Assessing the potential outcomes of achieving the World Health Organization global non-communicable diseases targets for risk factors by 2025: is there also an economic dividend?

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Highlights:

- Existing literature suggests that the SDG target 3.4 of 1/3 reduction in premature mortality from the four major NCDs by 2030 is achievable in high-income countries that have invested in prevention and treatment of NCDs and their related risk factors over the past years.
- WHO member states agreed on nine voluntary global targets on NCDs for 2025, of which six targets aim to reduce and control key risk factors (RFs) (smoking, harmful alcohol use, physical inactivity, obesity and diabetes, salt intake, and high blood pressure).
- The achievement of the six RFs targets (net of the natural decreasing trend in mortality) would contribute to half of the 2030 NCD premature mortality target in France.
- The achievement of the RFs targets by 2025 would improve life years and life years in good health in both working-age and retired people, and would help to reduce health care costs by about €660 million on average per year.

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The views expressed in this paper are those of the authors and do not necessarily reflect those of the OECD or its member countries.

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ABSTRACT

Objectives: This study aims to assess the change in premature mortality and in morbidity if the NCDs global targets for risk factors (RFs) are met by 2025 in France. It also estimates the economic impact in terms of medical expenditure avoided due to the NCDs reduction.

Study design: A microsimulation model is used to predict the future health and economic outcomes of the French population in 2030.

Methods: A 'RF targets' scenario, assuming the achievement of the six targets on RFs by 2025, is compared to a counterfactual scenario in order to estimate the effect of achieving the RF targets on health and economic outcomes (e.g. disability-adjusted life years and health care costs).

Results: The achievement of the six RF targets (net of the natural decreasing trend in mortality) would contribute to half of the 2030 NCD premature mortality target in France. The achievement of the RFs targets by 2025 would save about 25,300 (and 75,500) life years in good health in the population aged 25-64 (respectively 65+), and would help to reduce health care costs by about €660 million on average per year over 2016-2030, which represents 0.35% of the health care spending in France.

Conclusions: Achieving the RF reduction would help France to save life years and life years in good health in both working-age and retired people, and would reduce health care expenditures. But, while the RFs targets are not yet achieved, France has to continue strengthening policy interventions to curb the growing burden of NCDs.

Key words:
Non-communicable diseases, Projection, Obesity, Smoking, Alcohol, Health care expenditure

Introduction

In 2011, the UN General Assembly adopted a political declaration that mobilised member countries for the reduction and control of non-communicable diseases (NCDs). In particular, the resolution includes an ultimate SDG target to reduce by 1/3 premature mortality from NCDs by 2030. In order to achieve this, countries agreed on nine voluntary global targets for 2025 (with a baseline of 2010) which include a target on the reduction of the overall mortality from the four main NCDs (cardiovascular diseases, cancer, diabetes or chronic respiratory disease) by 25% (called the 25x25 target), six key risk factors (RFs) targets, and two national systems response targets (see Table 1).

Table 1. Nine global targets for the prevention and control of NCDs by 2025

1. A 25% relative reduction in the overall mortality from cardiovascular diseases, cancer, diabetes or chronic respiratory disease
2. At least 10% relative reduction in the harmful use of alcohol, as appropriate, within the national context
3. A 10% relative reduction in prevalence of insufficient physical activity
4. A 30% relative reduction in mean population intake of salt/sodium
5. A 30% relative reduction in prevalence of current tobacco use
6. A 25% relative reduction in the prevalence of raised blood pressure or contain the prevalence of raised blood pressure, according to national circumstances
7. Halt the rise in diabetes and obesity
8. At least 50% of eligible people receive drug therapy and counselling (including glycaemic control) to prevent heart attacks and strokes
9. An 80% availability of the affordable basic technologies and essential medicines, including generics, required to treat major NCDs in both public and private facilities.

