# Interventions on the urban environment yield significant public health gains

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## Introduction

Physical inactivity and excessive sedentary behaviours are risk factors for many non-communicable diseases. Physical inactivity has been linked to heart diseases, stroke, diabetes, and osteoporosis (Kruk 2014) Sedentary behaviours have been found to increase a risk for all-cause mortality, as well as mortality from and incidence of cardiovascular diseases and cancer (Biswas, Oh et al. 2015). Physical inactivity also has a significant economic cost, estimated at USD PPP 53.8 billion worldwide for health systems in 2013, of which 31.2 billion was paid for by the public sector, 12.9 billion by the private sector, and 9.7 billion by households (Ding, Lawson et al. 2016).

The urban environment plays a fundamental role in supporting or discouraging the development of unhealthy lifestyles including physical inactivity and sedentarism. While many of the policies affecting the urban environment are not directly under the control of health authorities (e.g. transportation and developing sports infrastructure), such policies can be designed to produce positive effects on physical activity on population health. For example, greater availability of stadiums, basketball courts, swimming pools and other recreational options can make it easier for people to increase their physical activity levels. Perhaps less intuitively, access to public transportation networks may also prompt people to be more physically active, for example by encouraging them to get to the transit stations on foot or on bike (Chang, Miranda-Moreno et al. 2017).

## Methodology

To assess the return of investment of such policies and to compare their effect against other health promoting interventions, the OECD has developed a model to forecast future chronic disease burden, longevity and direct economic costs. The OECD SPHeP-NCD (Strategic Public Health Planning for NCDs) model uses case-based microsimulation to create synthetic life histories from birth to death, and relies on detailed epidemiological and demographic information from various sources. The model was adapted to simulate a set of five policies in France: promotion of active transport (AT), workplace sedentarity interventions (WS), investments in sports and recreation (ISR), mass media campaigns (MMC) and prescription of physical activity in primary care (PPA). Interventions are modelled by considering their effectiveness at the individual level, their potential population coverage rates and their costs (Table 1). The interventions effectiveness parameters are taken from existing published meta-analyses (WS), meta-analyses carried out by the OECD (PPA, MMC, AT) or from individual studies (ISR).

More concretely, the following five policies were modelled:
a) ISR assumes that public spending on recreational and sports services in France will be increased by about 1%, or by 118 million Euros in 2019. Once started, this increase in funding is expected to be maintained at the same level in real terms in all subsequent years until 2050. The policy effectiveness evidence comes from (Humphreys and Ruseski 2007).

b) Providing access to public transportation to an additional 1% of the French population in 2019, and then every 5 years (AT intervention). No additional transportation expansion is assumed in the following years. This intervention was modelled based on the results of a systematic review and meta-analysed (Xiao, Goryakin et al. 2018).

c) Prescribing physical activity in the primary care (PPA) to people aged 40-70 years with at least one risk factor (overweight/obese; physically inactive; with diabetes; hypertension; smoking), but healthy enough to exercise. The intervention was modelled based on a recent systematic review and meta-analysis (Goryakin, Suhlrie et al. 2018)

d) Workplace interventions to reduce sedentarity time (WS) in full-time employees (aged 18-65 years) who work in services industry and in medium and large enterprises. The intervention provides the option to use stand-up desks to reduce the sitting time. The evidence on the effectiveness comes from (Chu, Ng et al. 2016).

e) Media campaign (MMC) to increase physical activity levels through radio, television, newspapers/magazines. The intervention is run in 6 segments between 2019 and 2050, with each lasting for 3 years. The evidence on the effectiveness comes from (Goryakin, Gatta et al. 2017)

