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Quantification of disparities in the distribution of lifestyle and metabolic risk factors, prevalence of non-communicable diseases and related-mortality in Belgium 1997-2018

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ABSTRACT

OBJECTIVES Comprehensively measure the trends in health disparities by socio-demographic strata in terms of exposure to lifestyle and metabolic risks, and prevalence of non-communicable diseases (NCDs) during the last 20 years in Belgium.

DESIGN Cross-sectional analysis of periodic national-representative health surveys.

SETTING Population-based study of adult residents in Belgium between 1997-2018.

PARTICIPANTS Adults aged 25-84 years and resident in Belgium in the years 1997 (7,256 adults), 2001 (8,665), 2004 (9,054), 2008 (7,343), 2013 (7,704), and 2018 (8,358).

MAIN OUTCOME MEASURE Age-standardised prevalence rates of modifiable lifestyle risks (poor diet, smoking, excessive alcohol use and leisure-time physical inactivity), metabolic risks (high body mass index (BMI), blood pressure and cholesterol levels), and major NCDs (type 2 diabetes (T2DM), cardiovascular diseases (CVD), cancer, asthma and chronic obstructive pulmonary disease (COPD)), with their relative health disparities across strata by age, sex, region of residence, nationality, education and income level, and according to high versus low engagement in the four lifestyle risks

RESULTS Greater avoidable disparities were observed between extremes of education and income strata. The most marked disparities were found for exposure to lifestyle risks, except excessive alcohol use, prevalence of high BMI as well as T2DM, asthma and COPD, with disparities of daily smoking and COPD worsening over time. High engagement in lifestyle risks was generally observed for men, residents of the region Wallonia, and among lower education and income strata. This subgroup (20%) had a worse health profile as compared with those who had a low-risk lifestyle (25%), shown by prevalence ratios varying between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD, asthma and COPD.

CONCLUSIONS Improving population health, including promoting greater health equity, requires approaches to be tailored to high-risk groups with actions tackling driving root causes of disparities seen by social factors and unhealthy lifestyle.

KEYWORDS

Lifestyle risks –metabolic risk factors – overweight – type 2 diabetes – cardiovascular disease – socio-demographic factors – disparities

ARTICLE SUMMARY

Strengths and limitations of this study

- The identification of vulnerable groups within populations and the quantification of the health disparity gaps according to their root causes is essential to support equitable health promotion programmes and preventive strategies aiming at more health gains for all.
- We used data of the Belgian Health Interview Surveys, the best available nationally relevant epidemiological evidence from Belgium over the last 20 years, to study disparities in health from lifestyle and metabolic risks to non-communicable disease outcomes.
- From the socio-demographic sources of health disparities, only age is unavoidable, others should be accounted for when formulating equitable health policies.
- The self-reported lifestyle, metabolic risks and prevalence of common non-communicable diseases were likely to be underestimates; as reporting of them is subjected to more than only their actual presence.
- The cross-sectional survey design cannot rule out the possibility of reverse causation where those with prevalent non-communicable disease did show to have less lifestyle risks.

INTRODUCTION

Chronic non-communicable diseases (NCDs), including type 2 diabetes mellitus (T2DM), cardiovascular diseases (CVD), cancer, and respiratory diseases, are the leading causes of morbidity and mortality in Europe with over 90% of all deaths attributed to NCDs, and 86% in Belgium.[1] The onset of NCDs is driven by primarily four major lifestyle risks: unhealthy diets, tobacco use, alcohol use and physical inactivity, all of which are modifiable.[2] These lifestyle risks are the main cause of the rising prevalence of metabolic risks such as high body mass index (BMI), high blood pressure, hyper-glycaemia, and -cholesterolemia leading to the onset of NCDs and a major population health burden.[2]

Monitoring risks and disease prevalence in the population is essential for public health planning. It is particularly relevant for identifying health disparities and less favoured population subgroups, given the urgent need to address health equity, as acknowledged by the World Health Organisation (WHO),[3,4] the European Union (EU),[4,5] and state members such as Belgium.[6,7] Variables such as age,[8] sex,[9] geographical region,[10] nationality[11,12] and socio-economic status (SES)[10,13] are well-known indicators of health disparities at the population level, as characterised in the EU.[10] In Belgium, health disparities have been consistently monitored over the years for region and educational level, with overall less prevalent NCDs risks and outcomes for residents of Flanders and the higher educated.[14,15]