The case of France is particularly interesting as there is conflicting evidence on whether France may be able to meet these targets. Some recent modelling studies suggest that if the six RF targets are met, France - as well as other high-income countries - may achieve the NCDs premature mortality target by 2025.[1,2] However, historical data suggests that premature mortality from the four main NCDs in France has declined by 20% between 2000 and 2012 and that at this pace, France would not be able to achieve the SDG target by 2030.[3] This is echoed in the GBD 2016 study, which estimated that only 6% of countries worldwide would meet the target of 1/3 premature mortality reduction by 2030, and France would not meet the target.[4]

From a policy-making perspective, it is important to know how much achieving the risk factors targets would contribute to the reduction in premature mortality, the achievement of the 2030 target and curbing the rising levels of health care expenditure. Previous literature has mainly focused on health outcomes concluding that the 2030 premature mortality target is achievable in high-income countries that have invested in prevention and treatment. However, more efforts are deemed necessary to achieve the RFs reduction, particularly in the case of low- and middle-income countries. For instance, a worldwide study found that achieving the six RFs targets would lower premature mortality from the four main NCDs to levels that are close to the 25×25 target by accelerating the already-decreasing mortality trends in cardiovascular diseases and chronic obstructive pulmonary disease, lowering mortality from lung and stomach cancer, and reversing the rising trend in diabetes mortality.[5] In China, if the current trends in RFs continue to 2030, the total premature deaths from NCDs would rise while the premature mortality rate would decrease by 13%.[6] If the six RFs targets are met, the 1/3 reduction goal would be achieved for cardiovascular diseases and chronic respiratory diseases, but not for cancers and diabetes. Reduction in the prevalence of high blood pressure, smoking, obesity played an important role in achieving the goals. In the UK, achieving all RFs targets would avert 300,000 deaths and 1.3 million years lived with disabilities

from NCDs for the period 2010-2025, with health gains resulting mainly from reduced mortality and morbidity from heart disease and stroke, and reduced morbidity from diabetes, depression and dementia.[7]

As previously mentioned, existing literature focuses on the impacts of RFs targets on premature mortality and, in one case, on morbidity from NCDs. However, none of the identified studies attempts to assess the economic outcomes of the achievement of the RFs targets.
This paper builds on the available evidence to assess the health and economic outcomes produced in a scenario in which France was to meet by 2025 the six NCDs global targets on RFs (i.e. targets 2 to 7) More specifically our analyses cover morbidity, mortality and impact on healthcare expenditure. This study does not cover targets eight and nine on access to care as the French health system is well advanced regarding treatment and counselling to prevent and control NCDs. Target one, reduction in mortality, is assessed through the effect mediated by a reduction in the prevalence of the RFs.

Methods

General framework

The OECD Strategic Public Health Planning for NCDs (SPHeP-NCD) model is used to predict the health and economic outcomes of the French population between 2016 and 2030. The model consolidates into a single modelling platform previous collaborative work[8,9] to reproduce a comprehensive set of key behavioural and physiological risk factors (smoking, alcohol consumption, obesity, physical activity, salt intake and blood pressure) and their associated NCDs. The principle of microsimulation is to simulate the individual lives of a group of individuals, representative of a country, from birth to death, including events such as lifestyles and incidence of chronic diseases, remission and fatality from these diseases. The relevant outputs of the model contain diseases prevalence and incidence, death cases, life years and life years lived in good health, medical costs of treatment of the diseases. Validation of the baseline projections of the model was verified by checking population structure, prevalence and incidence of diseases, as well as prevalence of risk factors for the historical period 1990-2015.

Structure of the model and Data Sources

The model is built on four major modules: demography, diseases, risk factors, and medical cost. The three first modules reproduce the demographic, epidemiological, and risk factors characteristics by age- and gender-specific population groups of a given country at different points in time. The demography module simulates births, deaths, and inward/outward migration following the United Nation population projections[10] and the Human Mortality database[11].

Epidemiological characteristics of the model include disease incidence, prevalence, remission and fatality using data from the IHME GBD 2016[12] for the following major NCDs: diabetes, cardiovascular diseases (CVDs) (ischemic heart disease, stroke and atrial fibrillation), respiratory diseases (chronic obstructive pulmonary diseases), neoplasms (lung, colorectal, breast and oesophageal), depression, dementia, musculoskeletal diseases (back pain, gout and rheumatoid arthritis), cirrhosis and lower respiratory infections. In addition, the model accounts for all the other causes of deaths through a residual mortality rate.