**Table 1. Interventions description**

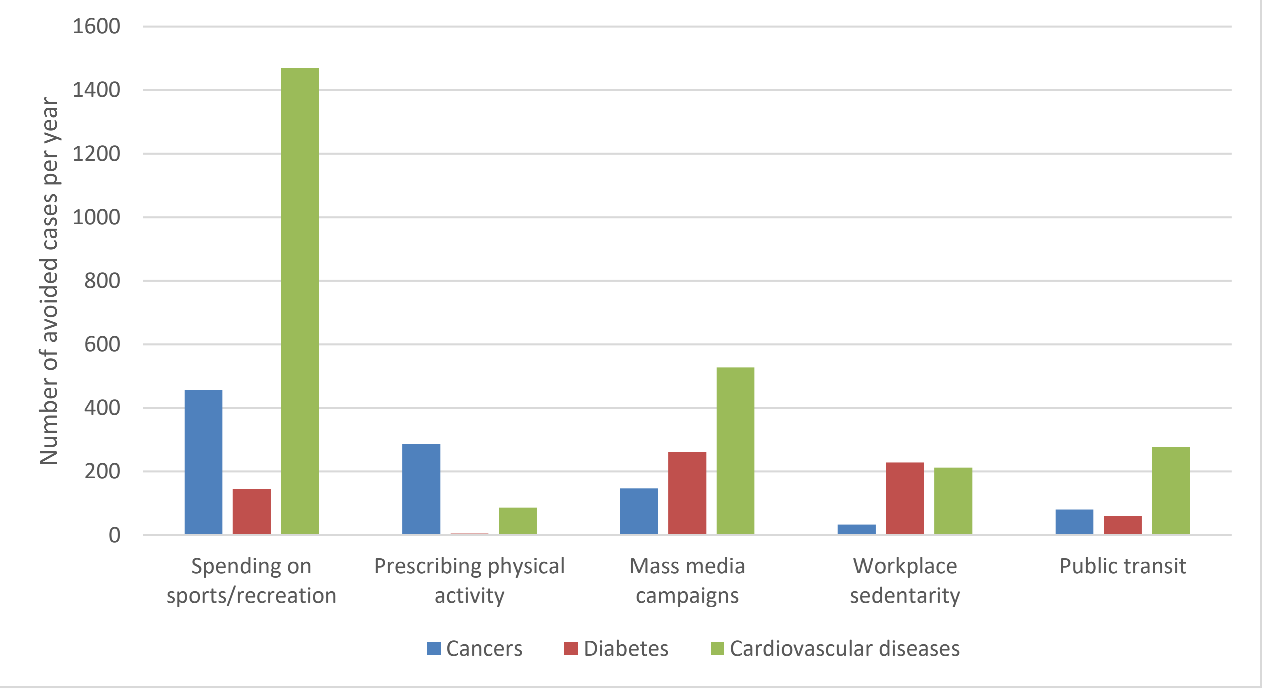
| Characteristics | Investment in sports and recreation | Prescribing physical activity | Media campaigns | Public transport | Workplace sedentarity |
|---|---|---|---|---|---|
| Target age | >18 | 40-70 | >18 | >18 | 18-65 |
| Target PA dimension | Sports | Sports | Sports | Transportation | SB |
| Restrictions | none | At least 1 risk factor for NCDs | none | Exposed communities only | Full time white collar workers |
| Target as % of population | 100% of eligible | 26.4% of eligible | 100% of eligible | 100% of eligible | 5.9% of those employed in 2019; 5.9% of newly employed in subsequent years. |
| Effectiveness | +50.7 MET-minutes/ week | +168.6 MET-minutes/ week | 60% increase* after 1 month; drop to 30% after 1 year, drop to 0 after 2 more years | +105.6 MET-minutes/ week | -72.78 min of SB/ 8-h workday |
| Pattern of exposure | Once started, maintain till death for 50%; for the rest, effect disappears after 2 years | Maximum effect after 6 months; reduced to 0 after 1 year | 6 waves of three years each | Once started, maintain till death | Once started, maintain till 65 y.o. for 50% of exposed; for others effect disappears after 1 year |
| Annual cost per capita, (constant 2015 Euros) | 1.76 | 0.76 | 1.72 | - | - |

*Note*: *Refers to change in the proportion of at least moderately active people. SB: sedentary behaviour; BMI: body mass index; y.o.: years old; MET: metabolic equivalent of task. The annual cost refers to expenditures by the Ministry of Sports (ISR intervention), or Ministry of Health (all other interventions).