While these socio-demographic risk factors are non-modifiable (*e.g.* age and sex) or difficult to change (*e.g.* SES), other risk factors, such as lifestyle choices, offer an opportunity to indirectly address disparities in the pursuit of health equity. Lifestyle choices, however, tend to cluster, *i.e.* most individuals engage in multiple lifestyle risks: poor diet, smoking, excess alcohol and physical inactivity,[16] with this accumulation of lifestyle risks having strong implications for living a longer life in good health.[17,18] Defining health disparities in terms of engagement to multiple lifestyle risks offers an additional perspective into identifying high-risk stratum for priority action. The comprehensive understanding of who is at risk and which lifestyle risks more frequently cluster would certainly support tailored health promotion programmes, aiming at more health gains.

To identify and quantify all relevant health disparities in Belgium, this study aims to provide a clear and comprehensive overview of the health status, from lifestyle risks to NCDs, by relevant population strata of socio-demographic factors as well as by engagement in multiple lifestyle risks, using nationally relevant epidemiological evidence from Belgium over the last 20 years.

METHODS

Data sources

Belgian Health Interview Surveys (BHIS)

The BHIS is a cross-sectional study, conducted by Sciensano, carried out periodically every four to five years since 1997 and including approximately a sample of 10,000 participants per survey wave representative of Belgian residents. Briefly, participants were selected from the Belgian national population register through a multistage stratified population sampling involving a geographical stratification according to the regions, and subsequently, a selection of municipalities within provinces, households within municipalities, and a maximum of four respondents within households was applied. Data were collected through face-to-face interview at the participant's home covering demographics, specific diseases and conditions, and nutritional status, and a self-administered questionnaire covering more sensitive topics, such as health behaviours and lifestyle. Survey weights were designed and applied to ensure the representativeness of the sample in terms of age, sex and province. Further details on the BHIS are described elsewhere.[19-21]

The present analyses included adults aged between 25 and 84 years. Participants younger than 25 years were excluded from the analysis since a large proportion achieved their highest educational level by the age of 25, and aged 85 years and older since a large proportion of them are institutionalised and the surveys did not include these people. The final sample included 7,256 adults in the year 1997, 8,665 in 2001, 9,054 in 2004, 7,343 in 2008, 7,704 in 2013 and 8,358 in 2018.

Standardised Procedures for Mortality Analysis (SPMA)

SPMA, operational since the early 1990s, was developed by Sciensano with the aim to facilitate the use of vital statistics data for public health policy and scientific research.[22] From 1998 up to 2017, cause-specific mortality data were coded by the ICD-10 using the initial cause of death only, and grouped by age, sex, region of residence and nationality. Data from 1998 was used as a proxy for the year 1997 so that cause-specific mortality could be coded using ICD-10 for all years included in the analyses, and similarly, data from 2017 as a proxy for the year 2018.

Patient and Public involvement

The concept of patient and public involvement of the BHIS was translated to the dissemination phase, *i.e.* in addition to full descriptive reports, main results of the BHIS were disseminated via an interactive and user-friendly data analysis tool promoting dynamic analysis of the aggregated data without the need for statistical skill of programming knowledge.

Health outcomes measures

Lifestyle risks

Data on dietary habits, smoking status, alcohol consumption, and physical activity were self-reported in the BHIS. Consumption of fruits (excluding juice) and vegetables (including salad, and excluding potatoes or juice) was assessed based on questions related to their daily intake. A non-daily consumer was defined as a participant reporting, at the time of the interview, a frequency of 4-6 times a week or less. Similarly, daily consumption of sweet or salty snacks and sugar-sweetened beverages (SSBs) was assessed based on a consumption frequency of one serving or more a day. Current smoking was defined as smoking at least 100 cigarettes in lifetime and currently a daily smoker. Alcohol consumption was assessed based on questions related to consumption frequency and the average number of drinks across weekdays and during weekends, and excess was defined as drinking more than 15 and 22 servings per week for women and men, respectively. For physical inactivity, a dichotomous categorical variable was created to differentiate between having sufficient physical activity and being at risk of physical inactivity during leisure time based on a description of the leisure time activities: hard training and competitive sports more than once week, jogging and other recreational sports or gardening at least four hours a week; jogging and other recreational sports or gardening at most four hours a week; walking, bicycling or other light activities at least four hours a week; walking, bicycling or other light activities at most four hours a week; or reading, watching TV or other sedentary activities.