Population exposure to six main RFs is modelled using data from IHME GBD 2016 (for smoking and physical inactivity), IHME GBD 2015 and WHO Global Health Observatory[13] for alcohol consumption and

the NCD-RisC data[14] (for obesity and blood pressure). In the model, the definition of smoking refers to current smoking. Alcohol consumption includes the level of alcohol intake (measured in grams of pure alcohol per day) and the prevalence of binge drinking (having six or more drinks per occasion in the past 12 months for men, and five or more drinks for women). Obesity is defined as a body mass index above 30 kg/m^2. Physical inactivity is defined as having below 600 METs (Metabolic Equivalent of Task). High blood pressure is defined as having a systolic blood pressure higher than 140 mmHg.

Medical costs of disease treatment are derived from national health-related expenditure data in France[15] and are replicated in the future. Individual health care access and consumption are considered constant over time (for a given age, gender and diseases profile). The methodology allows differentiation between: average residual costs, marginal disease-related costs (with and without comorbidities), death-related costs and cost of comorbidities. Disease-related costs were calculated for the following diseases: chronic obstructive pulmonary disease, dementia, depression, stroke, myocardial infarction, cancers, diabetes, and cirrhosis.

Relative risks that link risk factors to diseases are determined by gender and age group. Information on relative risks was collected from IHME GBD 2016[16], the DYNAMO-HIA model[17], and the OECD alcohol report[8]. Data sources for all model components are summarised in the Web Appendix.

The 'RF targets' and counterfactual scenarios

A 'RF targets' scenario is designed to reflect changes attributable to the achievement of the six RF targets by 2025 reported in table 1. The salt target is combined with the high blood pressure (HBP) target since the model features assume that the effect of salt intake on NCDs prevalence and mortality is entirely driven by the HBP exposure. Similarly, the diabetes target is fully driven by the obesity target.

The 'RF targets' scenario is compared to a counterfactual scenario in order to estimate the effect of achieving the RF targets on health and economic outcomes (e.g. disability-adjusted life years and health care costs). The counterfactual scenario assumes that age- and gender-specific mortality rates, prevalence of risk factors and relative risks are constant as observed in the last year of simulation.

The 'RF targets' scenario uses historical data between 2010 and 2015 (or the most recent year for which data is available) and assumes a linear reduction in the prevalence of the RFs until reaching targets by 2025. Age- and gender-specific prevalence rates for the RFs are then kept constant between 2025 and 2030. In order to discard the natural decreasing trend in mortality and to isolate the net effect of RFs reduction, age- and gender-specific mortality rates are kept constant as of 2016.

