



# Migrating Populations and Health: Risk Factors for Cardiovascular Disease and Metabolic Syndrome

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## Abstract

**Purpose of Review** To summarize results of recent studies of migrants in Europe and North America and ongoing efforts to adapt strategies to provide them with inclusive sensitive health care.

**Recent Findings** Major predisposing factors for developing hypertension, obesity, diabetes, and the metabolic syndrome in migrating populations and refugees were identified. Susceptibility to the metabolic syndrome is predominantly due to environmental factors and psychological stress. Acculturation also contributes to the emergence of cardiovascular (CV) risk factors in first-generation adult immigrants. Increased risk for later development of hypertension and dyslipidemia has also been detected in adolescent immigrants. Targets for public health efforts were based on data that show important differences in CV risk factors and prevalence of the metabolic syndrome among ethnic immigrant groups. Studies in young adults focused on lifestyle and dietary behaviors and perceptions about weight and body image, while the focus for older adults was end-of-life issues.

**Summary** Two important themes have emerged: barriers to health care, with a focus on cultural and language barriers, and violence and its impact on immigrants' mental health.

**Keywords** Immigration · Refugees · Cardiovascular disease · Diabetes · Obesity · Health care · Psychosocial stress

## Introduction

This is an update of the comprehensive reviews of the effects of migration on hypertension and cardiac risk factors published in 2014 and 2018 [1, 2]. Here we focus on challenges that affect the health and well-being of immigrants and refugees in different countries (Fig. 1). Acculturation, the process by which an individual adopts, acquires, and adjusts to a new cultural environment, is usually defined in two

dimensions: degree of contact and participation in the larger “new” society and the maintenance of the “old” heritage, culture, and identity [3••, 4]. Four acculturation strategies have been described: (1) “assimilation strategy,” seeking daily interaction with the host culture, (2) “separation strategy,” maintaining cultural identity and avoiding interaction with the host culture, (3) “integration strategy,” combining features of both assimilation and separation strategies, and (4) “marginalization strategy,” reflecting loss of the ability and interest to connect with other cultures. These strategies have been adopted, individually or in combination, by immigrant groups. Studies suggest that increased participation, integration, and assimilation in the host culture is associated with better health and disease management compared with adoption of marginalization and separation strategies [1, 2, 3••, 4]. Those who successfully apply dual modes of social behavior and develop attachment to both the host culture and the culture of origin are expected to be better self-managers. Acculturation results in changes in lifestyle, including the level and type of physical activity, as well as dietary changes such as consuming higher levels of sodium and fats and more processed foods, common in developed

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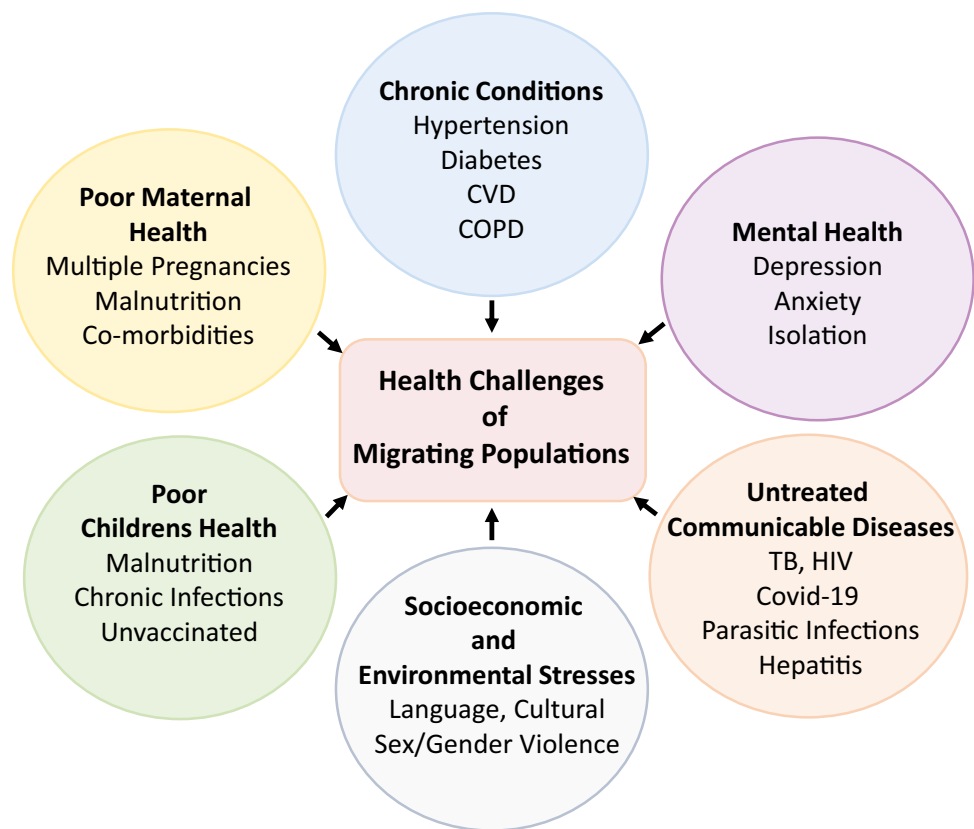
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**Fig. 1** Schematic demonstrating multiple modifiable and non-modifiable factors that contribute to health challenges of migrating populations. CVD, cardiovascular disease; COPD, chronic obstructive pulmonary disease



countries. These lifestyle changes are perceived as major predisposing factors for developing hypertension, obesity, diabetes, and the metabolic syndrome [1, 2, 3••, 4, 5].

Migration is associated with increased stress and risk of cardiovascular disease (CVD) [6–12]. Blood pressure (BP) elevation occurs early with migration, and may be a useful strategy for measuring the impact of acculturation [1]. Some studies indicate that immigrants' eating patterns serve as an index of their degree of acculturation and associated health risks, but others consider the stress associated with cultural change, reflected in higher BP, to have a greater effect than changes in diet or physical activity [2]. Other studies suggest that effects of acculturation on BP are common and that the magnitude of the effects is not region-specific, but similar worldwide. However, there are differences between immigrants' cultures, countries of origin, and host countries that modify the effects of acculturation on BP [13, 14].

