

## Review Article

# Emerging risk factors and the disease pattern in Turkey: an analysis based on burden of diseases

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### ABSTRACT

Knowledge about the burden of disease and injury alone is not sufficient for health improvement and for defining and evolving policies and strategies. In many low and middle income countries, the impacts of chronic diseases are increasing gradually each year. Anticipating, understanding and reducing the impact of chronic diseases on human health is of great importance. The aim of this paper was to assess the main risk factors in chronic diseases in a developing country and to identify the effects of individual risk factors on burden of disease by using comparative risk assessment methodology. The first BoD study in 2003 revealed that the high systolic blood pressure was ranked first and the prevention of high systolic blood pressure would prevent 108,468 of 430,459 deaths in Turkey. Smoking was at the second rank and prevention of smoking would prevent 54,699 deaths while control of cholesterol level within the normal limits would prevent 49,029 deaths. It is also indicated that adequate levels of physical activity would prevent 45,120 deaths and that consumption of the recommended amount of fruits and vegetables would prevent 38,734 deaths. In the 2013 study, smoking ranked first, followed by nutritional risks at the second rank followed by high BMI, high blood pressure and high sugar level respectively. Smoking, high blood pressure, obesity and tobacco use are the most important problems among the preventable deaths and disability in Turkey. It can be concluded that Turkey now resembles the pattern seen in developed countries and some developing countries with low mortality.

**Keywords:** Risk Factors, DALY, Turkey

### INTRODUCTION

The introduction of “Global Burden of Disease” (GBD), came at an important time in public health history where more countries are stressed and economically strapped while being pressured (both externally and internally) to improve health conditions. Resources are becoming limited and unequally distributed and governments are struggling to find ways to most efficiently use such resources to promote health. By providing a unique framework for analyzing, and disseminating fragmentary and contradictory information on population health, the GBD framework provides information on how countries

can allocate limited resources in such a way to generate better outcomes on health of the population.<sup>1</sup> The concept of Disability-Adjusted Life Years (DALY) was suggested as the standard unit of this approach, and it presents a new tool for health planners to use in the identification of social health requirements on a broader scale.

Using a single measure, the DALY concept seeks to evaluate premature deaths caused by various diseases, along with the burden of disease that does not result in death but causes long-term disability and loss of function. In other words, the DALY, combining the incidence/prevalence concept, helps in evaluating both the years of life lost due to premature mortality caused by

various diseases, and the disability and loss of function caused by diseases, accidents or injuries that do not result in death. Therefore, a common indicator or measure is required to include the effects of both fatal and non-fatal health outcomes. DALYs, just as in most of the other summary measures developed to date, use time as a common indicator by combining the years of life lost (YLL) from premature mortality in the population and the years of life lost due to disability (YLD).

In addition, studies indicate that chronic diseases increase steadily in many countries regardless of their development level and social structure. If the necessary action is not taken, studies estimate that 388 million people would die from chronic diseases in the next 10 years<sup>2</sup>. Turkey's population structure is still largely young which is similar to the population structure of developing countries. Significant progress has been achieved in Turkey in terms of maternal and child health, vaccination, and communicable diseases in the past decades. Today, similar to developed countries, chronic diseases are among the major causes of death. Unless it is controlled, non-communicable diseases would be quite high in the next 10 years along with the increase in the number of aged people.<sup>2,3</sup>

In a large part of the world including Turkey, the increase in chronic diseases can be explained by ongoing socio-demographic changes. Therefore, knowledge about the burden of disease and injury alone is not sufficient for the improvement of health and for defining strategies and policies for resource allocation. Anticipating, understanding and reducing the impact of chronic diseases on public health is of great importance<sup>3,4</sup>. We should as well know the burden of various basic risk factors such as smoking, alcoholism, hypertension or environmental pollution in order to determine strategies for the improvement of population health.<sup>3,4</sup>

The goal of this paper is to analytically review and assess the main risk factors for chronic diseases in Turkey and to identify the effects of individual risk factors on burden of disease by using comparative risk assessment methodology based on the Turkish burden of disease study.