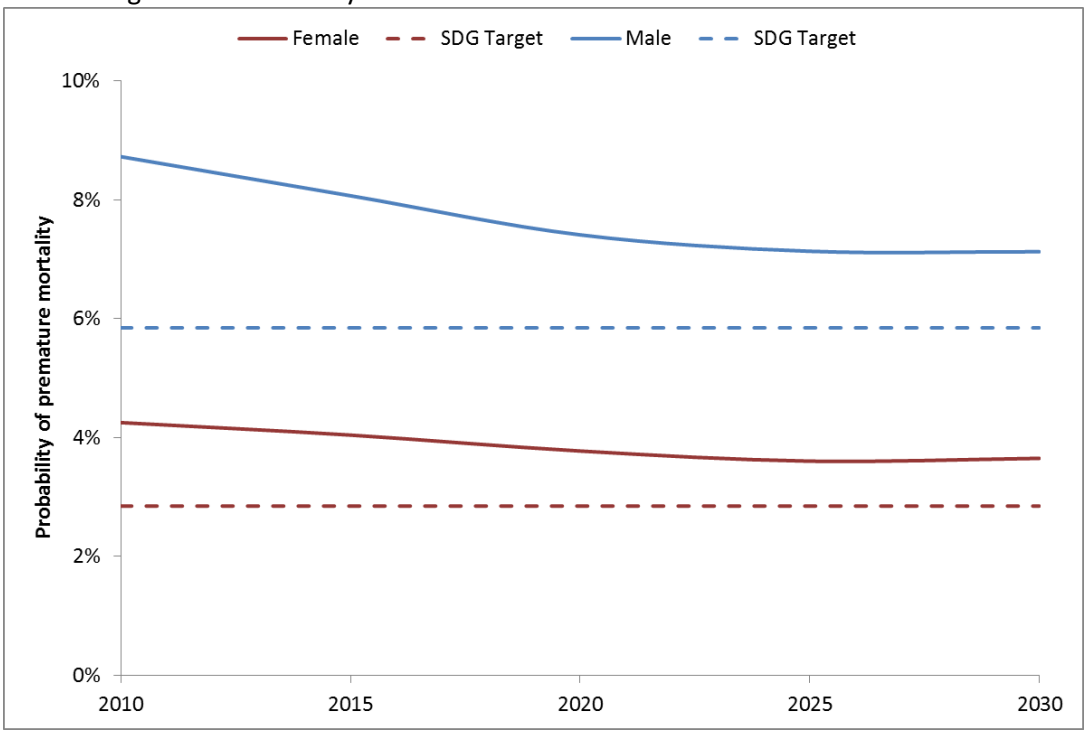
Comparing the 2025 and 2030 predictions with the 2010 situation allows assessing the distance from the targets on premature mortality (by 2025 and 2030), premature mortality being measured by the probability of dying between age 30 and 70 from the four main NCDs (cardiovascular diseases, chronic respiratory diseases, cancers, and diabetes). A sensitivity analysis was carried out to test the alternative assumptions on harmful alcohol use. For instance, the alcohol target was extended to binge drinkers by including a 10% reduction in the age- and gender-specific prevalence of binge drinking in addition to the 10% reduction in the level of alcohol intake among harmful drinkers. This sensitivity analysis showed that restriction on binge drinking does not strongly affect the overall results.

Results

Mortality

The probability of dying between ages 30 and 70 of one of the four main NCDs diminishes with the reduction in the 6 RFs by 2025 in a scenario where mortality is set constant as in 2016 (Figure 1). The RFs reduction reduces premature mortality (net of the natural diminishing trend in mortality) by 18% in men and by 15% in women from 2010 to 2025, which represents about half of the 1/3 reduction target by 2030. The UN projections of life expectancy -which reflect the natural decreasing trend in mortality in the model- result in an yearly reduction in premature mortality of 1.48% in the period 2010-2025, which is likely to reach a 26% reduction by 2030. If the natural decreasing trend in mortality was accounted for in addition to the reduction in risk factors, then France would probably meet both targets on premature mortality by 2025 and 2030.

Figure 1. Probability of Premature Mortality from the 4 main NCDs in France, net of the natural diminishing trend in mortality