Clustering of the lifestyle risks was summarised as a composite index (Supplementary Table 1). Each lifestyle risk factor was scored from 1 to 5, with higher points indicating the highest risk, as follows: Dietary risks (non-daily fruit , non-daily vegetables, daily snacks and daily SSBs, four present = 5, three = 4, two = 3, one = 2, none = 1); Smoking (current heavy smoker = 5, current non-heavy/occasional smoker = 4, former smoker quitting < 10 years ago = 3, former smoker quitting ≥ 10 years ago = 2, never smoked = 1); Alcohol consumption (≥ 22 servings a week = 5, 15-21 = 4, 8-14 = 3, 1-7 = 2, occasional

drinkers/abstainers = 1); Physical inactivity (sedentary activities = 5, leisure time sport < 4 hour a week or light activities = 3, intensive training or leisure time sport ≥ 4 hours a week = 1). The index ranged from 4 to 20, and was for the analyses further categorised into high engagement (12-20) versus low (4-7). Lifestyle risk index was calculated for the years 2013 and 2018, as dietary data were not available for previous years.

Metabolic risks

BMI was calculated as self-reported body weight divided by self-reported body height squared, using BMI ≥ 25 kg/m^2 for overweight and ≥ 30 kg/m^2 for obesity. Information on prevalent high blood pressure and high cholesterol levels was self-reported by providing participants with a list of clinical conditions for which they had to specify whether they had each clinical condition in the past 12 months.

Prevalence of NCDs

Similarly, data on the prevalence of NCDs, such as T2DM, myocardial infarction (MI), coronary artery disease, cerebrovascular disease, other serious heart diseases, cancer, asthma and chronic bronchitis/chronic obstructive pulmonary disease (COPD) or emphysema were self-reported collected using a list of chronic diseases for which participants had to specify whether they had each chronic disease in the past 12 months.

NCDs-specific mortality

Using the pre-defined procedures accessible from SPMA, age-standardised mortality rates per 100,000 were retrieved using ICD-10 codes for T2DM (E10-E14), coronary artery disease (I20-I25), cerebrovascular disease (I60-I69), cancer (C00-D48), asthma (J45-J46) and chronic lower respiratory diseases (J40-J44, J47) were obtained with comparisons made by sex, region and nationality.

Population stratification

To describe potential health disparities across the Belgian population, the following socio-demographic determinants of health were selected: 10-year age group, sex, region of residence, nationality, education and income. Educational level was based on the highest level of education attained in the household and was recoded into three categories: low (primary education or less),

intermediate (lower and higher secondary education), and high (higher education). Income level was based on the household's total available income and recoded into five quintiles. Additionally, the population was further stratified by lifestyle risk index: high versus low engagement in lifestyle risks, as an additional layer of potential health disparities.

Data analyses

Annual descriptive statistics were represented as weighted proportions of the characteristics of the survey participants as a whole per survey year. Age-standardised prevalence rates were computed by levels of the population stratification variables using direct standardisation with the Belgian population of 2018 used as reference. Health disparities were calculated by direct comparison between population strata: age (oldest vs youngest group), sex (women vs men), region (Walloon vs Flanders, Brussels vs Flanders), nationality (non-Belgian Europeans vs Belgians, non-Europeans vs Belgians), educational level (low vs high), income (low vs high), and engagement in lifestyle risks (high vs low). Health disparities were reported as prevalence ratios, *i.e.* the relative difference between the age-standardised prevalence between two levels of the population stratification variables; with the estimated relative differences and their uncertainty (95% confidence intervals (CI)) calculated using a survey-weighted Cox regression model with time equals one, and adjusting for age. The 20-year trend was tested by including an interaction term between time and the population stratification variable in the models, and *p*-values for this interaction term were reported. We only analysed outcomes for which at least 20 survey participants in any specific strata reported having the outcome of interest. Additionally, we measured health disparities by socio-demographic factors in absolute terms, using prevalence differences between two levels of the population stratification variables. To explore the role of individual lifestyle risks, independently of others, relative health disparities were estimated for having that lifestyle risk versus not (reference).