## FRAMEWORK

Burden of disease data can help to identify population groups in the society who are at risk depending on risk-stratification strategies.<sup>1,5,6</sup> By addressing risk factors and drawing a direct correlation between risk factors and their burden on disease, governments could evolve and implement and prevention strategies in order to reduce risk factors and consequently reduce burden of disease. Therefore, reliable and comparable data for risk factors associated with burden of diseases are an important component in the prevention of diseases, accidents and injuries.<sup>1,2,3,5,7</sup> There are different approaches to estimate such risk factors. All these methods require estimating some risk-surmount measure based on the exposed and

unexposed population as there are multiple risk factors.<sup>7-9</sup> For example, education, occupation, and income may affect smoking, physical activity, and diet which are risk factors for vascular diseases, both having direct effects and indirect effects through further intermediate factors such as body mass index, blood pressure, and the level of cholesterol.<sup>7,8</sup> Multi-causality means that more than one intervention program can be applied for the prevention of these diseases depending on the cost of the programs, the appropriateness of technology, and availability of resources. Thus, priority should be given to those studies that include evaluation of disease, accidents and injuries and the risk factors that have impacts on them. A number of cohort studies have estimated the joint effects of two or more risk factors among specific groups.<sup>9</sup> However, studies related to disease-specific joint effects of risk factors in the areas of epidemiology and population health are rare. For this reason, in the "Comparative Risk Assessment (CRA)" method, a systematic evaluation of a known risk factor or a group of risk factors in population health was conducted.<sup>5,11</sup>

Describing the distribution of risk factors and their consequences is an important step not only in medicine and public health but also in social sciences.<sup>1,5,8,9,11</sup> For a more complete description of the issues, we present the method aimed at assessing risk factors, which were used in this paper.<sup>7-9,11-13</sup>

## Comparable risk assessment

Comparable Risk Assessment (CRA) is a systematic evaluation of risk factors in public health and it also gives an idea of risk factors based on changes in exposure to a risk factor.<sup>11</sup> In epidemiology, in order to estimate the health effects of a risk factor, we compare (P) as a function of exposure prevalence and relative risk (RR) in the attributable risk of a risk-factor-based disease or injury with a non-exposed group. In such an "exposure-related" evaluation, the percentage of reduction that might be experienced in disease or death in case of reducing exposure of the main statistical risk factor to zero is the attributable fraction (AF).

The AF of a disease derived from a risk factor exposure is expressed by the following equation:

$$AF = \frac{\sum_{i=1}^n P_i RR_i - \sum_{i=1}^n P'_i RR_i}{\sum_{i=1}^n P_i RR_i}$$

Here, AF is the avoided part of the burden of disease, n is the exposure categories or levels, P<sub>i</sub> is the fraction of population in the exposure category, RR<sub>i</sub> is the part of population in i exposure category and P' is the part of the population under counterfactual distribution in the i exposure category. Here RR (x) is the relative death or

disease risk for x exposure level, P(x) is the distribution of the population as to the exposure level, P'(x) is the counterfactual distribution of exposure for the population.<sup>11,12</sup>

In this paper, we followed a similar approach. We conducted a systematic evaluation of eight risk factors for 2002 Turkish BoD study, which were water and sanitation, alcohol use, low fruit and vegetable intake, physical inactivity, high cholesterol, smoking, high BMI and high blood pressure and applied the Comparative Risk Assessment Methodology (CRA). The reason for selecting these risk factors is that they have been shown to be relevant for the burden of disease in Turkey and to benchmark Turkey results with the other countries.<sup>7,13</sup>

Data sources used in the analyses are from the TEKHARF study which is based on national sampling and is representative for Turkey. Data sources for alcohol use, fruit and vegetable intake, physical activity level were obtained from the National Burden of Disease project household study. The data was analyzed for both males and females and for 8 age groups (0-4, 5-14, 15-29, 30-44, 45-59, 60-69, 70-79 and 80+ years).<sup>7</sup>

Then we compared the results of the first comparative risk assessment (CRA) study with 2013 Turkish BoD study, which calculated the risk factors by using the same methodology explained above. The results are also compared to the estimates of CRA by the Institute for Health Metrics and Evaluations (IHME) in 2009-2019 for Turkey.