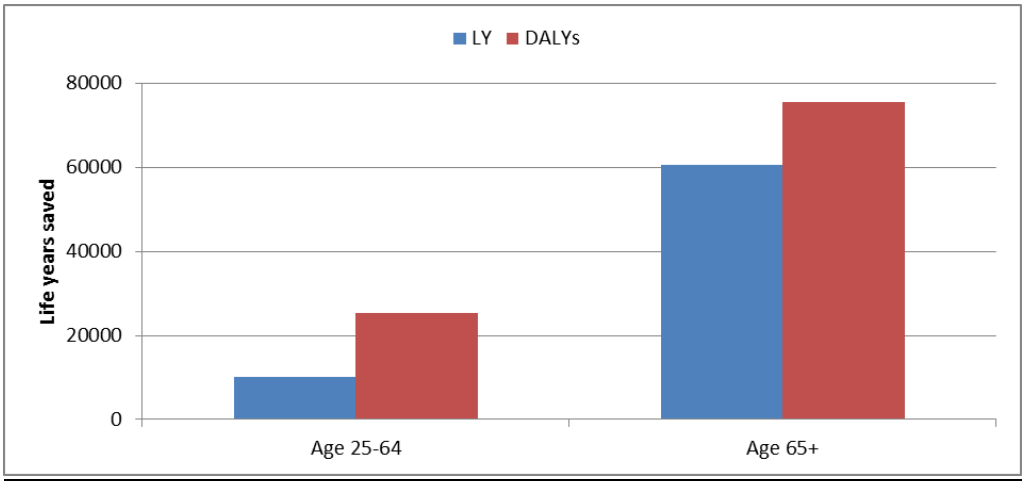


Source: OECD SPHeP-NCD model, 2018.

Morbidity

The achievement of the RF targets by 2025 would lead to an improvement in health outcomes. By meeting the six RF targets, annually, about 10,100 life years and 25,300 life years in good health could be saved in adults aged 25-64 between 2016 and 2030 (Figure 2). In the population aged 65+, about 60,500 life years and 75,500 life years in good health can be saved.

Figure 2. Life years and life years in good health saved in France, average per year 2016-2030, by age group

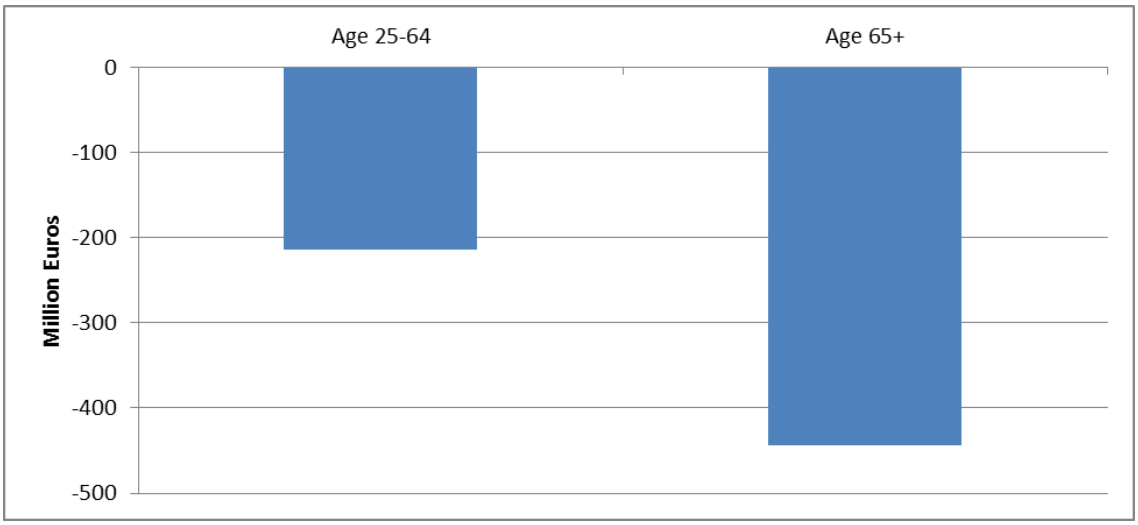


Source: OECD SPHeP-NCD model, 2018.

Expenditures

A reduction in NCD burden is associated with lowered health care costs. If the RF targets were met by 2025, health care costs would be reduced by about €220 million (population 25-64 years) and €440 million in people aged 65 and over, for a total of €660 million on average per year (Figure 3).

Figure 3. Reduction in health care costs, average per year 2016-2030 in France, by age group



Source: OECD SPHeP-NCD model, 2018.

Discussion

This paper shows notable health and economic impacts of the achievement of the WHO global targets for RFs by 2025 in France, notably towards contributing half of the 2030 NCDs premature mortality target in France. It would further improve life years and life years in good health in both working-age and retired

people, and reduce health care costs by about €660 million annually which represent about 0.35% of the total health spending in France. Expected health care savings are small, but this is the result of prevention policies: since people survive from NCDs, they will utilise more health care services and increase expenditure. However, the success of prevention should not just be measured in terms of health care savings. Health gains themselves are valuable; furthermore, social costs and indirect costs are not taken into account here.