## Results

All the interventions were found to reduce the number of new cases of diabetes, cancer (colorectal and breast) and cardiovascular diseases (including ischemic heart disease, myocardial infarction, ischemic and haemorrhagic stroke (Figure 1)). ISR had a notably large effect on cardiovascular diseases (CVD) and cancers. AT had a non-trivial effect on CVD incidence, higher than both PPA and WS. It also had a larger effect on cancers than WS.

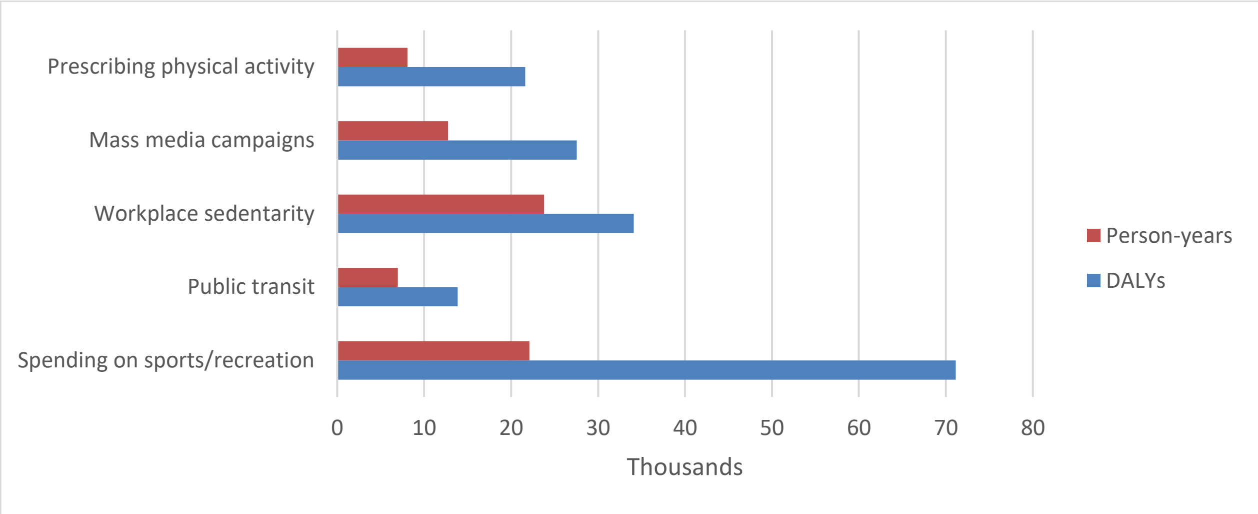
Figure 1. Average number of avoided cases per year by type of intervention in France, 2019-2050




*Note*: Each bar represents the number of diseases prevented every year by each intervention over the period 2019-2050. These diseases were selected based on their link with the modelled risk factors. CVD refers to ischemic heart disease, myocardial infarction, ischemic and haemorrhagic strokes. Cancers refer to colorectal and breast cancers.

On a more general level, all interventions were found to lead to a gain in Disability-Adjusted LifeYears - DALYs (discounted at 3% annually) starting from 2019 and over then following 32 years (Figure 2 and Figure 3), with ISR predicted to lead to a cumulative gain of 71,000 DALYs. This was followed by WS (34,000), MMC (28,000), PPA (22,000) and AT (14,000).