### OBSERVATIONS

In the National Burden of Disease Study, which was conducted between the years 2000-2003, 430460 deaths were determined while the number of DALYs was found to be 10802494. The main risk factor was high blood pressure. Population attributable fractions (PAF) regarding risk factors, attributable deaths and attributed numbers of DALYs are summarized in terms of all age groups and sex. PAF values for each risk factor, attributable deaths, burden to DALYs, for each age group and sex for the results obtained by the Comparative risk assessment method are also presented below.

**Table 1: Prevention of deaths, YLLs and DALYs through the prevention of selected risk factors for Turkey overall, (NBD-CE Study, 2000, Turkey).**

Prevented deaths	Number of deaths (total # 430.460)					
	Male		Female		Both	
Risk factor	N	%	N	%	N	%
High blood pressure	47.643	11,1	60.825	14,1	108.468	25,2
High BMI (>30)	26.006	6,0	31.136	7,2	57.143	13,3
Smoking	52.905	12,3	1.794	0,4	54.699	12,7
High cholesterol	26.487	6,2	22.542	5,2	49.029	11,4
Physical inactivity	22.515	5,2	22.605	5,3	45.120	10,5
Low fruit and vegetable intake	21.668	5,0	17.066	4,0	38.734	9,0
Alcohol use	10.850	2,5	2.585	0,6	13.435	3,1
Water and sanitation	2.807	0,7	2.812	0,7	5.619	1,3
Prevented DALYs	Number of DALYs (Total #10.802.494)					
	Male		Female		Both	
Risk factor	N	%	N	%	N	%
High blood pressure	443.788	4,1	485.162	4,5	928.950	8,6
High BMI(>30)	379.980	3,5	407.203	3,8	787.183	7,3
Smoking	870.603	8,1	61.306	0,6	931.909	8,6
High cholesterol	345.993	3,2	220.688	2,0	566.681	5,2
Physical inactivity	254.555	2,4	210.072	1,9	464.627	4,3
Low fruit and vegetable intake	250.660	2,3	166.216	1,5	416.876	3,9
Alcohol use	388.526	3,6	73.492	0,7	462.018	4,3
Water and sanitation	94.401	0,9	88.381	0,8	182.781	1,7

Source: Ministry of Health Refik Saydam Hygiene Centre Presidency School of Public Health Başkent University: National Burden of Disease and Cost Effectiveness Project Household Survey Interim Report. Ankara, 2004

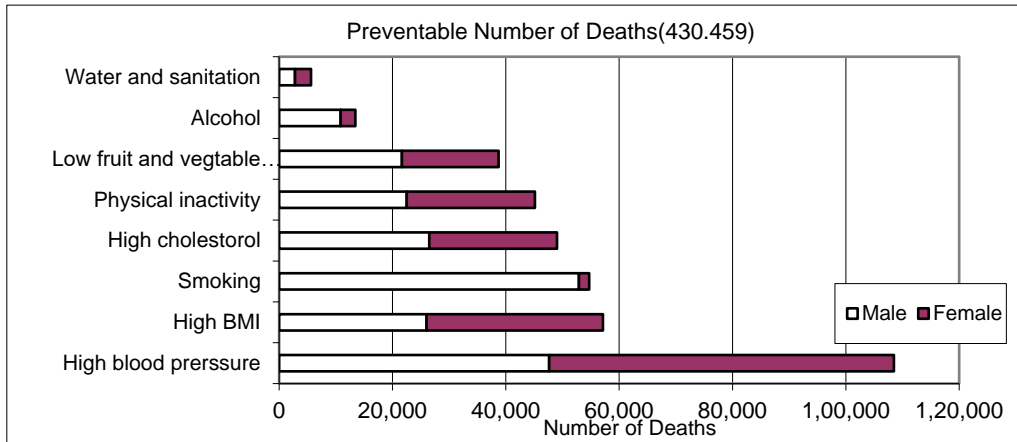
As seen in Table 1, the prevention of high systolic blood pressure will prevent 108468 of 430460 deaths in Turkey. This number is 47643 in males and 60825 in females. Prevention of smoking will prevent 54699 deaths. Control of cholesterol level within the normal limits will prevent 49029 out of 430460 deaths. A sufficient level of physical

activity will prevent 45120 deaths and the consumption of the recommended amount of fruit and vegetables will prevent 38734 deaths.<sup>7</sup>