Results of this study not only present novel results on the concrete health and economic impact of the SDG agenda in France, but also represent the first peer-reviewed results of the SPHeP-NCD model. SHPeP-NCD builds on and improves existing microsimulation models[8,9] estimating the health and economic impact of health and broader policy scenarios. As such, SHPeP-NCD stands out against existing, similar models in the following novel ways. First, SHPeP-NCD models real-life counterfactuals: for example, in the absence of exposure to smoking, the same individual might still be afflicted with heart disease due to other, non-affected risk factors. This lowers the impact of risk factor specific policy scenarios compared to traditional cost-benefit approaches, however, represents a much-closer-to-reality scenario. This translates into more realistic cost savings estimates, compared to approaches that model the cost-benefit trade-off without allowing for alternative outcomes. To some extent, this mechanism explains why the cost impact of the 25x25 strategy does not yield large size reduction in the spending: people whose morbidity and mortality is reduced however continue to consume healthcare.

Second, SHPeP-NCD, in novel fashion, distinguishes between costs at different stages of disease. For example, the extra cost of disease in the last year of life in a cancer patient (which is higher than when in remission) is taken into account. To the authors' knowledge, this is the first time that a microsimulation, whole-of-society model takes into account costs at different stages of disease, thereby allowing to address one of the most pertinent questions in this literature: does prolonging life lead to overall costs savings or increased costs? [18,19] The model can then better inform on what happens to national health care costs when prolonging life does not result in compression of morbidity, but rather, the extension of years lived with disease in the population.

Lastly, SHPeP-NCD further contributes to the field of modelling the cost burden of chronic diseases by incorporating the cost of co-morbidities, answering the question whether there is additionality when two or more diseases co-exist in one person. Only a limited amount of high quality results exist in this area, mainly from the US and Nordic countries, and for only a sub-set of conditions.[15] Therefore, by modelling the cost of co-morbidities, and showing that additionality and super-additionality is significant, but only for a subset of the modelled conditions, the results from SHPeP-NCD provide results that not only improve on existing models available to date, but provides results with immediate policy-relevance. SHPeP-NCD thus provides results that highlight the importance of targeting not single diseases, but also overall comorbidities, with policy interventions. It further can provide guidance on which co-morbidity reduction might results in the highest cost savings.

Policy context and implications

Obesity, smoking, and alcohol misuse are public health concerns that are being addressed with appropriate policy actions and national programmes in France. For instance, the French national nutrition and health programmes initially implemented in 2001 and revised since (PNNS 2017-21) offers dietary guidelines and physical activity recommendations for both general and specific population groups. The French strategy against obesity also includes restrictions on food advertising to children on TV and radio, and more recently,

the *Nutri-Score*, a voluntary front-of-pack food labelling scheme that aims to help consumers to make healthier choices. Regarding smoking control, a national programme against tobacco addiction for 2014-2019 has introduced plain tobacco packaging, smoking bans in public places and children's areas, and taxation to increase the price to 10 euros per pack by 2020. Regarding alcohol policy, France regulates on age limit, place and hours for selling alcohol, and on drink-driving, while regulations on alcohol advertising initially introduced in 1991 by the Loi Evin have been moderated over recent years.[20] Taxation on alcohol is uneven across type of beverages, in particular with low taxes on wine compared to other European countries.[21] While the RF targets are not yet achieved in France, continuous efforts for more actions and comprehensive strategies are required to strengthen the existing policy to curb the growing burden of NCDs.