Clustering of lifestyle risks was described using Spearman's rank correlation coefficients (P) with *p*-values adjusted for multiple testing according to Sidak. Such clustering was quantified using prevalence odds ratios, as estimated from a survey-weighted generalised ordered logistic regression model using the gologit2 command in STATA with the autofit function that identifies the partial proportional odds model that appropriately fits the data[23], with separate models for each lifestyle risk related to the other risks. To enhance interpretation of results, we only presented prevalence odds ratios

and their 95% CI for the extremes, *i.e.* estimates belonging to the comparisons between a score of 5 (high engagement in a lifestyle risk) versus 1 (low; reference), for having a higher score than 1 on the lifestyle risk of interest.

All analyses were conducted using STATA/SE 16, and a *p*-value of 0.05 was considered as statistically significant with no adjustment for multiple comparisons for quantification of health disparities.

RESULTS

An overview of the general characteristics of the study population across the six available surveys is presented in TABLE 1, including prevalence estimates for the lifestyle and metabolic risks, chronic diseases and NCD-specific mortality.

Relative health disparities by socio-demographic population strata

For all population strata, the relative health disparities were generally more pronounced for lifestyle risks and NCDs (FIGURE 1; and Supplementary Table 2).

Age: old versus young age groups. Exposure to lifestyle risks, except leisure-time physical inactivity, decreased with age, (prevalence ratios of 0.2 to 0.6; FIGURE1 and Supplementary Table 2.A), while prevalence of metabolic risks was, as expected, higher among the older age group (relative disparities between 1.6 to 14). Over 20 year' s, the disparity gap by age became smaller for asthma only.

Sex: women versus men. Lifestyle risks, except for leisure-time physical inactivity, was lower among women (prevalence ratios of 1.5; Supplementary Table 2.B). Women were significantly on average 1.3 to 3 times less frequently overweight, having high cholesterol and CVD. Relative disparities for high blood pressure reduced over 20 years' time, reaching more or less equal prevalence in the two most recent surveys (FIGURE 2B). Still, NCD-specific mortality rates were lower among women, most clearly seen for ischemic heart disease and cancer, with disparities increasing over time.

Region: Wallonia vs Flanders, and Brussels vs Flanders. Exposure to lifestyle risks was generally slightly higher for Wallonia, most clearly for daily smoking and leisure-time physical inactivity (Supplementary Table 2.C and 2.D) as well as higher prevalence of metabolic risks and NCDs. Over

time, the health disadvantages for Brussels were decreasing, as significantly seen for daily smoking, leisure-time physical inactivity (FIGURE 2A), overweight (FIGURE 2B), and cancer (FIGURE 2C).

Nationality: non-Belgian Europeans vs Belgians, and non-Europeans vs Belgians. As compared to the Belgians, exposure to non-daily vegetables and leisure-time physical inactivity was higher among the non-Belgian Europeans and non-Europeans (Supplementary Table 2.E and 2.F). The prevalence of high BMI and T2DM was also higher in the non-Europeans (relative disparities of 1.2 to 2.3), with the disparity of overweight significantly worsening over time (FIGURE 2B). Mortality rates were, however, lower in the foreign populations living in Belgium.

Educational level: low vs high. Exposure to lifestyle risks, except excessive alcohol use, was higher for the low educated (relative disparities up to 2.2; FIGURE 1 and Supplementary Table 2.G), with those of daily smoking and leisure-time physical inactivity worsening over time (FIGURE 2A). The prevalence of high BMI was and remained higher in the low educated (relative disparities of 1.4 and 1.8) as well as prevalence of T2DM, MI, asthma and COPD (up to 1.7 and 2.8 times higher).

Income level: low vs high. Similar to educational level, exposures to lifestyle risks, except excessive alcohol use, was higher for the lowest income quintile (FIGURE 1 and Supplementary Table 2.H), with those of dietary risks and daily smoking worsening over time (FIGURE 2A). The prevalence of metabolic risks as well as NCDs was and also remained higher in the lowest income quintile, with the relative disparity of high blood pressure (FIGURE 2B) and COPD (FIGURE 2C) worsening over time.

Absolute health disparities by socio-demographic population strata

Measuring this on an absolute scale did not alter conclusions (Supplementary Table 3). Similarly, when using absolute differences, health disparities were the most pronounced for age, education and income strata, with the highest disparities seen for lifestyle and metabolic risks, but not for prevalent NCDs related to their low prevalence in the general population.

