity of mortality data for migrants in France. Illegal immigration (leading to an under-estimation of the total number of migrants) and immigration for medical reasons (leading to an over-estimation of the number of deaths, at

least for some specific causes) may induce an over-estimation of mortality rates in migrants. Correction of these biases would even reinforce the migrants' health advantage in France.

More importantly, two other biases, which potentially result in an underestimation of the mortality of migrants, may be involved in the migrant mortality paradox. The first, known as the 'healthy migrant effect', is a selection bias comparable to the 'healthy worker effect'. Migrants probably come from the healthier sections of the population of their country of origin, as they are submitted to a positive selection, either via self-selection or a selection related to mandatory health controls at entrance. This would be consistent with the finding of a more limited health advantage in women than in men, the latter generally migrating as workers and the former for familial reunification. The second bias, known as the return bias (or 'salmon bias' in Ref. 9), refers to deaths occurring in the country of origin and therefore going unregistered in the host country. Migrants may not officially declare their return to their home country when struck down by a chronic or invalidating disease, or to keep the advantage of an allowance granted in the host country<sup>63</sup>. Recent analyses from other countries suggest that this type of bias, although present, is not likely to change the general pattern of the results<sup>9,63</sup>. In France, the under-registration of deaths of migrants from Morocco has been estimated to be as high as 30%. Even after correction for this under-registration, life expectancy remained higher and mortality rates by cancer and cardiovascular diseases lower in Moroccans than in the French<sup>34</sup>. For Portuguese also, the magnitude of the mortality difference was too large (−60%) to be attributable entirely to the under-registration bias<sup>31</sup>.

Evidence of health benefits linked to migration are particularly noticeable for those diseases known as diseases of affluence, which are associated with physical inactivity and with occidental diets. In addition, among migrants living in France, only those originating from Mediterranean countries shared these advantages, which strongly suggests that environmental factors are involved in the paradox. We will now examine the possibility that healthy dietary patterns might explain the relatively good health of Mediterranean migrants in France. Men, women and children will be considered separately, as well as migrants not living in private households.

### *Men*

A very high risk of mortality by thyroid diseases was observed in migrants from Algeria (and eastern Europe)<sup>31</sup>, which could be related to low iodine intake during the years they lived in their country of origin<sup>66</sup>. Apart from that, an under-mortality was observed in Mediterranean men for nearly all causes of death that may be related to nutrition, such as endocrine, metabolic and cardiovascular diseases, as well as digestive cancers. Migrants

originating from Italy<sup>32</sup> and North Africa<sup>33</sup> presented a lower mortality from colorectal cancers, and Moroccans<sup>34</sup> and Portuguese<sup>31</sup> were well protected from digestive and cardiovascular diseases. Consistent with the lower consumption of alcohol by migrants from North Africa<sup>21</sup>, their mortality from hepatic cirrhosis was also low<sup>31</sup>. In addition, despite a tobacco intake at least as high as that of French men of the same socio-economic level<sup>29</sup>, migrants from North African countries had a lower mortality from smoking-related cancers<sup>31,34</sup>. Altogether, these data suggest that, in addition to the healthy migrant effect, environmental factors and lifestyles, such as the traditional eating patterns which are maintained by men originating from southern Europe and North Africa may protect them from chronic diseases.

### *Women*

North African women do not present the same health advantage as men<sup>29</sup>. Various factors may explain this difference. First, most of the migrant women did not arrive in France as workers, and therefore they were not submitted to the positive selection linked to the working immigration. Second, North African women are more often non-working than are local-born women of similar socio-economic status<sup>46</sup>, and are therefore less likely than men to have regular medical check ups. Third, North African women are more frequently obese than French women of the same age and social background<sup>29</sup>.

In most developed societies including France, ethnic differences in the prevalence of obesity<sup>67,68</sup> and an inverse relationship between obesity and socio-economic status<sup>69–71</sup> are particularly noticeable in women, but not in men. On one hand, women of all races have a higher prevalence of obesity than men because a number of physiological processes contribute to an increased storage of fat in females<sup>72</sup>. On the other hand, it appears that several ethnic groups in industrialized countries are more prone to obesity: this may be due to a genetic predisposition which only becomes apparent once the individuals are suddenly exposed to a more affluent lifestyle<sup>72,73</sup>. Consequently, the risk is particularly high in women from ethnic minorities living in industrialized countries<sup>72,74</sup>.