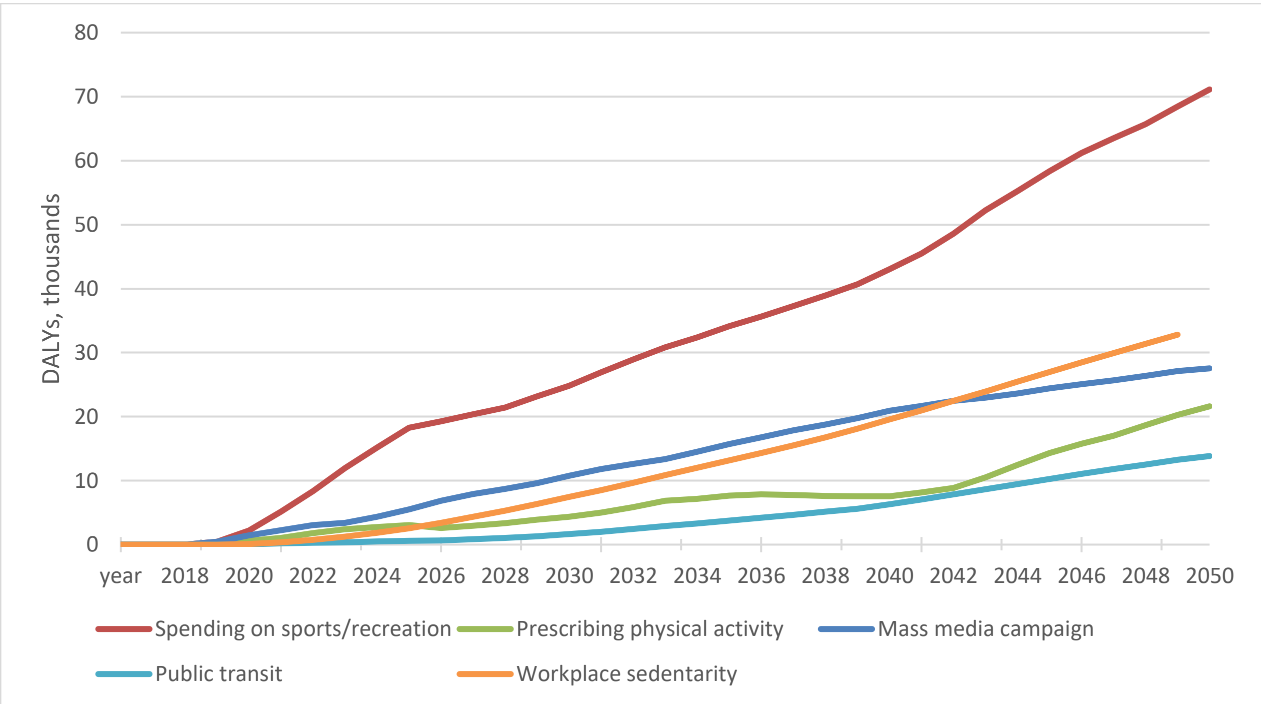
Figure 2. Cumulative health outcomes at the population level in France, 2019-2050




*Note*: DALYs: disability-adjusted life years. PY: person-years. Each bar shows the cumulative effect of a corresponding intervention on DALYs and PYs gained over 2019-2050. All future DALYs and PYs are discounted at 3% per year.

All modelled interventions are also predicted to lead to a larger gain of DALYs compared to person-years (PYs) - see Figure 2. This suggests that implementing these interventions in France is more likely to reduce the morbidity burden, such as by delaying or preventing the onset of chronic diseases, than to reduce the chronic disease-associated mortality rate.