Clustering of lifestyle risks

One-fifth was engaged in multiple lifestyle risks of poor diet, smoking, excessive alcohol use and physical inactivity, while one-fourth reported an overall healthy lifestyle (Supplementary Table 4). High engagement in multiple lifestyle risks was most frequent among men, residents of Wallonia, the lower educated and income strata with their multiple risks mainly characterised by non-daily intakes of fruit, daily snacking, current smoking and physical inactivity, but no distinct pattern of alcohol consumption.

Belgian residents with at least one dietary risk were slightly more likely to be physically inactive, heavy smokers, and heavy drinkers, with former or current smokers also more likely to be heavy drinkers and physically inactive, but heavy drinkers less likely to be physically inactive (Supplementary Table 5). The odds of having at least one dietary risk was higher for heavy smokers (OR 3.17; 95%CI 2.54, 3.95; TABLE 2), and for the physically inactive (1.45; 1.24, 1.69). Similarly, the odds of being a former or current smoker was higher when having four dietary risks (2.84; 1.87, 4.25), for heavy drinkers (4.75; 3.61, 6.25), and for the physically inactive (1.39; 1.18, 1.64). The odds of being a frequent (at least weekly) drinker was only higher for heavy smokers (2.45, 1.95, 3.08). Lastly, the odds of being at most light physically active was higher for heavy smokers (2.17; 1.73, 2.72), but lower for heavy drinkers (0.60; 0.46, 0.78).

The prevalence of metabolic risks and NCDs were higher among individuals with high engagement in multiple lifestyle risks (TABLE 3). In 2018, relative disparities were significantly varying between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD, asthma and COPD, with only high cholesterol levels significantly higher in 2018 than in 2013. Focussing on individual lifestyle risks, the prevalence of high BMI, T2DM, and CVD was more frequently reported for abstainers/occasional drinkers and the non-physically active, independently of age, sex and other lifestyle risks, with the prevalence of T2DM also more frequently reported when having none dietary risks, and of CVD and COPD more frequently for former and current smokers (Supplementary Table 6).

DISCUSSION

Using nationally representative data of Belgium, we identified the population strata where health disparities are present, and we traced the evolution of these disparities over 20 years. Older age, lower education, and lower income strata were the most affected by unfavourable health. For the latter two strata, we also observed a greater prevalence of engagement in multiple lifestyle risks, with their

disparities worsening over time. Multiple lifestyle risks were also more prevalent in men, and the region of Wallonia. Attention is also warranted for non-Europeans living in Belgium for whom high BMI, high blood pressure and T2DM were more prevalent, although no different lifestyle risks than the native Belgians were observed.

The socio-economic distribution of health as reported in this study corroborates earlier surveillance findings from western countries, including Belgium,[14,15] as operationalised by highest educational attainment. The inverse education-health gradients are a long-lasting universal phenomenon in Europe with widening disparities for common chronic diseases,[24] self-assessed health,[25] and mortality[26]. Following earlier observations,[27] results of the present study also confirmed that at present engagement in lifestyle risks remained more frequent for the low educated, and because of the mediating role of health illiteracy, *i.e.* insufficient knowledge, motivation and competence to make appropriate health decisions, likely to persist.[28,29] Using education as a single indicator of socio-economic position at the individual level, however, captures only the knowledge-related assets of the socio-economic stratification, disregarding the full understanding of the existing health disparities by ranks in a society.[30] In our study, health disparities by education resemble well those by income, though slightly more pronounced for income. This suggests that both the social and financial resources provided by education and income, respectively, play a key role in a healthy lifestyle, and thereby delaying the onset of metabolic conditions and NCDs.

We used the most simple absolute and relative measures of disparities in health to illustrate the existing disparities in Belgium, and in this way avoid the value-laden of an arbitrary choice. Our findings might be limited by participants' self-reporting. Reporting risks and diseases is subjected to not only the actual presence of it, but also participant-related characteristics like health knowledge, ability to recall, willingness to report, and in case of health problem, frequency of contact with physician and disadvantages experienced in everyday life. This shortcoming of self-reports has been acknowledged by the first Belgian Health Examination Survey (BELHES), conducted for the first time by Sciensano in 2018.[31] Early findings of the BELHES showed that one-third of the population suffers from high blood pressure, half from high cholesterol levels and one-tenth from T2DM, while according to the self-reports only 15%, 20% and 6%, respectively.[32] This potential bias might differentially affect our population strata, with a misclassification likely to occur to a larger extent in the most disadvantaged group, leading to an underestimation of the true disparity. Besides, our findings provide a general profile of the high-risk