Limitations

At least three limitations can be discussed. First, the magnitude of health care costs reduction may appear small compared to the level of expenditure in France (around €200 billion in 2017). As mentioned previously, part of this can be explained by the fact that people who survive longer with the lessening of NCDs will utilise more health care services. Plus the effect of RFs on health and costs is not immediate and will take time to materialise. Besides, this analysis disregards the indirect costs (e.g. labour market outcomes) which can be important. Second, the OECD SPHeP-NCD model does not capture all the premature mortality compared to published estimates (respectively in men and women, 8.7% and 4.2% in the model versus 14.6% and 7.3% in WHO estimates[22]). This is due to the fact that the model does not cover all types of cancers and CVDs, and accounts for 56% of the deaths attributable to the 4 major NCDs. Lastly, model-based results rely largely on data and assumptions. The model input data taken from NCD-RisC and IHME does not necessarily represent the latest national trends. For instance, the IHME data suggest a slight increase in the rates of obesity between 2010 and 2016, whereas other sources conclude that obesity has stagnated in France since 2006.[23] However, this does not greatly affect the results, since the RFs target scenario simulates a halt in obesity.

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ANNEX

Annex Table 1. Data source for the OECD SPHeP-NCD model

Model module	Data	Source
Demography	Population projection	United Nations. World Population Prospects - Population Division - United Nations. Retrieved 01 01, 2016, from https://esa.un.org/unpd/wpp/
	Mortality	Human Mortality Database. Retrieved 03 29, 2016, from http://www.mortality.org/
Diseases	Disease incidence, prevalence, remission and fatality	GBD 2016 Disease and Injury Incidence and Prevalence Collaborators, T., Abajobir, A., Abate, K., Abbafati, C., Abbas, K., Abd-Allah, F., et al. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet (London, England), 390(10100), 1211-1259.
Risk Factors	Smoking, physical inactivity, and salt intake	GBD 2016 Disease and Injury Incidence and Prevalence Collaborators, T., Abajobir, A., Abate, K., Abbafati, C., Abbas, K., Abd-Allah, F., et al. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet (London, England), 390(10100), 1211-1259.
	Alcohol	WHO, 2018, Global Health Observatory Data Repository, Indicator on Average daily intake in grams of alcohol, by country. Accessed on 21 December 2017 at: http://apps.who.int/gho/data/node.main.A1037?lang=en and IHME 2015
	Obesity and blood pressure	NCD Risk Factor Collaboration (NCD-RisC), L., Abdeen, Z., Hamid, Z., Abu-Rmeileh, N., Acosta-Cazares, B., Acuin, C., et al. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet (London, England), 390(10113), 2627-2642.
	Relative risks	Gakidou, E., Afshin, A., Abajobir, A., Abate, K., Abbafati, C., Abbas, K., et al. (2017). Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet, 390(10100), 1345-1422. Lhachimi, S., Nusselder, W., Smit, H., van Baal, P., Baili, P., Bennett, K., et al. (2012). Dynamo-HIA-a dynamic modeling tool for generic health impact assessments. PLoS ONE. 7(5): e33317. Cecchini, M., Devaux, M., & Sassi, F. (2015). Assessing the impacts of alcohol policies: A microsimulation approach. OECD Health Working Paper No. 80, Paris.
Costs	Health care expenditure by disease	Cortaredona, S., & Ventelou, B. (2017). The extra cost of comorbidity: multiple illnesses and the economic burden of non-communicable diseases. BMC Medicine, 15(1), 216.

REFERENCES

[1] WHO. (2017). Noncommunicable diseases progress monitor, 2017. (WHO, Ed.)

[2] Kontis, V., Mathers, C., Rehm, J., Stevens, G., Shield, K., Bonita et al. (2014). Contribution of six risk factors to achieving the 25x25 non-communicable disease mortality reduction target: a modelling study. The Lancet, 384, 427-437.

[3] Hege, E., Vaillé, J., Demailly, D., & Brimont, L. (2016). La France passera-t-elle le test des Objectifs du développement durable (ODD) ? Une évaluation des nouveautés et des défis des ODD pour la France. IDDRI. French.

[4] GBD 2016 SDG Collaborators, N., Barber, R., Abajobir, A., Abate, K., Abbafati, C., Abbas, K., et al. (2017). Measuring progress and projecting attainment on the basis of past trends of the health-related Sustainable Development Goals in 188 countries: an analysis from the Global Burden of Disease Study 2016. Lancet (London, England), 390(10100), 1423-1459.