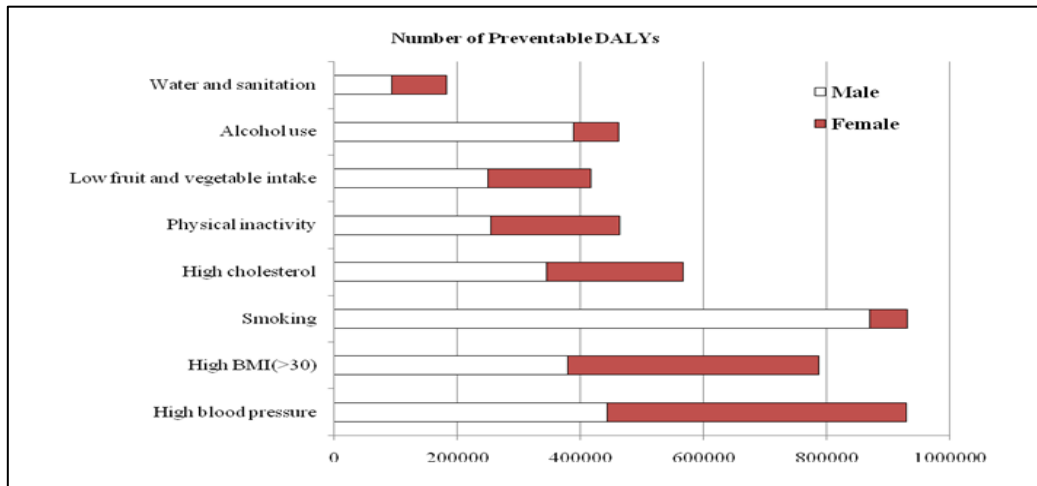
Likewise, when we carry out the calculations in terms of DALYs, we can prevent approximately 928950 DALYs

through prevention of high systolic blood pressure. These figures are 931909 DALYs for smoking, 787183 DALYs for obesity, 566681 DALYs for high cholesterol, 464627 DALYs for physical activity habits, 462018 DALYs for

alcohol consumption, 416876 DALYs for fruit and vegetable consumption, and 182.781 DALYs for the improvement of water and sanitation conditions.<sup>7</sup>

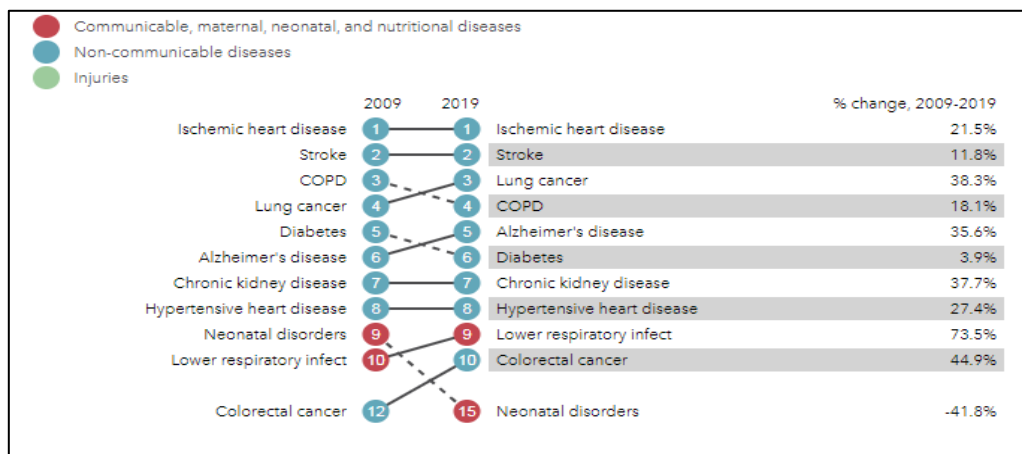


**Figure 1: The Distribution of the number of preventable deaths when selected risk factors in overall Turkey are eliminated (NBD-CE Project, 2004, Turkey).**

