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Nutrition Transition in Iran: An Analytical Study of the Factors Related to Life-Style Regarding Non-Communicable Diseases in Recent Decades

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ABSTRACT

Background: In the current scoping review, nutrition transition and its consequences in Iran have been reviewed, and relevant health improvement policies have been described. **Methods:** This was an analytical study which concerned demographic, economic and socio-political context, nutrition, dietary patterns and related metabolic syndrome, or their consequences among Iranian population in recent decades. **Results:** In the last decades, socio-economic problems increased food insecurity, and unhealthy diet has been common. The prevalence of obesity was higher in urban areas compared with rural areas. There was also a high prevalence of nutritional risk factors; food choices tended to be less healthy; high-fat food choices has been increased, and there was lower physical activity. The prevalence of non-communicable diseases and metabolic syndrome including hypertension and type 2 diabetes mellitus are progressively elevated. **Conclusions:** Urgent preventive strategies and policies by the government and healthcare community are essential. These strategies are necessary for promoting national health, increasing life expectancy, and decreasing metabolic syndrome, diet-related and lethal diseases including cardiovascular diseases, and diabetes.

Keywords: *Nutrition transition; Obesity; Iran; Health; Chronic diseases*

Introduction

The nutrition transition definition is basically according to changes in the quality and quantity of dietary patterns and behaviors in a population. These changes also involve some lifestyle-related factors including general health, work environments, physical activity and socioeconomic situation, all of which ultimately influence energy consumption (Rouhani-Tonekaboni *et al.*, 2018). The current status of nutrition transition in Iran is characterized by high consumption of energy categorized as fat, fast foods and sugary foods, less physical activity and low fiber intakes (Popkin, 1993). In the current study, the authors evaluated the aspects of nutrition transition and its related changeable and unchangeable risk factors that contribute to higher burden of non-communicable diseases (NCDs) among the Iranian population.

Population and mortality changes

Improving global and regional public health is possible via improving in nutrition, vaccination,

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and perfect sanitation which leads to lowering infant mortality and increasing life expectancy. After the Islamic Revolution of 1979, Iran developed some policies to decrease birth rate, and after the Iraq war against Iran, some plans changed and led to an increased growth rate. Based on the data obtained from Iran Statistics Center (ISC), Iran's total population is 83 million people, while it is estimated that the total population size will reach to 92 million people in 2050 and then be reduced to 70 million in 2100. Accordingly, Iran has a large population size ranking 19th to 26th between 2050 and 2100 (United Nations, 2015b) . Over the last few decades, the fertility rate has reduced due to some preventive strategies like family planning programs which were administered by the government, increased women's literacy, increased marriage age, reduced child mortality rate, increased life costs, and pregnancy control by women (Abbasi-Shavazi, 2001, Abbasi Shavazi and Hosseini-Chavoshi, 2011, Ghobadi, 2010, Mirzaie, 2005, World Bank, 2010). Furthermore, it is demonstrated that the growth rate in Iran has been reduced in the last three decades and reached to about 1.2% in 2015-2020. It has been estimated that the growth rate would reach 0% by 2050, and after that, it will be negative (**Figure 1**) (United Nations, 2015b) . Since 2000, the Total Fertility Rate (TFR) of Iran was less than 2.1; however, it is estimated to be positive by 2050 (**Figure 1**) (United Nations, 2015b). The age range of the majority of population (~70%) by the year 2020 will be 15–64 years old, and the median age about 32.4; the median age will be continuously increasing to 44.7 in 2050 (United Nations, 2015b) . In 2010–2015, the life expectancy of the Iranian population was about 75, and based on the World Population Prospects (WPP), it will be approximately 80 years in 2050 (United Nations, 2015b) .