## Definition of Migrating Populations

The studies included in this review refer to three populations: immigrants, migrants, and refugees. An immigrant is a person who comes to a country to take up permanent residence. A migrant is any individual who moves across international borders away from their country of origin,

regardless of legal status or cause [3••, 4, 15]. A refugee is a person who, resulting from a well-founded fear of persecution for reasons of race, religion, nationality, and/or membership of a particular social group or political opinion, is outside the country of his/her nationality and is either unable or too afraid to seek protection of the host country. Each of these migrating populations places a different burden on the host country to provide health care, humanitarian aid, and social care. The distinction between these populations is often the result of the host country's assessment based on their political stance in granting temporary or permanent status. Refugees are not generally screened for chronic diseases and may not be up to date on immunizations against vaccine-preventable diseases [16, 17]. Determining the health care needs of specific groups should lead to the establishment of evidence-based guidelines for providing screening and health care services to immigrant populations. This will benefit both the migrant and the host country [1, 2].

The majority of investigations evaluating cardiovascular and metabolic risks in migrants are population-based, cross-sectional studies of trends and rates of hypertension, hypercholesterolemia, diabetes, abdominal obesity, and high body mass index (BMI) [14, 18]. These studies make comparisons between the migrating populations and native populations in the host country, including comparing newly arrived migrants and refugees with settled, urbanized migrant

populations, populations in the migrants' country of origin, and age-matched non-immigrants in the host country [18].

## Health Issues and Refugees in Europe

There has been a continuous flow of immigrants from the global south to northwestern countries, including Germany, the Netherlands, Sweden, and Italy [19, 20]. Immigrants are typically motivated to leave their native countries due to the inability to achieve economic and social development. They flee from countries where dictatorial regimes have impoverished the population and sown hatred and famine during years of wars between states, civil wars, and tribal clashes. In 2015, over one million displaced people entered Europe. Numerous studies have found that a major challenge facing health care systems is providing inclusive and culturally sensitive health care to refugee populations. Collaborative efforts should focus on forming multidisciplinary teams coordinated with local health care systems and organizations to meet the needs of the refugees. Upon arrival, refugees should receive an immediate health assessment. Further interventions then need to be coordinated. Health care providers and services need to be informed about the special needs of the refugees for their mental and physical care, and transportation must be arranged to ensure the efficient delivery of that care [21, 22]. Many health problems, including maternal and reproductive issues, high risk of sexual abuse, and pregnancy, are specific for female refugees [23]. Access to preventative health screening as well as prenatal and obstetric care upon arrival is crucial in order to identify problems stemming from poor nutrition, exposure to violence, and drug and alcohol abuse [19].

The duration of migration or refugee status can impact health and should be taken into consideration, as most common health problems of refugees may be related to the situation in their home countries and the journey to the host countries. The increasing burden of hosting and caring for large immigrant populations requires cooperation and coordination by the host countries. The long-term solution for these refugees will involve a coordinated effort to reduce the socioeconomic and health inequalities that drive increasing populations worldwide to become refugees. In the short term, there is a need to increase preparedness for the management of both communicable and non-communicable diseases with interventions based on evidence collected on global disease and medical needs during migration. Early intervention in refugee camps, as well as longer term intervention strategies and collaboration between physicians, health care workers, and public health authorities, is important for the integration of these populations into the host countries [19, 20, 24].

A systematic review of 26 articles on refugees' experiences with health care in European host countries showed that refugees suffer from worse mental and physical health and are at higher risk for morbidity and mortality compared to the native populations of the host countries [25]. Factors that contribute to increased morbidity due to chronic diseases in migrants include (i) poor communication between migrants and health care providers in the host country, (ii) violence and mental health, (iii) unvaccinated status, (iv) poor maternal health, and (v) impact of western cultures on adolescents.

## Cultural and Language Barriers to Health Care

Poor communication due to linguistic and cultural differences often leads to refugees experiencing discrimination due to low proficiency in the language of the host country and because of their race or accent [26, 27]. Culturally appropriate health care is needed and includes improved communication between the migrants and the health care providers. Providing support to refugees through good communications allows them to have a positive experience with health care. Furthermore, refugees need written and oral information about the host country's health care system and their rights to its utilization.

## Violence and Mental Health

A study of newly arrived migrants and refugees in Europe showed that mental illness and social difficulties significantly impacted morbidity rates [24]. Asylum seekers in Belgium and the Netherlands suffer primarily from psychological illness [28]. It is impossible to discuss refugees, migrants, and immigration without mention of violence: both the violence that led to the movement from the home country and the violence faced in the host country [29]. Refugees, asylum seekers, and undocumented migrants, even those with a higher education and past professional experience, often suffer a decline in socioeconomic position and low social status linked to their immigration status [30]. This restricts them from working, participating freely in civil society, and investing in the host country by turning their human capital potential into economic and social capital. Low social status predicts ill health, and low income is associated with the progression of ill health. Women, young people, and refugees are particularly vulnerable to sexual and gender-based violence worldwide, putting these populations at great risk of high morbidity [31, 32].

## Vaccine-Preventable Diseases

Infectious diseases that are preventable by vaccines play a significant role in the overall burden of disease. A systematic

review of vaccine-preventable diseases in Europe (i.e., hepatitis B, measles, rubella, mumps, tetanus, poliomyelitis, pertussis, diphtheria, meningitis, and varicella) found that migrants and refugees have lower immunization rates compared to European-born individuals [33]. The factors that determine the vulnerability of immigrants to infectious diseases include the country of origin, the period of time the migrants traveled until they first arrived, whether they settled in refugee camps or other reception sites, and further resettlement. Information on immunization status of migrants is often lacking, and the lack of coordination among public health authorities of neighboring countries may result in either duplicate or absent vaccine administration. Migrants often refuse registration with medical authorities for fear of legal consequences. In addition, migrants often continue to move about in their host country, which is problematic since many vaccines require multiple doses at regular intervals. Finally, prevention of disease by immunization suffers the same barriers as prevention or treatment of any other disease: lack of the patient's understanding of treatment due to challenges in communication between health care providers and services and the refugees, migrants, and immigrants in need of treatment. Elderly migrants and their children are particularly susceptible to infectious diseases [34].