The increased risk of morbidity<sup>29</sup> and mortality<sup>34</sup> by endocrine diseases, particularly diabetes mellitus, observed in North African women living in France is consistent with their increased susceptibility to obesity<sup>72</sup> and to a less stringent medical follow-up of diabetes in migrants<sup>75</sup>. There was less evidence, however, of a parallel increase in the risk of cardiovascular diseases in these women<sup>29,34</sup>. In fact, there are conflicting reports on whether obesity confers similar cardiovascular and coronary heart disease risks in different ethnic groups<sup>76,77</sup>. Ethnic differences in the relationship between body mass index and percent body fat<sup>78</sup> or central distribution of adipose tissue<sup>79</sup>, might explain these controversies.

Although adjustment for occupational status of the family head was made<sup>29</sup>, the high prevalence of obesity found in North African women in France might be related to other socio-economic factors known to be associated with obesity, such as urban (vs. rural) place of residence, and lower levels of education and/or income<sup>72</sup>. Their non-working status<sup>46</sup>, associated with the tradition of women remaining within the home in Muslim cultures, might limit their level of physical activity and induce obesity. In addition, the lack of difference in energy intake between men and women in North Africa<sup>45</sup> suggests that North African women are less subject than European women to negative social pressure regarding ideal weight. In fact, in many traditional cultures, increased weight and girth are viewed as a sign of health and prosperity<sup>72</sup>. Accordingly, it has been observed in the United Kingdom<sup>80</sup> and in the USA<sup>81</sup> that women from ethnic minorities are less likely to rate themselves as overweight and to diet. Despite these high rates of obesity, there was a global and significant diminution (−16%) in disease prevalence in North African compared with local-born women in France<sup>29</sup>. Their traditional patterns of eating<sup>21</sup> and the low proportion of smokers among them<sup>29</sup> might explain such a global protection.

### Children

North American studies have shown that the risks of both obesity<sup>82</sup> and nutrient deficiencies, especially iron deficiency<sup>83</sup>, are higher in pre-school children at the lower end of the socio-economic spectrum. Therefore, it can be argued that the nutritional risks observed in migrant children living in France, namely nutrient deficiencies<sup>55–58</sup> and obesity<sup>61</sup>, are only related to the low social status of their parents. However, other factors, more specific to their position as migrants also need to be looked at. Higher risks for vitamin D deficiency in migrant children might be related to insufficient sun exposure linked to cultural habits and a low rate of endogenous synthesis when the skin is highly pigmented. Iron deficiency might be partly explained by intestinal dysfunction secondary to intestinal infections, alactasia, gluten intolerance, or lead poisoning, possibly more frequent, or more frequently undiagnosed, in migrant children. In addition, the introduction of weaning foods is delayed in migrant children<sup>84,85</sup>, and weaning diets may have a high phytate-to-iron molar ratio, possibly inducing iron deficiency.

More importantly, cultural and language barriers might limit access to dietary information. Because they do not strictly follow the mandatory preventive care of their children<sup>22</sup>, migrant families would have less access to preventive dietary advice for children, such as fluoride supplementation and the use of iron and vitamin D fortified milk formula. Lastly, the accelerated dietary transition observed in this young population might be involved in the high frequency of obesity observed in North African children<sup>61</sup>.

### *Institutionalized and lonely migrants*

The proportion of people not living in private households (i.e. living in collective shelters, institutions, mobile housing, etc.) has been estimated to be 5% among migrant populations, which is higher than the 2% found in the general population<sup>86</sup>. However, nothing is known about the dietary habits or nutritional status of institutionalized and/or lonely migrants. Some physicians have reported difficulties in feeding hospital patients from Africa because of cultural barriers<sup>87</sup>. The difficult situation of elderly male migrants living alone and disconnected from their home country is beginning to receive attention from demographers and sociologists<sup>13,18</sup>. These migrants often live in extremely precarious conditions and in great social isolation, which might lead to malnutrition.

### Conclusion

Given the socio-economic profile of migrants in France and their limited utilization of preventive health services, they are expected to be at higher risk of diseases than the local-born population. Paradoxically, Mediterranean migrants stand out as having better health than the local born, suggesting that very efficient protective factors are operating in this population. The present review has shown that these migrants have dietary patterns quite close to some of the recommendations recently set up in the National Programme on Nutrition and Health coordinated by the French 'Haut Comité de la Santé Publique', namely a high consumption of fruits and starchy products and low consumption of alcohol<sup>88</sup>.

The Mediterranean pattern of eating might protect adults from chronic diseases. However, it is likely that the second generation of migrants will lose the advantages provided by their cultural background as they rapidly adopt a more occidental diet. A better knowledge of food and nutrient intakes of North Africans living in France, in relation to their health status, is clearly needed as it may provide clues for designing nutritional education campaigns, particularly those aimed at low-income people. Both population-based nutritional surveys and in-depth surveys of the food habits of migrant communities would be very useful in this respect.

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