Economic and socio-political context

There are considerable disparities of wealth and income in Iran; previous studies have shown great economic inequalities in Iran, particularly between rural and urban areas (Heslot, 2014). The total unemployment rate is 12%, while 30-40% of the youth are unemployed (Heslot, 2014). There are some accumulated resources, in old age, regarding socio-economic security and welfare, including income from work, family support, employers' comfort, owning pension savings, and other benefits such as health coverage and insurance (Mehri *et al.*, 2020). On the contrary, the Iranian old-age economic situation is different in comparison with the above sources, and there is not a citizen-based pension like western countries such as the United States and Europe. Therefore, rich people are relying on their origins, but middle and low-income groups rely on their family and government supports (Mehri *et al.*, 2020). However, there is some support and pensions for specific employees who worked in certain private or government organizations. Some of them are Boniyad Shahid Foundation, Komiteh Emdad Emam, and Astan Qods Razavi. Furthermore, low-income groups receive a monthly cash transfer of 450,000 rials (3 USD) (Mehri *et al.*, 2020). Likewise, the income of the top decile of the population is 15-20 times higher than the bottom one, showing a great inequality of income distribution among the Iranian population (Ghassemi *et al.*, 2002). Other studies revealed that Iran has acceptable industrial equipment in the field of animal protein, milk, cheese and wheat with self-sufficiency threshold (Alamdarlo *et al.*, 2019, Soltani *et al.*, 2020).

Nutritional status of Iranian population

Among countries, the variety of food consumption patterns is different and relies on cultures and social levels (Jessri *et al.*, 2011). In recent decades, there have been considerable lifestyle modifications in Iran, especially in food consumption behaviors. Besides, several policies has been administered to improve nutrition statues and prevent malnutrition or obesity (Abdi *et al.*, 2016, Baranowski *et al.*, 2003, Legg *et al.*, 2000). In 2005, a nationwide program was devised to reduce malnutrition in children under five years old. This program had two phases; first phase, was a collaborative phase, that covered all the mothers

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and their under six-year-old children in rural/urban health centers. The coverage included health planning, breastfeeding education, growth monitoring, illiteracy elimination, and also increasing access to food stores. The Second phase was a supportive phase focusing on low-income families who suffered from nutrition deficiencies and had growth-retarded or malnourished children. Previous studies have suggested that after ten years of administration, this program had some positive effects on children and reached an adequate extent; but, some aspects remained unclear, and there were some gaps that need more work (Ghodsi *et al.*, 2018). Moreover, some vitamin and mineral deficiencies were prevalent in Iran including iodine, iron, zinc, vitamin B2 and vitamin A. In the case of vitamin B2, the most affected community were rural people, and non-standard food and dairy products were recognized as the most important factors (Ghassemi *et al.*, 2002). A study in 2016 reported that in children under 5, there were 7.6%, 4.5% and 13.1% prevalence of underweight, wasted and stunted in Iran which were globally 16%, 8% and 26% (Abdi *et al.*, 2016).

Food consumption

In Iran, the primary source of food production is agriculture, and due to several difficulties in marketing and production system it does not have an acceptable efficiency (Ardakani *et al.*, 2017, Ardakani *et al.*, 2009, Heslot, 2014). Moreover, about 35% of agricultural products, feeding 15 to 20 million people, are wasted and lost (Pirmoradi *et al.*, 2013). To determine the changing trend in delivering food and nutrition security, an index for each dimension has been calculated by Ardakani *et al.* in five-year period, including accessibility, availability, stability and utilization; it has been indicated that in this period, accessibility and availability dimensions were steadily reduced (**Table 1**). Also, nutrition and food security in Iran from 2007 to 2011 sharply declined (**Figure 2**) (Ardakani *et al.*, 2017). However, there have been great changes in Iranian dietary context and habits over time. The Iranian dietary pattern generally includes three categories of traditional, healthy, and western dietary patterns; the traditional dietary pattern is semi-healthy and mainly consists of rice, vegetables, red meat, fruits, soy, pickles, animal fat, and poultry. Healthy dietary pattern comprises fish, olive and vegetable oil, and little amounts of bread and animal fat; finally, western dietary patterns includes fast foods, soft drinks, sweets, cream, and high-fat meats (Zaribaf *et al.*, 2019). Furthermore, Iranian food security has been affected by international sanctions, with greatest impact on the middle-class and poorer households. The sanctions caused great inflation in the price of food products; while people showed tendency to buy food products with lower price and less nutritional values (Heslot, 2014). Nowadays, the majority of population in Iran are not able to prepare foods with high nutritional quality, and they tend to buy cheap foods with high energy and less micronutrients, leading to more diet-related disease like obesity, type two diabetes mellitus (T_2DM)and cardiovascular disorders (Pouraram *et al.*, 2018).