### Poor Maternal Health

Pregnant migrants and refugees are at increased risk of cardiovascular and metabolic diseases compared to native-born women [35]. These inequities are compounded by the barriers to care that many migrant and refugee women experience, such as cultural or linguistic challenges. A recent systemic review suggested various strategies to improve maternal and postpartum care, including culturally responsive, woman-centered care, ensuring continuity of care, providing effective communications, and psychosocial and practical support to navigate health care systems in host countries. However, it is not clear which practices provide the greatest benefit [36].

### Effect of Western Culture on Metabolic Health of Adolescent Immigrants

Studies of young children and adolescents of immigrant origin often focus on behaviors (i.e., lifestyle, physical activity, and dietary habits) and perceptions about weight and body image since these children are particularly at risk of developing overweight and obesity, important risk factors for CVD and the metabolic syndrome [37•]. A review of longitudinal and cross-sectional studies in Europe found that the prevalence of childhood and adolescent overweight and obesity in ethnic groups from North Africa was higher compared with the European population, especially among girls. This trend

was also present in urban areas in North African countries. Important contributing factors included westernization of eating habits, lack of physical activity, and body image perception. Factors linked to acculturation in the host society and factors originating in the country of origin play a role in determining childhood overweight and obesity among North African immigrants in Europe [38].

### Trends in Germany

During the past decade, with large numbers of refugees fleeing war-torn home countries, the German health care system has had to accommodate an increasing number of immigrants (20% of the population). Research of immigrant origin populations of all ages, from young children and adolescents to elderly and aged, has been undertaken [39]. While studies in younger populations focused on lifestyle, dietary behaviors, and perceptions about weight and body image, the focus shifted to end of life issues in the older populations.

### Hospice/Palliative Care Among Immigrants in Germany

An epidemiological study examined usage of hospice and palliative care (HPC) among 51- to 90-year-old immigrants in Berlin, Germany, in the 1960s and 1970s [40]. Although many of the immigrants needed hospice and palliative care, a significantly lower proportion of them used these facilities compared to the general population. There were also differences in usage among ethnic groups. Turkish immigrants accounted for 24% of the immigrant population in Berlin, but only 14% used HPC facilities. Russian and Polish immigrants comprised 5% and 9% of this population and accounted for 11% and 24% of HPC usage, respectively. Possible reasons for these differences include lack of awareness of these populations by palliative care providers and insufficient knowledge on the part of immigrants regarding the type of care that was available to them.

### Vitamin D Deficiency in Turkish Women in Germany vs. Native German Women

Compared to native German women, Turkish women in Germany had a significantly higher prevalence of vitamin D insufficiency (74 percent vs 33 percent) and deficiency (44 percent vs 11 percent) [41]. Vitamin D insufficiency was most prevalent in Turkish women who wore traditional garments, perhaps limiting their exposure to sunlight. Providing vitamin D supplements and access to facilities that permit exposure to sunlight has been recommended as part of an overall preventative strategy to reduce the burden of vitamin D insufficiency in this immigrant group [42].

## Transnational Travel Among Immigrant Groups in Germany

A comparison of between-group differences and individual level determinants of transnational travel (i.e., frequency of return trips to their country of origin) was carried out among immigrant women in Germany [43]. Participants were of Russian, Jewish, or Turkish origin. There was substantial transnational travel by all groups, with the highest levels reported among Turkish immigrants. A major determinant of the frequency of transnational travel in all three ethnicities was the network size in their home country. Co-ethnic identifying was a positive determinant only among the Turkish women. Importantly, as opposed to their emotional state when leaving Germany, all of the women were happy and calm upon return from their homeland.

## Metabolic Syndrome Among Non-immigrant Adolescents in Germany and Iran

There were major differences in the prevalence of the metabolic syndrome and its three main components, defined according to Pediatric International Diabetes Federation (IDF) criteria, between adolescents from Germany and Iran [44]. The metabolic syndrome was four times more prevalent in Iranian than in German adolescents. These ethnic disparities were revealed in two separate studies. The German adolescents were part of the German Prevention Education Program (PEP) Family Heart Study, a prospective controlled study of the efficacy of family-oriented life style modification in the reduction of CV risk and disease [45]. The Iranian adolescents were part of the Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable Disease (CASPIAN) Study, a large national, cross-sectional study of 14,440 Iranian children and adolescents [46]. Schwandt et al. confirmed the ethnic predisposition of non-Europeans, especially Asians, to central body fat deposition and the metabolic syndrome [44]. They agreed with the recommendation of the American Heart Association to consider the use of race and ethnicity-specific criteria in evaluation for the metabolic syndrome [47]. An additional analysis of PEP Family Heart Study data on German adolescents aged 12 to 18 years concluded that cardiovascular disease (CVD) risk factors such as dyslipidemia and elevated BP can be detected in adolescents by anthropometric screening. They found that risk factor clustering was three to four times higher among adolescents with abdominal obesity than in adolescents without abdominal obesity. Significant associations of

abdominal obesity with hypertriglyceridemia (OR: 4.9), elevated LDL-C (OR: 2.0), low HDL-C (OR: 1.6), fasting blood glucose (OR: 1.3), and a 2.5-fold higher risk of hypertension were also found [48].