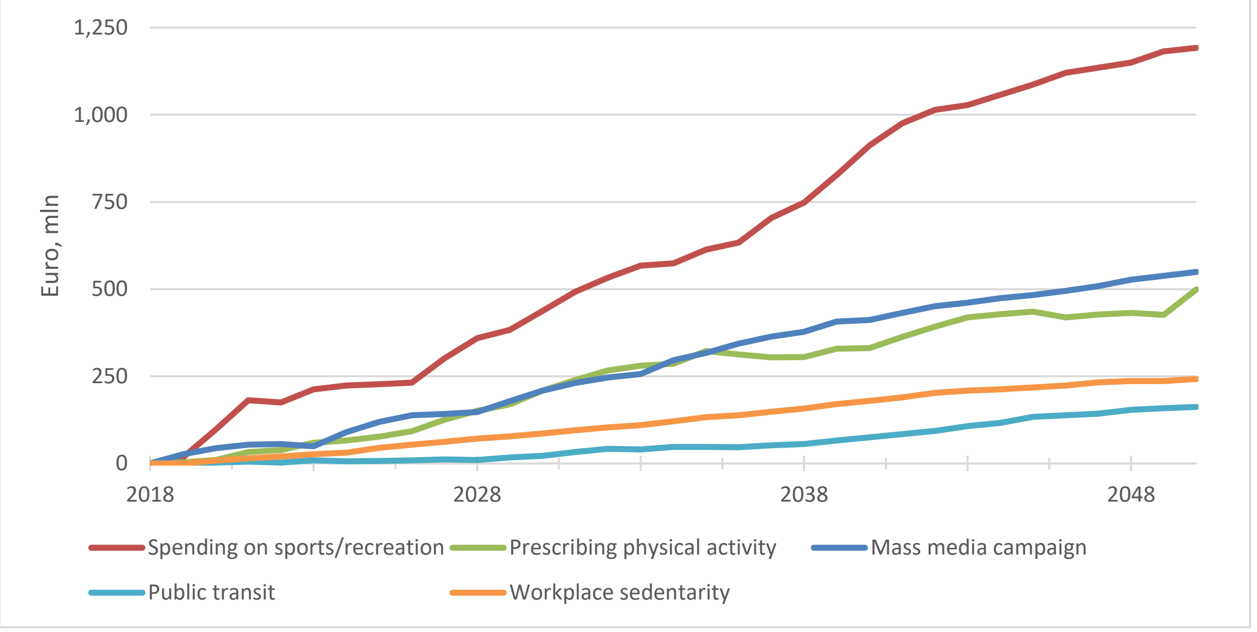
Figure 3. Cumulative impact on DALYs gained in France, 2019-2050




*Notes*: DALYs: disability-adjusted life years. Each line shows the cumulative effect of a corresponding intervention on DALYs gained over 2019-2050. All future DALYs are discounted at 3% per year.

All the interventions are also predicted to result in significant decreases in health care expenditures (Figure 4). Thus, starting in 2019 and over the next 32 years, ISR in France will cumulatively save about 1.2 billion Euros of health care expenditures. This is followed by 549 million Euros for MMC; 499 million Euros for PPA; 242 million Euros for WS and 162 million Euros for AT.

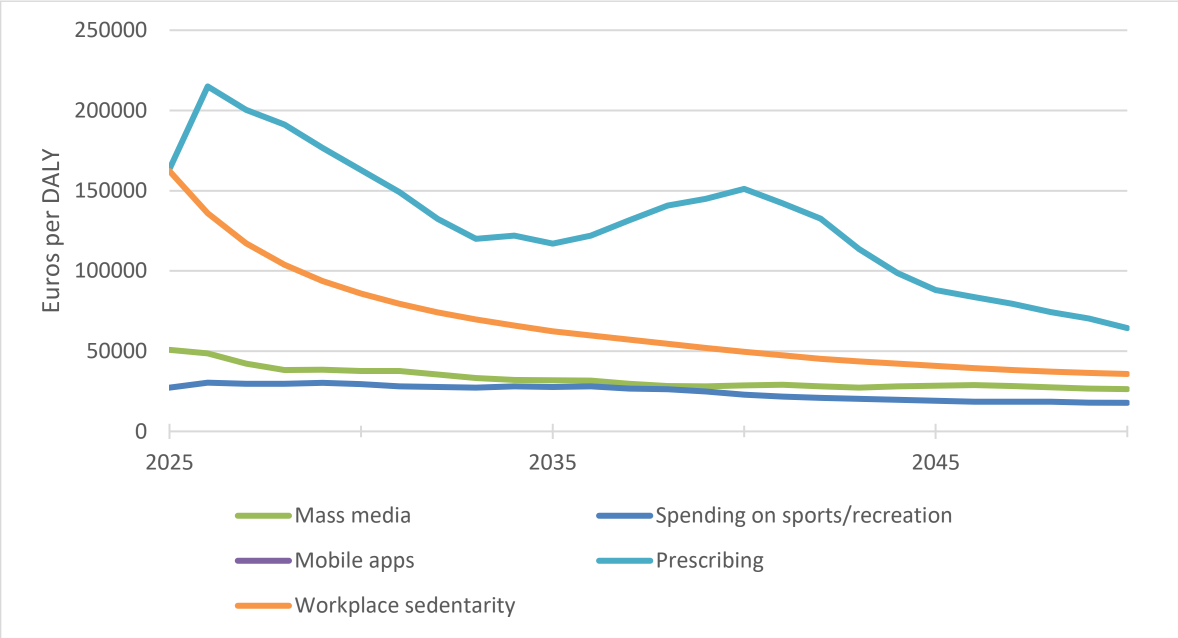
Figure 4. Cumulative impact on health expenditures saved in France, 2019-2050