Dietary changes

Besides nutrition transition, considerable dietary changes have also occurred, and fatty food consumption has increased. In traditional countries, fat consumption increased as well (Popkin, 1993, Umanath *et al.*, 2016). Despite unhealthy food consumption, some lifestyle habits such as smoking and low physical activity contribute to adiposity and cardiovascular disease (CVD) (Sadeghi *et al.*, 2017). Khatibi *et al.* demonstrated that high-fat and high-salt foods' led to the high prevalence of hypertension and CVD (Khatibi *et al.*, 2018). Other studies showed that there was a higher prevalence of obesity in lower socio-economic levels of society, and also obesity increased through urbanization of big cities such as Tehran (Emamian *et al.*, 2017). Based on the previous studies, people have more tendency toward fatty and fast foods (Mansouri-Tehrani *et al.*, 2019, Mohammadbeigi *et al.*, 2018, Rouhani-Tonekaboni *et al.*, 2018). The prevalence of food insecurity among different groups in Iran is 49% in households, 49% in adolescents, 61% in mothers,

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65% in the elderly, and 6% among children (Behzadifar *et al.*, 2016, Shahraki *et al.*, 2016). Traditional food patterns containing high amount of vegetable, wheat, and fruit is replaced with sugars and high fatty foods with less amounts of iron, iodine and other micronutrient deficiencies (Ardakani *et al.*, 2017). Furthermore, 30% of households consume 80% of per capita energy-3000 kcal per person- and this diet provides less than 80% of the essential micronutrients such as vitamin A, calcium, and riboflavin (Ghassemi, 2000, Rastegar, 2016).

Sedentary lifestyle and obesity

Obesity has a high prevalence worldwide, and a sedentary lifestyle is one of its main contributing factors, responsible for 5% of total deaths (Xie *et al.*, 2014). A sedentary lifestyle is a health-related risk factor and leads to obesity and related co-morbidities (Smith *et al.*, 2015). In Iran, evidence shows that obesity has been increased in recent years (Emamian *et al.*, 2017), with a high prevalence in children and adolescents (Esmaili *et al.*, 2015). Esmaili *et al.* in a nationwide study, demonstrated that the prevalence of overweight, obesity, and abdominal obesity among Iranian children and adults was higher in urban areas than in rural areas (**Figure 3**) (Esmaili *et al.*, 2015). The cause of obesity is screen addiction including watching TV, cell phones, and tablets, and personal computers. Screen addiction such as TV watching is associated with lower metabolic rate in comparison with reading and writing which also sedentary activities (Hu *et al.*, 2001, Sisson *et al.*, 2012), and the risk of CVD increases by prolonged TV watching (Grøntved and Hu, 2011). Currently, the epidemiological transition in Iran led to nutritional problems among primary-school children and watching TV aggravated their food habits, which resulted in developing obesity independent of physical activity (Ghobadi *et al.*, 2018). Also, according to a nationwide cross-sectional survey, the leisure-time physical activity in men and women was 35.4% and 20.3%, respectively (Janghorbani *et al.*, 2007). Iran is a developing country that has experienced urbanization, cultural, social, and economic transitions (Kelishadi *et al.*, 2008). Over the past years, the prevalence of obesity among Iranian people significantly increased (Esteghamati *et al.*, 2010). Interestingly, as described before, obesity in Iran for males and females was 3.34% and 3.50% in 2004 and 13.58% and 10.15% in 2012. However, the prevalence of abdominal obesity was 47.9% in 1999 and 71.1% in 2011 (Barzin *et al.*, 2015, Djalalinia *et al.*, 2016). Moreover, the prevalence of obesity has increased in children and adolescents (Djalalinia *et al.*, 2016). The highest rates of obesity belonged to women of 40 and men of 20 ; higher waist circumference (WC) and lower education were also related to higher risk of obesity (Barzin *et al.*, 2015). Sedentary behaviors and changes in diet could be the most important contributing factors to the increased prevalence.

Blood cholesterol and dyslipidemia

Dyslipidemia and high cholesterol levels in plasma are the most common problems leading to CVD. Dyslipidemia is defined with lower levels of high-density lipoprotein cholesterol (HDL-C), and higher values of triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and total cholesterol (TC) in the blood (Hedayatnia *et al.*, 2020). Among the Iranian population, the prevalence of low HDL-C, hypertriglyceridemia, high levels of LDL-C, and hypercholesterolemia in both genders are 43.9, 46.0, 35.5, and 41.6 %, respectively (Hedayatnia *et al.*, 2020). Recently, Hedayatnia *et al.* assessed the prevalence of dyslipidemia and related components among 8698 participants aged 35–65 with experience of heart attack in Mashahd (**Table 2**) (Hedayatnia *et al.*, 2020). Moreover, it has been indicated that among Iranian adult patients with CVD, the prevalence of dyslipidemia was 87% (Darroudi *et al.*, 2018, Hedayatnia *et al.*, 2020). CVD is the major cause of mortality in Iran; among the cause-specific death rates, 79% of deaths are from chronic diseases, and 50% are related to CVD (Sadeghi *et al.*, 2017). It has also been estimated that until 2025, CVD mortality will be increased (**Figure 4**); obesity, unhealthy diet, high-fat diet, and