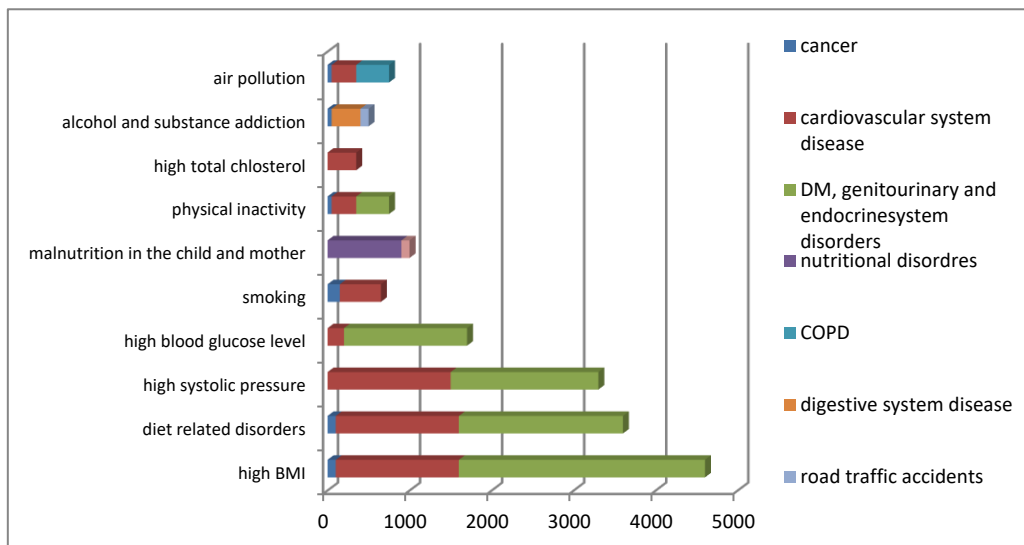
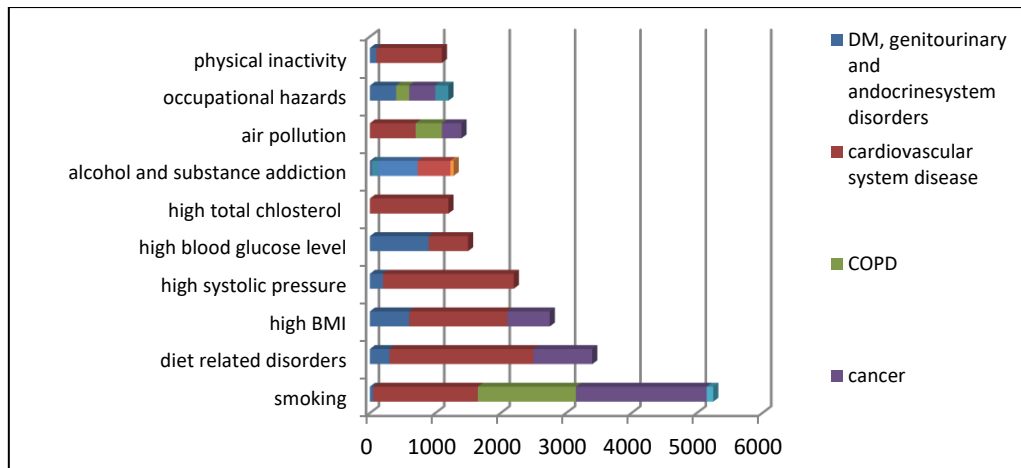


Source: Ministry of Health, Refik Saydam Hygiene Centre, Presidency School of Public Health Başkent University: National Burden of Disease and Cost Effectiveness Project Household Survey Interim Report. Ankara, 2004

**Figure 2: The distribution of preventable DALYs when selected risk factors in Turkey are eliminated.**



**Figure 3: Top 10 causes of total number of deaths in 2019 and percent change 2009–2019, all ages combined.**



Source: [http://www.hips.hacettepe.edu.tr/UHYCSunumu\\_06122016.pdf](http://www.hips.hacettepe.edu.tr/UHYCSunumu_06122016.pdf)