groups, and therefore cannot be directly extrapolated to all individuals belonging to certain strata, for example within the low educated prevalence of risks and outcomes might differ by age group and sex.[24] In cross-sectional studies, there is a potential bias for reverse causality bias, potentially explaining our contra-intuitive finding of a higher reported T2DM prevalence when having none dietary risks and being abstainers/occasional drinker, since among those with T2DM around 60% of them followed a diet for this condition, as also inquired by the BHIS. While excessive alcohol use (*i.e.* drinking very high amounts of alcohol weekly) is a well-recognised risk factor for NCDs, the light-to-moderate levels of alcohol consumption remain controversial.[33] In fact, zero consumption is nowadays ever more regarded as the consumption amount fitting a healthy lifestyle, since estimated protective effects for some health conditions at low levels are outweighed by increased risks of other health-related harms, including cancer.[34]

Our study implies that over a wide range of risk and health indicators important population strata to target are the elderly, the low educated, the low income strata, and the immigrants, of which only the former is an unfortunately unavoidable disparity difficult to argue to be unjust.[35] Narrowing the disparities by socio-economic position and nationality should be the focus of health policy programmes, likely with interventions based on the principles of proportionate universalism,[36] *i.e.* a universal action with a targeted intervention component tailored to tackle the driving root causes either simultaneously or sequentially, with due consideration to the upstream determinants of health that may lie outside the health sector (e.g. illiteracy, unemployment, the barrier to healthcare consumption).[37]

CONCLUSION

In conclusion, health status is not only a product of individual choice but also related to the population strata where a person belongs to, with this defined particularly by the socio-demographic factors influencing lifestyle. In addition, the tendency of lifestyle risks to cluster strengthens the need for health promotion programmes that tailor multiple targets and aim at reaching the socio-economic disadvantaged for narrowing health disparities.

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TABLES & FIGURES

TABLE 1 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to survey year.

	Year of the survey						
	1997	**2001**	**2004**	**2008**	**2013**	**2018**	*p*-trend[a]
Number of individuals	7,256	8,665	9,054	7,343	7,704	8,358	
	(%)	(%)	(%)	(%)	(%)	(%)	
Socio-demographic factors							
Age groups							<0.001
25-34 years	26.1	20.6	19.8	18.8	18.5	19.1	
35-44 years	21.0	19.5	19.1	18.3	17.1	15.7	
45-54 years	20.1	19.4	19.6	20.2	20.4	19.2	
55-64 years	15.7	16.9	17.5	19.0	20.1	21.4	
65-74 years	12.1	14.8	15.9	13.8	14.1	15.4	
75-84 years	4.9	8.8	8.9	9.9	9.9	9.2	
Sex, men	49.7	48.4	48.3	48.2	48.8	48.6	0.236
Region of residence							0.650
Flanders	57.8	58.4	58.3	58.8	57.6	56.7	
Brussels	10.7	9.9	10.0	10.3	10.7	10.1	
Wallonia	31.6	31.7	31.7	30.9	31.7	33.2	
Nationality							<0.001
Belgians	90.8	93.2	92.0	91.4	89.4	88.6	
Non-Belgian Europeans	5.6	4.6	5.0	5.9	6.4	6.6	
Non-Europeans	3.5	2.2	2.9	2.7	4.2	4.8	
Educational level							<0.001
Low	33.7	37.2	33.5	28.8	24.1	29.1	
Intermediate	32.5	30.2	30.8	32.7	33.5	32.0	
High	33.8	32.5	35.7	38.5	42.4	48.4	
Income level							<0.001
Quintile 1	20.4	20.2	19.4	17.9	16.6	11.8	
Quintile 2	19.7	19.0	18.9	17.8	17.0	15.1	
Quintile 3	22.2	19.6	20.0	21.3	21.0	19.9	
Quintile 4	19.6	20.8	19.9	16.8	21.0	25.9	
Quintile 5	18.1	20.4	21.8	26.2	24.2	27.3	
Lifestyle risks [b]							
Dietary risks							
No daily fruits					43.9	44.1	0.810
No daily vegetables					20.4	23.2	0.004
Daily snacking					37.0	34.5	0.027
Daily SSBs					22.6	19.8	0.008
Daily smoking	25.1	23.5	23.4	20.5	19.2	16.1	<0.001
Excessive alcohol use	7.1	9.7	9.0	8.2	6.8	6.2	<0.001
Leisure time physical inactivity	35.1	36.8	28.1	29.4	28.2	29.0	<0.001
Metabolic risks [b]							
Overweight, BMI ≥ 25kg/m²	45.4	48.8	48.1	50.9	51.7	52.7	<0.001
Obesity, BMI ≥ 30kg/m²	12.1	13.6	14.2	15.1	15.2	17.4	<0.001
High blood pressure	12.9	16.7	17.8	18.6	19.2	20.5	<0.001
High cholesterol					19.1	20.2	0.334
NCD prevalence [b]							
Type 2 diabetes mellitus	3.3	4.0	5.0	4.9	6.4	6.9	<0.001