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dyslipidemia are the most common causes of CVD (Després and Lemieux, 2006, Mathers and Loncar, 2006, Ordovas, 2006, Tveden-Nyborg *et al.*, 2016). In a study on Iranian adults over 20 in 2019, it was demonstrated that from 1990 to 2011 the borderline increase in the blood cholesterol level in males was 39.8% and in females was 46.3% (Hosseini *et al.*, 2019). Hosseini *et al.* reported that the prevalence of borderline increase in blood cholesterol nationwide had had an increasing trend with the prevalence of 46.3%, while hypercholesterolemia's prevalence rate was 18.0% in 1990-2011 (Hosseini *et al.*, 2019). In the study conducted by Alimohammadi *et al.*, the total cholesterol levels in females and males was reduced in the period of 1980 to 1990 and increased in 1990-2010; whereas, the figure for females had increased constantly from 1980 to 2010 (Alimohammadi *et al.*, 2018).

Hypertension, T_2DM and metabolic syndrome

Hypertension is one of the five global causes of mortality among children and adults, when obesity, hypertension, and other CVD risk factors are combined, the likelihood of adverse CVD significantly increases, and there is a need for aggressive treatment (Natsis *et al.*, 2019). Based on the meta-analysis of 42 studies in Iran between 1980 and 2012, the total prevalence of hypertension was 22%, 23.6% in men and 23.5% in women. In addition, the prevalence of hypertension was higher in women ≥ 40 (**Figure 5**) (Mirzaei *et al.*, 2016). In a study with 402,282 subjects, the prevalence of hypertension in urban and rural areas was 22.1% and 18.6% respectively (Mirzaei *et al.*, 2016). Moreover, Mirzaei *et al.* showed that from 1980 to 2010, there was an increased prevalence of hypertension which increased with age; at the age range of over 40, the prevalence of hypertension in women was more than men (Mirzaei *et al.*, 2016). It has also been indicated that Iranian people had higher daily consumption of salt compared with the National Training Program of United States guidelines, and people with lower socio-economic status had higher salt intake compared with people with higher socio-economic status (Mazloomy Mahmoodabad *et al.*, 2016). There was a strong relationship between T_2DM, and obesity, both of which are the most dangerous diseases among metabolic disorders (Verma and Hussain, 2017). In a study among 728 Iranian patients with T_2DM, the relationship between obesity and dietary patterns was evaluated, and the results showed that there was a negative and positive association between healthy and unhealthy dietary habits, and the prevalence of general obesity (Basiri *et al.*, 2015). Every year, T_2DM imposes a huge financial burden on society and healthcare systems (Bakker *et al.*, 2016). Previous studies demonstrated that there was a 35% increase in the prevalence of T_2DM among the Iranian adult population between 2005 to 2011, contributing to the total prevalence of 11.4% (Esteghamati *et al.*, 2014). Furthermore, Esteghamati *et al.* indicated that all kinds of diabetes showed a 85.5% prevalence of T_2DM (Esteghamati *et al.*, 2017). In a study in Tehran city, the prevalence of T_2DM among people with low socio-economic status was higher than the other regions; they had a higher rate of T_2DM (Asadi-Lari *et al.*, 2016). Metabolic syndrome (MetS), is also a prominent disorder contributing to T_2DM, hypertension, obesity, and dyslipidemia. A nationwide survey showed that the prevalence of MetS among the urban population, older adults, low educated people, postmenopausal women, and people with unhealthy diets and low physical activity was higher than the other groups (Hajian-Tilaki, 2015). Since one of the significant factors of MetS is obesity, and obesity directly relates to lifestyle, some studies revealed that the rate of obesity among Iranian adults has increased in the last decades (Azimi-Nezhad *et al.*, 2012, Hajian-Tilaki and Heidari, 2007, Jouyandeh *et al.*, 2013, Shahini *et al.*, 2013); this rate was almost higher in women (Azimi-Nezhad *et al.*, 2012, Delavari *et al.*, 2009).