*Note:* Each line shows the cumulative effect of a corresponding intervention on health expenditures (in million Euros) saved over 2019-2050. All future expenditures are discounted at 3% per year. The expenditures are reported in constant Euros, with 2015 as the base year.

A fuller picture of the intervention impact is provided by estimating intervention cost-effectiveness over time, because both costs (of interventions themselves, offset by changes in health expenditures) and benefits (expressed in DALYs gained) can be taken into account at the same time. Two interventions are predicted to be cost-effective by conventional thresholds, with the most commonly known ones (Devlin 2003; Eichler, Kong et al. 2004) being in the range of 20,000 to 30,000 GBP (i.e. about 22,000 to 33,000 EUR) per quality-adjusted life year gained in the United Kingdom (Figure 5), although higher values for commonly accepted thresholds also exist (Devlin 2003; Eichler, Kong et al. 2004. For example, cost-effectiveness ratio for ISR will go below 30,000 EUR by 2030 and for MMC- by 2036. As the main goal of improving public transportation infrastructure is not to increase physical activity, but to improve transportation options for people, which is impossible to account for in the context of this analysis, no cost-effectiveness results are presented for AT.

Figure 5. Cost effectiveness ratios by intervention in France over 2025-2050




*Note:* Each line represents a ratio of cumulative intervention costs (minus health expenditures saved) divided by DALYs gained. All costs are reported in constant Euros, with 2015 as the base year. Both costs and DALYs are discounted at 3% per year.

**Discussion**

A number of policy options exist to nudge people into doing more physical activity. According to the OECD SPHeP-NCD model, the intervention with the largest population-level exposure - ISR - would have the greatest positive effect on population health, with about 71,000 cumulative DALYs gained starting from 2019 and over the following 32 years in France. The predicted impact of this intervention is so large mainly due to its sizeable and continuously maintained population coverage.

Another intervention with the potential to modify the urban environment - AT- is predicted to have smaller impact mainly because it was assumed to apply to a very small proportion of the population, and only once every five years. This assumption was made based on the fact that public transportation coverage in France is already relatively extensive. In countries with less generous public transportation coverage, potential gain from AT expansion can be much greater. Nevertheless, AT was found to have an impact on CVD and cancer disease incidence which was comparable (or even greater than) 3 other modelled interventions.

In addition, considering only the health-related benefits of the reviewed interventions will give a limited picture, as at least some of them should be placed in the broader context of making improvements to the urban environment. For example, improving public transportation networks is an example of a policy whose benefits may extend well beyond the health-related outcomes. They may include, for example, economic efficiencies gained from better infrastructure; welfare benefits from better transportation options; as well as environmental benefits stemming from reduced pollution. Likewise, spending on sports and recreation will have a number of benefits going beyond health improvements. For this reason, traditional cost-effectiveness analysis of such policies should be considered as a conservative approach, as these broader benefits cannot be taken into account when the health-oriented perspective is chosen.

## Conclusions

Findings from this study suggest that investments in careful urban design and planning can have a positive and significant public health impact without the need of mobilizing resources from the healthcare budget. Further benefits can be achieved by the associated reduction in air pollution.

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