**Figure 4: Distribution of risk factors contributing to DALYs by gender according to the in 2013 Turkish BoD and risk factor study (male and female).**

Figure 1 shows the number of deaths due to ischemic heart disease, cerebrovascular disease, hypertensive heart disease and other heart diseases that could be prevented by lowering the average systolic blood pressure to <115 mmHg. For instance, by preventing high systolic blood pressure 20% of ischemic heart diseases among the 30-44 age group could be prevented<sup>4</sup>. As can be further seen in the Figure 1, by having cholesterol under control, it is possible to prevent 54% of all ischemic heart diseases. Also, by preventing smoking, the incidence of trachea, bronchus and lung cancers can be reduced by 77%.<sup>7</sup>

For adults, 34% of ischemic heart diseases can be prevented by the consumption of 600±50 grams of fruits and/or vegetables a day; for stroke, this ratio is 22%, for trachea, bronchus and lung cancers 15%, for stomach cancer 23%, for esophagus cancer 23% and for colon and/or rectal cancer 3%<sup>29</sup>. Given the physical activity habits (frequent exercises) of the population, 35% of ischemic heart diseases could be prevented. This value

becomes 26% for stroke, 19% for diabetes, 21% for breast cancer and 22% for colon and rectum cancer.<sup>7</sup>

As seen in Figure 2, keeping the body mass index within normal ranges, through the prevention of smoking, the provision of daily fruits and vegetables, the control of cholesterol level, and the prevention of alcohol use 931903 DALYs can be prevented. As seen in Figure 3, in terms of the number of years of life lost (YLLs) due to premature death in Turkey, ischemic heart disease, cerebrovascular disease, and congenital anomalies were the highest ranking causes in 2020. Of the 25 most important causes of burden, as measured by disability-adjusted life years (DALYs), lower respiratory infections showed the largest decrease, falling by 73.5% from 2009 to 2020. One of the leading risk factors in Turkey which needs urgent attention is dietary risks. (<http://www.healthdata.org/turkey>). This is especially important given the high BMI among the females (Figure 4).

## DISCUSSION

The identification of risk factors that cause diseases and injuries is essential for the development of evidence-based preventive strategies.<sup>2</sup> It is evident that progress has been made towards eradicating communicable diseases worldwide. Polio is on the verge of eradication and smallpox has been eradicated early in the last century. However, it is not always as easy to identify risk factors for non-communicable diseases as it is for communicable diseases. There are many factors involved and additionally evidence-based data on the diseases and risk factors are inadequate and sometimes inconsistent especially in the developing world.<sup>4,5,11,12</sup> In addition to lack of routine surveillance systems on non-communicable diseases in developing countries, studies on risk factors, especially multi-factorial studies, are very rare. There are almost no such studies in Turkey.<sup>7,8</sup> The NBD-CE (National Burden of Disease-Cost Effectiveness) study especially is important as it is the first such study in the country.

In Turkey, out of 430460 deaths in 2003, 108468 fatal cases could be avoided by preventing high blood pressure, 49.029 by taking high cholesterol level under control, 54699 by preventing tobacco use and 57143 by preventing obesity. High blood pressure, obesity, tobacco use and high cholesterol level are considered the most important risk factors for mortality in Turkey (Table 2), and smoking is a more important risk factor for males than for females.<sup>7,8</sup> The report "World health statistics 2020: monitoring health for the SDGs, sustainable development goals" published by the WHO showed that among the factors threatening global health, the most important risk factors are high blood pressure, tobacco use, alcohol consumption, unsafe water, sanitation and hygiene, iron deficiency, indoor air pollution, urban air pollution, high cholesterol and overweight.<sup>3</sup> It is known that the underlying causes of the main NCDs are complex and multi-factorial. They include genetic predispositions, as well as modifiable risk behaviors (such as tobacco use, harmful use of alcohol, physical inactivity and unhealthy diets) and environmental risks (such as air pollution), the prevalence of which varies geographically, by income groups and by sex. However, the report shows that the distribution does not have the same trend everywhere in the world. It is observed that while the diseases associated with poverty (protein energy malnutrition, unsafe sex, insufficient breastfeed, unsafe water, sanitation and hygiene, etc.) rank first especially in the developing countries with high mortality, high blood pressure, alcohol-associated diseases, tobacco use, obesity, high cholesterol and low fruit-vegetable intake are more prevalent in developed countries and developing with low mortality. Since 2000, the age-standardized prevalence of obesity among adults (18 years and older) globally has increased 1.5 times, and the crude prevalence in children (5–19 years) has more than doubled (from 2.9% to 6.8%) in 2016. (3) On the other hand, hypertension is considered as a major risk factor for the development of several NCDs, including heart and brain diseases. Global prevalence of hypertension decreased by 11% from 2000 to 2015.