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Table 1. Change in nutrition and food security dimensions in Iran (Ardakani *et al.*, 2017, Ardakani *et al.*, 2009).

Dimension	1992-96 to 1997-01	1997-01 to 2002-06	2002-06 to 2007-11
Availability	-8.1	-14.6	-1.11
Accessibility	-3.9	-0.93	-9.8
Stability	+7.8	-2.05	-5.2
Utilization	-12.9	+16.11	-5.03

Table 2. Prevalence of dyslipidemia and related components (Hedayatnia *et al.*, 2020).

The population	Dyslipidemia	High LDL-C	High TC	High TG	Low HDL-C
Total population (n = 8698)	85.40 (7424)	32.30 (2811)	38 (3309)	33.90 (2947)	65.80 (57.19)
Men (n = 3582)	80.30 (2877)	29.80 (1067)	34.10 (1223)	36.90 (1321)	55.60 (1990)
Women (n = 5116)	88.90 (4547) [a]	34.10 (1744) [a]	40.80 (2086) [a]	31.80 (1626) [a]	72.90 (3729) [a]

LDL-C: Low density lipoprotein cholesterol; TC: Total cholesterol; TG: Triglycerides; HDL-C: High density lipoprotein cholesterol; [a]: P < 0.001 for comparison between men and women.

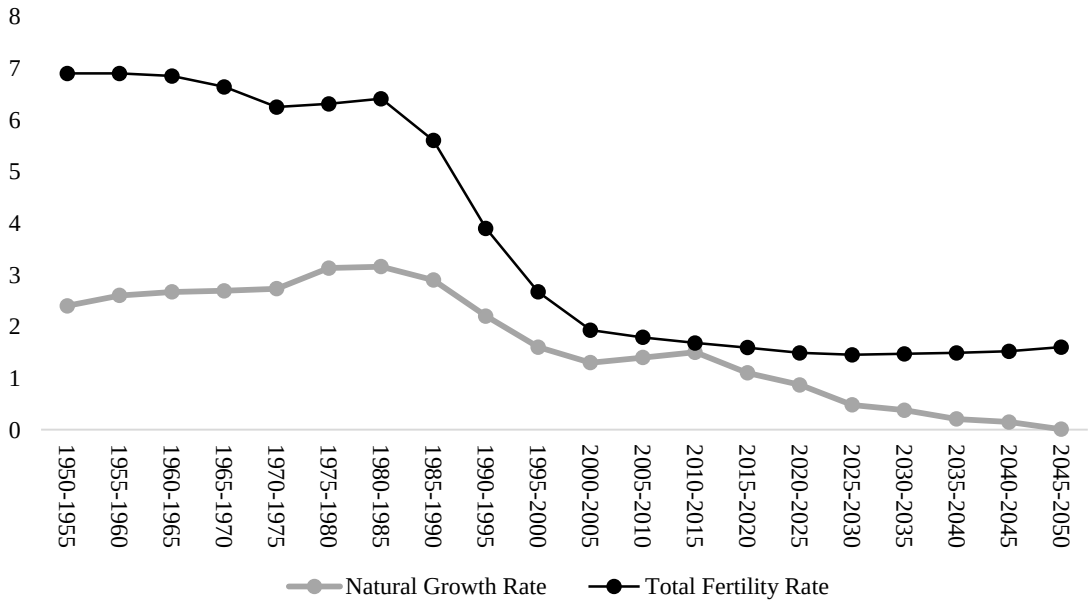

Figure 1. Continued natural growth rate and fertility change intersection from 1950-1955 to 2045 2050 (United Nations, 2015a).