[5] Kontis, V., Mathers, C., Bonita, R., Stevens, G., Rehm, J., Shield, K., et al. (2015). Regional contributions of six preventable risk factors to achieving the 25x25 non-communicable disease mortality reduction target: a modelling study. The Lancet Global Health, 3, e746-e757.

[6] Li, Y., Zeng, X., Liu, J., Liu, Y., Liu, S., Yin, P., et al. (2017). Can China achieve a one-third reduction in premature mortality from non-communicable diseases by 2030? BMC Medicine, 15(1), 132.

[7] Cobiac, L., & Scarborough, P. (2017). Translating the WHO 25×25 goals into a UK context: the PROMISE modelling study.

[8] Cecchini, M., Devaux, M., & Sassi, F. (2015). Assessing the impacts of alcohol policies: A microsimulation approach. OECD Health Working Paper No. 80, Paris.

[9] Cecchini M, Cortaredona S, Devaux M, Elfakir A, Goryakin Y, Lerouge A et al., Scientific paper on the methodology, results and recommendation for future research, FRESHER report Deliverable 5.3, December 2017.

[10] United Nations. World Population Prospects - Population Division - United Nations. Retrieved 01 01, 2016, from https://esa.un.org/unpd/wpp/

[11] Human Mortality Database. Retrieved 03 29, 2016, from http://www.mortality.org/

[12] GBD 2016 Disease and Injury Incidence and Prevalence Collaborators, T., Abajobir, A., Abate, K., Abbafati, C., Abbas, K., Abd-Allah, F., et al. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet (London, England), 390(10100), 1211-1259.

[13] WHO, 2018, Global Health Observatory Data Repository, Indicator on Average daily intake in grams of alcohol, by country. Accessed on 21 December 2017 at: http://apps.who.int/gho/data/node.main.A1037?lang=en

[14] NCD Risk Factor Collaboration (NCD-RisC), L., Abdeen, Z., Hamid, Z., Abu-Rmeileh, N., Acosta-Cazares, B., Acuin, C., et al. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet (London, England), 390(10113), 2627-2642.

[15] Cortaredona, S., & Ventelou, B. (2017). The extra cost of comorbidity: multiple illnesses and the economic burden of non-communicable diseases. BMC Medicine, 15(1), 216.

[16] Gakidou, E., Afshin, A., Abajobir, A., Abate, K., Abbafati, C., Abbas, K., et al. (2017). Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational,

and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet, 390(10100), 1345-1422.

[17] Lhachimi, S., Nusselder, W., Smit, H., van Baal, P., Baili, P., Bennett, K., et al. (2012). Dynamo-HIA-a dynamic modeling tool for generic health impact assessments. PLoS ONE. 7(5): e33317.

[18] Nisticò, F., De Alfieri, W., Troiano, G., Nante, N., Dei, S., & Piacentini, P. (2017). Age-specific patterns of health care expenditure in dying people. Public health, 152, 17-19.

[19] Aldridge, M., & Kelley, A. (2015). The Myth Regarding the High Cost of End-of-Life Care. American journal of public health, 105(12), 2411-5.

[20] OECD. (2015). Tackling Harmful Alcohol Use: Economics and Public Health Policy. OECD, Paris.

[21] OECD/European Observatory on Health Systems and Policies. (2017). France: Country Health Profile 2017, State of Health in the EU. OECD Publishing, Paris/European Observatory on Health Systems and Policies, Brussels.

[22] WHO, 2018, Global Health Observatory Data Repository, Indicator on Risk of premature death from the four target NCDs, Data by country. Accessed on 27 March 2018 at: http://apps.who.int/gho/data/node.main.A857?lang=en

[23] Verdot, C., Torres, M., Salanave, B., & Deschamps, V. (2017). Corpulence des enfants et des adultes en france métropolitaine en 2015. Résultats de l'étude Esteban et évolution depuis 2006. BEH, 13, 234-241. French.