Disaggregation by World Bank country income groups shows that the prevalence of hypertension was highest in low-income countries (28.4%) and lowest in high-income countries (17.7%) in 2015. All these figures are very similar to trends in Turkey.<sup>3,7</sup>

Of the deaths worldwide, 30% are associated with Group I diseases, 60% with Group II and 10% with Group III. However, looking at the regional distribution of the causes of deaths, we encounter a picture similar to the risks factors in 2020. While lower respiratory infections, ischemic heart diseases, diarrhea, HIV/AIDS, prematurity and low birth weight are among the 10 most important causes of deaths in low-income countries, ischemic heart diseases, cerebrovascular diseases, respiratory system cancers, lower respiratory infections and chronic obstructive pulmonary diseases are prominent in high-income countries.<sup>3</sup> In 2019, there were 11 countries where non-communicable disease and injury YLDs constituted more than half of all disease burden.<sup>4</sup>

As to the deaths in 2029, among the global risks are high blood pressure, tobacco use, diabetes, physical inactivity and obesity.<sup>4</sup> And for the low-income and high-income countries, the risk factors are distributed similarly as shown in the report published in 2020. According to Global burden of disease and risk factor studies, at least 80% of the early deaths caused by heart diseases and stroke could be prevented through healthy nutrition, regular physical activity and prevention of tobacco fume. The available data show that a significant part of the deaths worldwide are still associated with preventable reasons. Considering that major part of the causes of deaths of the people especially from the low-income group is observed in the youth age group and associated with Group I diseases.<sup>3,4</sup>

This analytical review shows that the distribution of risks affecting the deaths in Turkey are rather similar to that of developing countries with low mortality. It can be assumed that this situation is based on the success gained during the last 50 years in preventing deaths of the below-five-years-old group, maternal deaths and deaths of young people. However, considering that the priorities of the health system are changing, this situation is still important. The reason is that the Turkish health system has established its priorities on maternal and child health problems, communicable diseases, expansion of immunization and family planning services so far. However, based on the data that we presented, the priorities should be switched to non-communicable diseases such as cardiovascular and cerebrovascular diseases, cancers, obesity and diabetes.

Table 1 and Figures 1 and 2 show the percentage of death and DALYs that could be prevented by taking actions on some selected risk factors in the country. It becomes evident that keeping the systolic blood pressure below 115 mm/Hg would protect 50% of the population against ischemic heart disease and 56% against cerebrovascular diseases. By control of systolic blood pressure in Turkey,

It is possible to prevent 50717 deaths associated with ischemic heart disease, 39731 deaths associated with cerebrovascular disease and 11503 deaths associated with hypertensive heart diseases. This pattern is broadly similar to the distribution worldwide. Globally, 51% of the cerebrovascular diseases is associated with heart diseases and 45% with high systolic blood pressure. This is a complex scenario especially because of the differences between the countries of high-income group and more importantly even between those of the low-income group. For the people below 60 years of age, 7% of the deaths in the high-income segment and 25% in Africa is associated with high blood pressure.<sup>3</sup> In our analysis, high blood pressure control was shown to be an effective intervention in preventing non-communicable disease in Turkey. Especially the people in the aging group should have their blood pressure controlled by constant monitoring by the healthcare personnel. Such controls can enable early diagnosis and prevention before problems related to high blood pressure occur.