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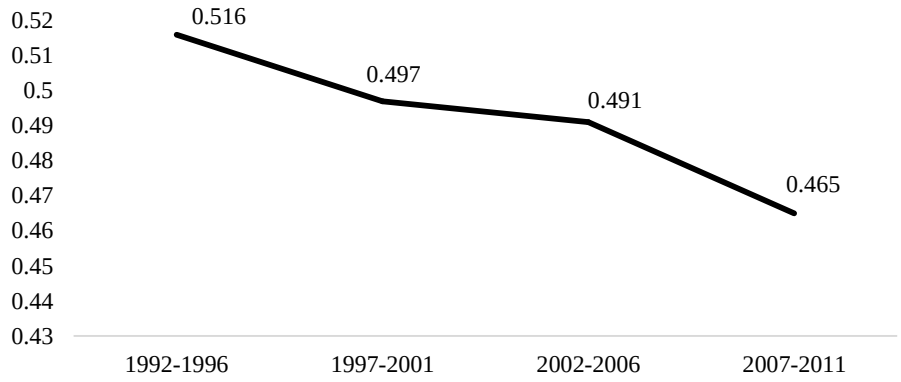

Figure 2. Food and nutrition security trend in Iran from 1992 to 2011 (Ardakani *et al.*, 2017, Ardakani *et al.*, 2009).

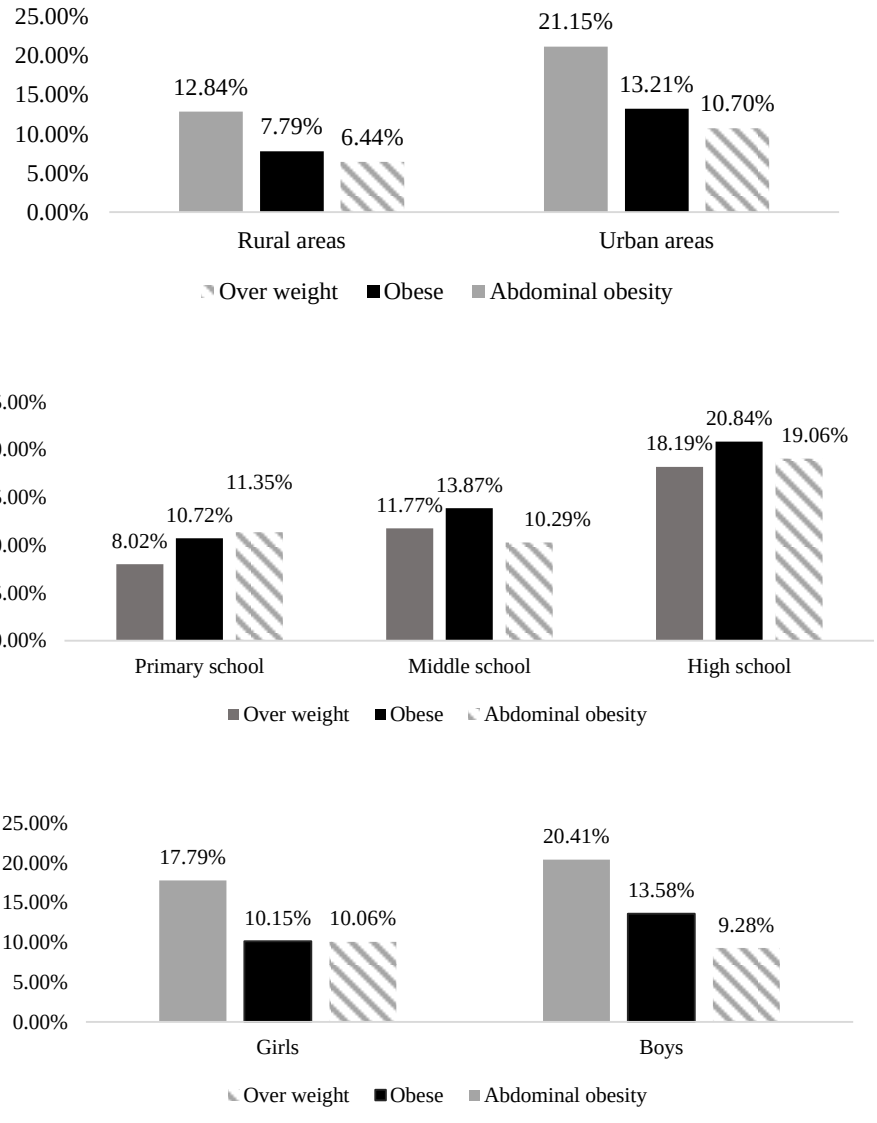

Figure 3. Prevalence of overweight, general, and abdominal obesity (Esmaili *et al.*, 2015).