The increasing prevalence of the metabolic syndrome in children and adolescents in recent decades has been attributed to changes in adolescent lifestyle (i.e., decrease in physical activity, changes in eating habits, and smoking) and a higher prevalence of obesity [49]. In Iran, additional factors, including epidemiologic transition state and the double burden of nutritional disorders, have led the authors of the CASPIAN study to review the prevalence of metabolic syndrome in Iranian children and adolescents. They found prevalence rates of metabolic syndrome of 1 to 22 percent, with higher rates in older children, likely as a result of changes occurring around puberty, i.e., increased insulin resistance, increased body fat, increased BP, and decreased insulin sensitivity [50••]. These findings provide useful information for health policy makers for the prevention of the metabolic syndrome and resultant CVD in the population. An additional analysis of the CASPIAN-V cross-sectional nationwide study collected data from 14,440 students, 7 to 18 years of age, using validated questionnaires to gauge the students' weight perception and psychological distress. Weight misperception, a discordance between an individual's actual weight and perceived weight status, which may indirectly reflect body dissatisfaction, was highly prevalent (59%) among Iranian children and adolescents, associated with their dietary patterns and physical activity behaviors [51].

## Turkish and German Adolescents in Germany

Among adolescents, studies have focused on differences in eating behaviors between migrants and natives and between ethnic groups in their home country vs. in their host country. Two studies examined the differences in eating behavior between adolescents living in their home countries (Turkey and Germany) and Turkish migrant adolescents living in Germany [52]. The longitudinal study included adolescent Turkish migrants and adolescent Germans. The cross-sectional study included adolescent Turkish migrants and adolescent Turks living in Turkey. Both studies assessed eating behaviors (eating either unhealthy or healthy foods) using a prototype-willingness model, and data were collected with a questionnaire. Regulation of eating behavior among adolescent Turkish migrants was intentional, as compared to both native German and Turkish adolescents, whose eating behavior was both impulsive and intentional.



## Trends in Italy

### Overweight and Obesity Among Adult Immigrants to Italy from Sub-Saharan Africa, Central-Western Asia, and the Americas

In 2012, there were nearly three million foreign citizens in Italy, according to the Italian National Institute of Statistics [53]. Currently, there are almost 5 million non-Italian citizens in Italy, representing about 8 percent of the country's population [54]. This increase places a greater burden on Italy's health care system. In 2011–2012, a cross-sectional study of a subsample of 15,195 foreigners aged 18 to 64 years evaluated sociodemographic and behavioral factors associated with overweight and obesity, defined as BMI > 25 kg/m<sup>2</sup> and ≥ 30 kg/m<sup>2</sup>, respectively. Among foreigners in Italy, 31 percent were overweight (40 percent of men and 23 percent of women) and 7.5 percent were obese. The probability of overweight and obesity was found to increase with age and with length of stay in Italy and to be higher among the unemployed and less educated immigrants. Compared to European born persons, the probability of overweight and obesity was lower among immigrants from Sub-Saharan Africa and Central-Western Asia, and higher among immigrants from the Americas [54].

### Weight and Nutritional Status in Moroccan Women in Rural Morocco and Immigrants to Urban Italy

A study evaluated the nutritional status and physical structure of immigrant Moroccan women in Italy as compared to their nonimmigrant counterparts living a traditional, rural lifestyle in Morocco in 2012 [55]. Changes in dietary habits and lifestyle and in cultural, social, and economic status resulting from their migration were assessed. The immigrant group included Moroccan immigrant women (20–59 years), mostly leading an urban lifestyle; the non-immigrant Moroccan group included women (29–65 years) living a rural lifestyle in the province of El Jadida. The immigrant women had major increases in weight, as assessed by both anthropometric and impedentiometric parameters, with fat mass substantially greater than the women remaining in Morocco. Non-immigrant women had an average weight of 63 kg; the immigrant women, 70 kg. The BMI of immigrant Moroccan women in Italy was 34 percent; the BMI for nonimmigrant women living in Morocco was 29 percent. While immigrant Moroccan women tended to adopt a diet that included both traditional food and food typical of their host country (pasta), native women in Morocco had a diet based on non-processed traditional food and local products.

## Violence Among Immigrants and Refugees in Italy

In a cross-sectional study, interviews were conducted with immigrants and refugees, average age 35 years (15 to 74 years) [56]. A total of 46 percent had experienced some form of violence since having arrived in Italy, with 40 percent experiencing violence in the last 12 months and 21 percent being victims of more than one form of violence. Among women, 56 percent experienced at least one form of violence and 28 percent experienced multiple victimizations, most of these occurring during the 12 months prior to the survey. Additionally, 62 percent experienced at least one episode of violence with racial discrimination; 69 percent did not know their attacker; 21 percent were attacked by their employer; and 6.5 percent were attacked by their partners. Furthermore, 69 percent of these attacks took place in the street. Over half of those interviewed experienced stress and anxiety disorders (post-traumatic stress disorder), and one-third experienced chronic anxiety. In 75 percent of these violent attacks, the victim did not report the incident to anyone.

## Belgium

### Adolescents' Health Behavior Regarding Diet and Effect on Overweight, According to Migration Status

The cross-national Health Behavior in School-Aged Children survey was first conducted in 2014 in Belgium among 19,172 adolescents 10–19 years old, 70 percent native Belgian, 22 percent second-generation immigrants, and 8 percent first-generation immigrants [57]. Food consumption, estimated using a self-administrated food frequency questionnaire, showed that 17.2 percent of adolescents ate fruits and 18.8 percent ate vegetables > once a day, while 20.2 percent ate fish ≥ two days a week and 80 percent ate dairy products > once a day. Nearly half of the adolescents (43.7 percent) drank sugar-sweetened beverages ≥ once a day, and 12.2 percent ate chips and fries ≥ once a day. First- and second-generation immigrant adolescents consumed healthy foods (fruits, vegetables, and fish) but not dairy products, and also unhealthy foods (chips, fries, and sugar-sweetened beverages) significantly more often than did natives. Girls ate fruits and vegetables more often, possibly due to taste preferences, health beliefs, and concern about weight. A study based on the same cross-national survey of adolescents in Brussels found that young immigrants were more likely to be overweight than young natives or first-generation immigrants (OR 1.76). This was also true for second-generation immigrants with both parents born abroad vs. natives (OR 2.06) and for second-generation immigrants with one parent born abroad vs. natives (OR 1.69). This

effect was partially explained by sociodemographic status and health-related behaviors [58•].