While prevention of high cholesterol level protects 54% of the population against ischemic heart disease, prevention of high body mass index protects 40% of it. Hyperlipidemia and obesity, generally co-existing, are potential risk factors for cardiovascular diseases and cerebrovascular diseases. When accompanied by diabetes and high blood pressure, the patient follow-up and treatment becomes difficult and can lead to increased risks of complications.<sup>3,4,10</sup>

2020 data show that controlling high cholesterol, overweight or obesity and high blood glucose level can prevent high percentage of the deaths worldwide. Obesity is not only a problem in developed countries anymore but is also very prevalent in developing countries. In 2016, the global age-standardized prevalence of physical inactivity for adults aged 18+ years was 27.5%. Malnutrition and low physical activity habits and low fruit-vegetable intake increase the risk of obesity and associated problems. Difficult treatment of obesity and high treatment cost related to obesity and associated health problems further increase the importance of adequate preventive measures. Probably, professional vertical organization models may be used in future to address obesity and associated problems.<sup>3,4</sup>

Another prominent problem among the risk factors is tobacco use. By means of many reports, WHO draws attention to the global tobacco epidemics.<sup>2,3,4</sup> 23.6% of adults (15 years and older) globally used tobacco in some form in 2018, down from one third (33.3%) in 2000. The average prevalence of tobacco use among men globally declined from 50.0% in 2000 to 38.6% in 2018. However, that rate is expected to remain above 35% until at least 2025 unless tobacco control policies are tightened on an urgent basis. Among women globally, tobacco use declined from 16.7% in 2000 to 8.5% in 2018.<sup>8</sup>

In our analysis, the main finding regarding tobacco use is that most of the preventable deaths and DALYs are attributable to tobacco consumption. 54699 of the deaths that can be prevented and 931909 of DALYs in Turkey are associated with tobacco use. It is considered that this situation is due to a higher use of tobacco by males. According to the household survey performed in 2003, 17.6% of the women and 49.4% of the men above 18 years of age smoke cigarettes every day.<sup>7</sup> Thus, cigarette-associated preventable deaths and DALYs are largely a male phenomenon.

Globally, tobacco use accounts for 71% of lung cancers, 42% of chronic respiratory tract diseases and for about 10% of cardiovascular diseases. 12% of male deaths and 6% of female deaths are associated with tobacco use.<sup>10</sup> Problems that may arise in association with tobacco use may perhaps be prevented entirely. Because tobacco use is discretionary nature and habitual, and could be influenced by educational programs. In Turkey, large number of lung cancer, cardiovascular system and cerebrovascular system diseases could be prevented by appropriate interventions addressing largely males. Considering the difficulty of treating these diseases, their effects on the quality of life and treatment costs, the frequency of tobacco use should be reduced in the country. In addition, anti-smoking clinics providing first-line service may be introduced in different regions of the country. When the costs of the health problems associated with the tobacco use are taken into account, these clinics may be quite cost-effective. Therefore, we need to put emphasis on primary health care services such as health centers, health houses, mother and infant health services and family medicine. As shown in the National Burden of disease study, the Turkish population is also becoming an aging population and non-communicable diseases should be considered as important disease burdens in the near future. Thus, primary health care facilities are very important for preventing these problems. Family medicine and primary health should become the backbone of the health program in Turkey. As patients having chronic disease have to utilize health care facilities frequently, the demand will increase and so will the costs. Furthermore, these high-cost services create serious pressure on the social security systems, therefore family medicine and primary health care services may make considerable contributions to the follow-up of non-communicable disease in terms of the reduction of costs for healthcare.

## CONCLUSION

Tobacco use, high blood pressure, obesity and physical inactivity and high cholesterol are the most important risk factors contributing to preventable deaths and DALYs in Turkey. It is possible to prevent almost half of the deaths by effectively addressing the first three factors. These findings show that the burden of disease situation in Turkey is similar to the situation in developed countries and some developing countries with low mortality. Preventing the aforementioned risk factors requires

effective health and social security systems. Especially, primary health care services and family medicine should be the backbone of the health system. In Turkey, radical changes have been made both in the health system and the social security system over the last five years. Such changes should also take into consideration the characteristics of the population dynamics and the present patterns in disease burden. Otherwise, an effective health model cannot be established which may lead to extremely high costs in the delivery of health services.

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