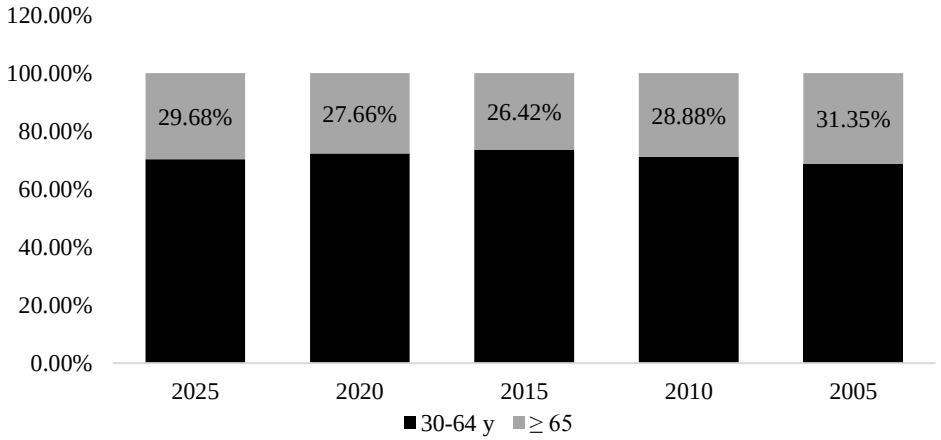

Figure 4. Predicted annual CVD burden by age in Iranian adults (2005-2025) (Sadeghi *et al.*, 2017).

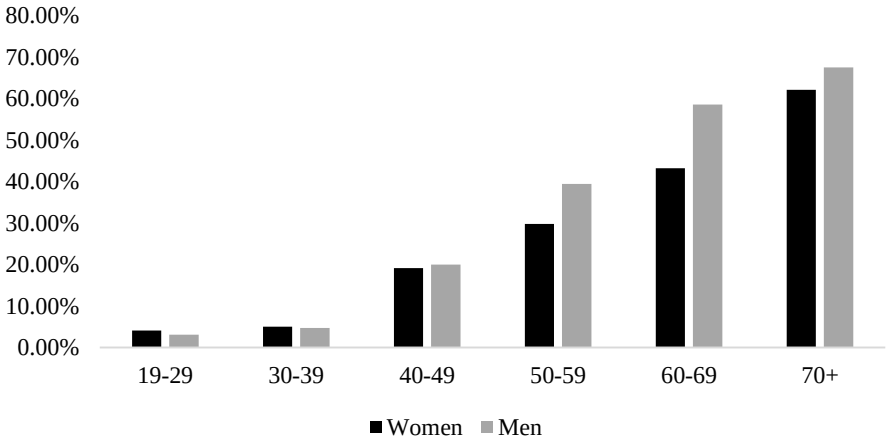

Figure 5. Prevalence of hypertension in 1980–2012 based on age and gender (Mirzaei *et al.*, 2016).

Conclusion

Nutritional transition in Iran is ongoing alongside with increased prevalence of several health-related changeable and unchangeable risk factors; they include unhealthy diet, low physical activity, and age which leads to increased prevalence of NCDs like hypertension, T_2DM, and metabolic syndrome. The reasons for such change are increased urbanization, fast food and fatty food consumption, increased unhealthy and western dietary habits, lower intakes of micronutrients, and increased sedentary lifestyle. In recent years, the socio-economic status of the majority of population has become worse in Iran, leading to great tendency of low-income population to choose insufficient and unhealthy food items. Moreover, in contrast to increased general knowledge about the beneficial aspects of regular physical activity, most of the people particularly in urban areas have a sedentary lifestyle possibly due to increased use of personal cars, TV watching, smart gadgets and social media. Although maternal morbidity and infant mortality rate has decreased, the rate of obesity, hypertension, T_2DM and related metabolic compliances such as metabolic syndrome have increased to an alarming point. Iran's government has made great policies to reduce mother and child's mortality rate and increase life expectancy. However, further preventive policies and integrated strategies are required to develop vital habits in general population, such as physical activity, dietary patterns, financial support,

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decreasing urbanization and lowering stress. Although industrial communities encourage people to use unhealthy foodstuff, healthcare system and government could apply health policies to population, in small or great communities, workplaces, schools, universities, and social media.

Conflict of interest

The authors declared no conflict of interest.

Authors' contributions

All authors read and approved the manuscript; Barzegari M, collected data collection and wrote the first draft of the manuscript. Abbasalizad-Farhangi M designed the project, revised the manuscript, and supervised the project.

Ethical considerations

The current work has been approved by research undersecretary of Tabriz University of Medical Sciences (IR.TBZMED.REC.1401.087).

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