## The Netherlands

### Disease Disparity Among Ethnic Populations in the Netherlands: the HELIUS Study

The Dutch conducted a study to examine CVD, mental health and infectious diseases across various ethnic groups living in Amsterdam in order to uncover the causes of an unequal burden of disease. The Healthy Life in an Urban Setting (HELIUS) is a prospective cohort study that collected data from 2011 to 2015 on health and health care utilization among adults (18 to 70 years) of six similar sized ethnic groups: Dutch, African Surinamese, South Asian Surinamese, Ghanaian, Turkish, and Moroccan, living in Amsterdam [59]. Data from participants ( $n = 24,789$ ) in HELIUS were collected from questionnaires, physical exams, and blood tests. Initial results showed large disparities among ethnic groups in the prevalence of diabetes and chronic kidney disease, depressive symptoms, and early markers of disease, including arterial wave reflection. Differences in traditional risk factors, obesity, and socioeconomic status were not sufficient to fully explain these disparities. These findings are key for targeting health care and disease prevention.

Data based on 12,974 participants in the HELIUS study found large differences in the prevalence of hypertension: lowest in Moroccan men and women (24 percent and 16 percent) and highest in Ghanaian men and women (52 percent and 62 percent) [60]. With the exception of Moroccan women, age-adjusted prevalence rates of hypertension were higher in all ethnic minority groups compared to those of Dutch origin. Furthermore, BP control rates in ethnic minority groups, particularly among African Surinamese and South Asian Surinamese, were poor despite high treatment levels.

### Older Immigrants from Turkey, Morocco, Surinam, and the Netherlands Antilles

The population of older immigrants in the Netherlands is growing. A cross-sectional study based on data collected from the 2003 survey *Social Position, Health and Well-being of Elderly Immigrants* found major ethnic disparities in health and health care utilization among four first-generation immigrant groups, including participants from Turkey, Morocco, Surinam, and the Netherlands Antilles compared to Dutch natives, aged 55 years and older [61]. Older immigrants had greater use of general medical services and lower use of physical therapy and home care than Dutch natives of similar age.

Disparities in health care utilization were also documented in studies of terminally ill older Turkish and Moroccan immigrants in the Netherlands [62].

### Acculturation Strategies in Older Turkish Immigrants in the Netherlands

A cross-sectional study among community-dwelling older [average 73, range 66 to 95 years] Turkish immigrants residing in the Netherlands assessed the relationship between acculturation strategies (attachment to the Dutch host country) and broader self-management abilities [63]. The majority (80 percent) had low education levels. Women, single individuals, and those with multimorbidity used the separation strategy more often and experienced lower levels of attachment to the Dutch culture. Older Turkish women also reported poorer self-management abilities, possibly because they had to rely more on relatives and the government. In multivariate analyses, multimorbidity negatively affected the self-management abilities of older Turkish people living in the Netherlands.

## Trends in Sweden

Undocumented migrants in Europe are typically in a vulnerable and marginalized situation, as most have been rejected for asylum and protection from war and persecution. A cross-sectional study of undocumented adult migrants was conducted in the three largest cities in Sweden [64•]. Migrants were screened for psychiatric symptoms (Beck's Depression Inventory II, Beck's Anxiety Inventory, and the PTSD Checklist (PCL) for civilians). Of these, 68 percent suffered from moderate or severe anxiety, 71 percent suffered from moderate or severe depression, and 58 percent scored significantly higher for PTSD. The majority expressed fear of returning to their country of origin for political reasons. While 45 percent of the women and 31 percent of the men had a university/college degree, more than half reported that they were often hungry; 57 percent suffered from food insecurity and 56 percent reported long-standing illness. There was a constant fear of disclosure, potentially leading to deportation, and these stressors had detrimental effects on mental health.

### Depression in Second-Generation Immigrants in Sweden

A study interviewed young adult Swedish citizens born in 1990 to assess symptoms of depression [65]. Participants were divided into three groups according to the country of origin of their parents. The groups with either Yugoslav or native Swedish parents had similar levels of depressive

symptoms, while the group with Iranian parentage had a significantly higher prevalence of depressive symptoms. Thus, the increased tendency for depressive symptoms may be the result of concerns about maintaining social status and fear of the expected social ramifications of having an occupation based on manual labor, leading to ostracism and/or marginalization. The variation of results in depression was also explained by perceived ethnic identity.

### **Mental Health and Risk of Psychotic Disorders in Second Generation Iraqis in Sweden**

Studies have demonstrated that some non-Western immigrant groups in Europe have increased risk of psychosis compared to native-born people. A study of 1,442,931 individuals 15 to 60 years of age without prevalent psychopathology who were followed from 2005 to 2010 showed that the cumulative incidence of psychiatric disorders was greater in Iraqi enclaves than in predominantly Swedish neighborhoods [66]. Second-generation Iraqis had higher risk of psychotic disorders than first-generation immigrants.

### **Quality of Life Among Iraqi Women Immigrants in Sweden**

Poor self-rated health is commonly used to estimate quality of life and to predict mortality, yet is seldom studied in immigrant populations. A cross-sectional population-based study conducted from 2010 to 2012 among Iraqi immigrants and native Swedes found a significant difference in poor self-rated health between those born in Iraq (44 percent) and native Swedes (22 percent) [67]. The highest prevalence (56 percent) of poor self-rated health occurred among Iraqi women, and this excess risk could not be fully attributed to known risk factors such as socioeconomic status, lifestyle, or comorbidity.

### **Vitamin D Deficiency in Non-Western Immigrants and Refugees**

Vitamin D deficiency has been implicated in various chronic diseases, including CVD and metabolic disorders [68, 69]. Severe vitamin D deficiency and rickets are common in non-western immigrants and refugees [70, 71]. Vitamin D deficiency is often due to low sunshine exposure in host countries, while pigmented skin and skin-covering clothing style due to cultural or religious habits further decrease the potential for cutaneous vitamin D production. This leads to a fivefold higher risk of vitamin D deficiency in immigrants, which is exacerbated by low calcium intake. A meta-analysis found an increased risk of vitamin D deficiency with longer residence in the host country [72]. Vitamin D status was found to be lower in Turkish, Moroccan, Indian,

and sub-Sahara African populations in Europe than in their countries of origin [73]. Consequences of severe vitamin D deficiency in immigrants include musculoskeletal pain and fatigue. In adolescents and adults, the presenting symptoms of clinical vitamin D deficiency and osteomalacia are muscle weakness and bone pain. The myopathy is often localized to the shoulder and pelvic girdle, causing difficulties in standing up from a sitting position, walking, and stair climbing. In case of severe osteomalacia, bone mineral density (BMD) can be very low, suggestive of severe osteoporosis. Healing of nutritional osteomalacia can be achieved with vitamin D (800–1200 IU) supplementation, while higher doses (2000–3000 IU/d) can result in accelerated healing of osteomalacia [71]. Prevention of vitamin D deficiency is feasible with administration of vitamin D3, 400–800 IU/d depending on age. Children < 1 year require 400 IU/d; older children and adults require 600 IU/d, while older persons (> 70 year) require 800 IU/d. Vitamin D supplementation should begin with suspicion of vitamin D deficiency and blood should be tested to confirm the diagnosis.

### **Vitamin D Status in Immigrants from Africa and the Middle East**

A cross-sectional population-based study of the prevalence and determinants of vitamin D deficiency included 1306 immigrants from Africa and the Middle East living in Umeå, Sweden [74, 75]. Twelve percent of these had vitamin D deficiency (25(OH)D < 25 nmol/L), which was twice as common in African immigrants as in the Middle Eastern group. This study found an association between vitamin D deficiency and reduced muscle strength. A diet including a high intake of fatty fish (> twice a week) helped to prevent vitamin D deficiency, while absence of travel abroad from Sweden and use of long-sleeved clothing in summer were detrimental to vitamin D status. An open, partially randomized controlled trial concluded that oral cholecalciferol supplementation was safe and effective in increasing 25(OH)D in healthy individuals with initial 25(OH)D deficiency [76].

## **North America**

### **USA**

#### **Elevated COVID-19 Risks Among Immigrants**

During the COVID-19 pandemic of the last two years, already-marginalized communities, including immigrants and racial minorities, suffered disproportionately from the impact of the virus. Though the US Centers for Disease Control and Prevention's coronavirus case report form does



not track nativity and immigration status, information from other surveys found that non-citizens were more likely than citizens to face economic and other barriers to physical distancing as well as other factors such as food insecurity that has left them more vulnerable to the effects of the pandemic [77–79].

### **Hypertension in Mexican Immigrants and Mexican-Americans**

Many health care institutions have increased their efforts to provide services designed to examine experiences of Mexican immigrants and those of Mexican origin living with hypertension in the USA. Rates of hypertension are similar in people of Mexican origin and in non-Hispanic whites, but rates of BP control are lower in the Mexican immigrants and Mexican Americans [80]. Major differences also exist between Mexican immigrants and Mexican-Americans in the experience of living with hypertension. Misconceptions regarding the causes and treatment of hypertension and the prohibitive cost of antihypertensive medications were substantially greater issues for Mexican immigrants than Mexican-Americans. The authors concluded that, in order to improve BP control in Mexican immigrants, information about the disorder needs to be available in both English and Spanish.

### **Alcohol and Drug Use Among Young Immigrants from Mexico in the USA**

Persons who immigrated to the USA from Mexico at a young age frequently have had migration-related experiences that adversely affected their health later in life. Those who migrated before the age of 14 years have been found to have more alcohol- and drug-related problems than those who migrated at a later age. Migration before the age of 20 years was also associated with a higher prevalence of CVD mortality than migration later in life, even after adjusting for age, sex, education, income, and baseline CV health. Non-CVD deaths did not differ according to age at migration [81].

### **Violence on the USA-Mexico Border**

A study of the effects of enforced immigration policy and militarization in the Arizona border region on permanent residents of Mexican descent in 2006–2008 examined their experience with everyday violence and the normalization of that violence by the immigration enforcement policy [82]. The study documented the frequency and nature of immigration-related profiling and mistreatment, as well as resistance to institutionalized victimization. Data were taken from a random household sample of US citizens and permanent Mexican residents who reported that they were

living and working in a militarized environment in which immigration-related profiling and mistreatment were common practice among law enforcement officials. A total of 25 percent of respondents reported a mistreatment event related to immigration; 62 percent of these were personally victimized and 75 percent of events took place in a community location. The immigration-related mistreatment appeared to have been accepted as normal by both law enforcement officials and residents. Militarization of immigration policies had a detrimental effect on the daily lives of Mexican-born US permanent residents and their non-immigrant Mexican descendants. These policies enabled institutionalized acts of discrimination, such as racial profiling and mistreatment. To deal with this, the authors recommended metrics and systems for monitoring immigration and border enforcement policies and for establishing programs for eliminating institutional practices deleterious to the health of US citizens and residents.

### **Blood Pressure-Related CVD Mortality Among Non-immigrant Mexicans in Mexico**

While immigration clearly plays a part in increasing risk factors for disease, the effects of globalization as a contributing factor cannot be overlooked. This is evident in research published in 2014 showing that in the Mexican adult population aged 50+ years, 32 percent had systolic hypertension and 47 percent had systolic prehypertension [83]. In this population, 48 percent of all CVD-related deaths were attributed to high systolic BP. Hypertension accounted for the highest rate (83 percent) of CVD-related death; of these, 67 percent were among patients over 70 years of age. In 16.5 percent of CVD-related death, patients had systolic prehypertension. Additionally, one-third of adult Mexicans had either untreated or uncontrolled systolic hypertension, and there was a significantly higher prevalence of systolic hypertension in women.

### **Cross-Border Health Care Usage by Mexican Immigrants in the USA**

Recent research has found that hundreds of thousands of Mexican immigrants in the USA return to Mexico annually to seek health care there [84]. For many, this is motivated by barriers to access to health care in the USA, such as a lack of health insurance, language barriers, or the high cost of US health care. However, some are not using care in Mexico as a replacement for care in the USA, but as a supplement to it. Raudenbush found that the reasons behind utilizing health care in both countries included factors such as dissatisfaction with treatment of medical issues in the USA, less personal interactions with doctors in Mexico, refusal of US doctors to refer cases to specialists, costs of procedures in

both countries, and the lower cost of some pharmaceuticals in Mexico. Whether these immigrants return to Mexico for all of their health care needs or merely some of them, the existence of this practice speaks to the failure of the US health care system to provide for all of its residents' needs.

### **Overweight and Obesity Among Asian Men in the USA**

A study based on data from the 2002 to 2015 National Health Review Survey used relevance ratios to determine the correlation of overweight, obesity, and ethnicity in Non-Hispanic white men ( $n=199,767$ ) and Asian men ( $n=21,609$ ) in the USA [85]. The Asian ethnic subgroups included Chinese ( $n=4,473$ , 2%), Filipino ( $n=4,293$ ), Asian Indian ( $n=4,819$ ), and Other Asian ( $n=8,024$ ). Asian men, when compared to Non-Hispanic white men, had a higher prevalence of overweight, while Filipinos had a higher prevalence of obesity. Thus, Asian men are at higher risk for the metabolic syndrome than their Non-Hispanic white counterparts.

### **Metabolic Syndrome Among Immigrants in the USA**

An analysis of data from the 2010–2016 National Health Interview Survey (USA) that included 41,717 immigrants with a mean age of 46.5 years examined the prevalence of CVD risk factors (hypertension, obesity, and diabetes) in a diverse population of immigrants, including those from Russia, Southeast Asia, Africa, Mexico, Central America, and the Caribbean [86]. The highest prevalence of diagnosed hypertension was in immigrants from Russia and Southeast Asia. Female European immigrants reported a higher prevalence of diagnosed hypertension than female Asians. Immigrants from Southeast Asia, Africa, Mexico, Central America, and the Caribbean had a higher prevalence of hypertension compared with European immigrants, while those from South America had a lower prevalence. Female Asian immigrants reported hypertension diagnosis at lower rates than did female European immigrants, and male Russian immigrants had higher prevalence of hypertension than male European immigrants.

### **Hypertension Among Ethiopian Immigrants in the USA**

A community-based, cross-sectional, nonrandomized study carried out in Minnesota in 2007–2012 assessed the prevalence of hypertension in adult Ethiopian immigrants who were participants in a parish nursing CVD risk factor screening program [87]. BP was in the normal range in only 31.6 percent of participants and was significantly higher in men than in women. Women had significantly higher levels of total and LDL cholesterol and blood glucose than men.

Results of this study suggest a high prevalence of CVD risk factors in Ethiopian American adults and indicate the need for comprehensive, systematic assessment of their health needs with regard to chronic disease prevention.

### **Obesity Among Philippine Immigrants in the USA**

The Health of Philippine Emigrants Study (HoPES) investigated factors underlying the rise in obesity among Philippine emigrants to the USA [88]. The study found that immigrants to the USA tended to be healthier upon arrival than their native-born counterparts, but that their health deteriorated with time. Additional analyses of the HoPES data suggest that pre-acculturation (the process by which one becomes familiar with the culture of a country before moving to it) may be a risk factor for obesity in Philippine migrants to the USA [89]. Pre-acculturation was associated with increases in BMI, waist circumference, and waist to height ratio.

### **Quality of Life in Nonwhite Residents or Immigrants in the USA**

The California Health Interview Survey (CHIS) assessed perception of discrimination in health care, its association with worse quality of life and mental health outcomes and poorer physical health, and whether it was associated with racial and ethnic health disparities among California residents from 2003–2017 [90]. Analyses of CHIS data from 2003 and 2005 found that participants who reported non-white race ethnicity, were immigrants, or had limited English proficiency were more likely to report discrimination in health care. The question on discrimination in health care was removed from the survey after 2005, and then reintroduced in 2015. Over the intervening 10 years, California's health care community and legislature made concerted efforts to address health care disparities. It was proposed that that perception of discrimination in health care decreased over time overall and for all subgroups of the population. To determine whether perceptions of discrimination in health care had indeed changed over time in California, the cross-sectional study combined CHIS data sets from 2003 to 2005 and from 2015 to 2017. While overall perceptions of discrimination showed a slight decrease (from 6 to 4%), there was no significant statistical difference in the proportion of immigrants.

Another growing trend of immigration to developed countries is late-life immigration by seniors to be reunited with their families. A study used the World Health Organization's Quality of Life instrument short form (WHOQOL-BREF) combined with other psychosocial measures to examine the quality of life (QoL) of Asian Indian seniors who immigrated to reunite with their adult children in the USA [91]. The scores on overall QoL and

QoL domains (physical and psychological health, social relationships, and environment) were similar to established norms in non-immigrant populations.

### Chinese Immigrants in Canada

Individuals of Chinese origin make up the largest (27.5 percent) visible minority population in Canada. There is a notable lack of awareness of heart disease and stroke among Chinese-Canadians, and data suggest that they have a relatively low or even total lack of awareness of warning symptoms for common CV emergency situations. A study of elderly Chinese-Canadians with hypertension who participated in the intervention group of the DASHNa-CC study assessed factors that influenced their adherence to the dietary training in the study [92, 93]. While the training succeeded in conveying nutritional information, other factors influenced the eating habits of these immigrants, including their belief in traditional Chinese medicine and their visits to Chinese medicine practitioners. Traditional Chinese medicine is based on belief in a need for balance between Yin and Yang as well as the balance between hot and cold in the body, which is facilitated by diet. Therefore, the Chinese medicine practitioner is considered an authority for dietary advice [92].

A study in first generation Chinese immigrants living in four urban centers across Canada (Vancouver, Toronto, Halifax, and St Catherine's) found that most immigrants preferred the Chinese diet, while availability of food was determined by local markets [94]. Few participants preferred making friends with mainstream Caucasian Canadians. The authors concluded that health interventions, including diet and lifestyle education for this population, should be communicated in Chinese languages and via channels this population is already using. This conclusion is congruent with similar findings and recommendations for first-generation migrant populations in the USA. A study that used Leininger's Sunrise Model of culture care theory to examine Chinese Canadians' high prevalence of hypertension determined it to be a result of the traditional Chinese diet, which is high in sodium and low in potassium, in combination with the tendency of the Canadian diet to be low in calcium [95].

### Infectious Disease

Many host countries put strict measures into place to prevent migrants with infectious diseases from entering. However, infections, such as hepatitis C, tuberculosis, and HIV, are common in migrants and refugees [96–98].

### Hepatitis C Virus Infection

Studies on the epidemiology and management of hepatitis C virus (HCV) infections have shown a worldwide prevalence of 0.5 to 6.5 percent, with wide variation from region to region: 0.5 to 1.5 percent in Western countries, Australia, and India; 2.3 percent in Southeast Asia and Eastern Mediterranean; 3.2 percent in China; 6.5 percent in Pakistan; and 4 to 9 percent in sub-Saharan Africa [99, 100••, 101]. The risk of HCV infection in immigrant populations is less clear. Coppola et al. concluded that immigrants are more likely to have an increased risk due to HCV exposure in their countries of origin, assuming that immigrants and refugees from intermediate/high HCV endemic countries move to less- or non-endemic areas [100••]. An alternate view is that we should examine how the prevalence in the migrant populations reflects the prevalence in their countries of origin [101]. Much can be learned from the report on chronic HCV infection in undocumented immigrants and low-income refugees in Italy [102]. The majority of those offered testing agreed to be tested, suggesting that the environment was welcoming and adequate pre-test counseling was provided, a key factor that must be considered when developing similar programs. Following diagnosis, the reality in most parts of the world is that major barriers persist in accessing optimal HCV treatment [103, 104]. Cost remains a major barrier, and other concerns include access to providers. Future efforts should focus on screening programs that reach out into the community with the help of cultural mediators to identify immigrants living with HCV and offer them ongoing care and support.

### Tuberculosis Infection

Immigrants with hypertension, overweight, obesity, or diabetes may be at increased risk for communicable diseases such as tuberculosis (TB). More than 50% of non-US born persons diagnosed with TB had migrated from five countries: Mexico, the Philippines, India, Vietnam, and China. Nationwide, statistics from 2010–2014 showed that 65 percent of all patients with TB in Hawaii were immigrants, as were 81 percent of those in the Philippines [105]. Between 1995 and 2012, the relationship between immigration and TB was explored in the Netherlands to determine if immigration can be a predictor for TB in immigrants from countries of origin with high incidences of TB, including Morocco, Somalia, and Turkey [106]. A 17-month lag was found between Somali immigration and the emergence of Somali immigrant TB cases, but no time lag was seen for Moroccan or Turkish immigrants. The authors concluded that the absence of a time lag may have been due to the relatively low prevalence of TB in their countries of origin, combined with increased likelihood of reactivation TB in an aging

immigrant population. Understanding the time lag between Somali immigration and occurrence of TB disease would benefit from a closer epidemiological analysis of cohorts of Somali cases diagnosed within the first years after entry. A study based on sentinel surveillance data on migrant travelers to Canada from Sub-Saharan Africa, Southeast Asia, South Central Asia, the Philippines, China, and Vietnam, collected through the CanTravNet website, concluded that, compared with non-migrant travelers, migrants were more likely to present with a communicable infectious disease, such as TB, potentially complicated by an underlying immunosuppressive condition such as HIV [107•].

## Conclusions

A comprehensive understanding of the effects of migration on health must take into account the heterogeneity of immigrants, due predominately to their countries of origin and different behaviors relating to their cultural, ethnic, and religious backgrounds, as well as to their socioeconomic status and education. Previous analyses found that the overall well-being of immigrant groups is likely to improve despite an increased risk of hypertension and weight gain. Migrants and refugees are at increased risk of both non-communicable diseases (hypertension, CVD, obesity, diabetes, and the metabolic syndrome) and communicable diseases. For example, there have been outbreaks of cutaneous leishmaniasis among Syrian refugees in Arab host countries and a re-emergence of TB among migrants to Europe and North America. Vaccine-preventable diseases, including measles, are also prevalent. Refugees are often not up to date on routine immunizations. In addition, many immigrants have stress- and trauma-related mental health problems due to continued violence and gender victimization, which are often not addressed by the health care systems where they reside. Determining the health care needs of specific immigrant groups should lead to the establishment of evidence-based guidelines for providing screening and health care services to immigrant populations for the benefit of the individuals concerned, as well as the host countries. Health screening of refugees after resettlement is now conducted according to varying local policies, and there are vast differences in which health conditions are covered in the screening and for whom screening is available.

Overcoming barriers to controlling disease in immigrants requires culturally appropriate health care that includes written and oral information in the migrants' native language about the host country's healthcare system and their right to its utilization. This is needed to establish among refugees and immigrants a positive experience with healthcare in the host country that will lead to future successful implementation of preventative and treatment interventions, including dietary and lifestyle change for control of BP and diabetes.

Further studies are needed to explore the factors, including the environment, continuous psychological stress, possible epigenetic markers, and other patterns that increase the susceptibility of second- and third-generation populations of immigrant origin to the development of hypertension, CVD, diabetes, and the metabolic syndrome, all of which contribute to the global burden of chronic disease.

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## Compliance with Ethical Standards

**Conflict of Interest** None.

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