Cardiovascular diseases					4.6	5.3	0.203
Myocardial infarction				0.8	1.1	0.8	0.845
Coronary heart disease				2.4	1.5	1.3	<0.001
Heart disease					2.3	3.5	0.002
Cerebrovascular disease	0.9	0.7	0.8	1.2	1.0	0.9	0.766
Cancer	1.5	1.9	1.4	2.5	2.3	2.8	0.001
Asthma		4.8	4.4	4.3	4.5	5.7	0.071
chronic bronchitis/COPD or emphysema		6.5	6.3	4.3	4.3	4.4	<0.001
NCD-related mortality rates (per 100,000) attributed to							
Diabetes	19.3	16.7	17.1	16.4	12.8	10.6	0.024
Coronary artery disease	159.5	137.4	124.2	92.9	67.5	55.9	0.009
Cerebrovascular disease	90.0	79.2	73.4	60.5	48.1	42.8	0.009
Cancer	378	351	330	324	303	274	0.060
Asthma	4.63	3.96	2.33	1.34	1.25	0.87	0.009
Chronic bronchitis/COPD or emphysema	64.5	54.7	50.2	46.9	43.1	38.0	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease.
[a] *p*-trend calculated using the p-value of corrected weighted Pearson chi square statistic for socio-demographic factors, the p-value of the time term in a survey-weighted logistic regression for lifestyle and metabolic risks and NCD prevalence, and the p-value of Mann-Kendall trend test for NCD-related mortality rates. [b] Self-reported prevalence of lifestyle and metabolic risks and NCDs.
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TABLE 2 Clustering of lifestyle risks in the Belgian population, aged 25-84 years, in 2013 and 2018 [a].

Clustered with		Dietary risks At least one dietary risk	Smoking Former or current smoking	Excessive alcohol use At least weekly drinking	Physical inactivity At most lightly active
Diet	ρ (*p*-value)				
	No dietary risks		Reference	Reference	Reference
	Four dietary risks		2.82 (1.87; 4.25)	0.94 (0.61; 1.45)	1.08 (0.58; 2.00)
Smoking	ρ (*p*-value)	0.160 (<0.001)			
	Never smoked	Reference		Reference	Reference
	Heavy smokers	3.17 (2.54; 3.95)		2.45 (1.95; 3.08)	2.17 (1.73; 2.73)
Alcohol	ρ (*p*-value)	0.003 (0.9980)	0.189 (<0.001)		
	Abstainers/occasional	Reference	Reference		Reference
	Heavy drinkers	1.03 (0.83; 1.28)	4.75 (3.61; 6.25)		0.60 (0.46; 0.78)
Physical inactivity	ρ (*p*-value)	0.122 (<0.001)	0.071 (<0.001)	-0.128 (<0.001)	
	Very active	Reference	Reference	Reference	
	Sedentary	1.45 (1.24; 1.69)	1.39 (1.18; 1.64)	0.36 (0.30; 0.43)	

[a] Clustering described using ρ, Spearman rank correlation coefficient with *p*-value adjusted for multiple testing according to Sidak, and quantified using prevalence odds ratios with 95% confidence intervals for the extremes, *i.e.* estimates belonging to the comparisons between high engagement in a lifestyle risk versus low engagement (reference), for having a higher score than 1 on the lifestyle risk of interest.

TABLE 3 Prevalence (weighted %) of and relative disparities (age-standardised prevalence ratios) in health from metabolic risks to NCDs according to the level of engagement in multiple lifestyle risks for the Belgian population, aged 25-84 years. [a,b]

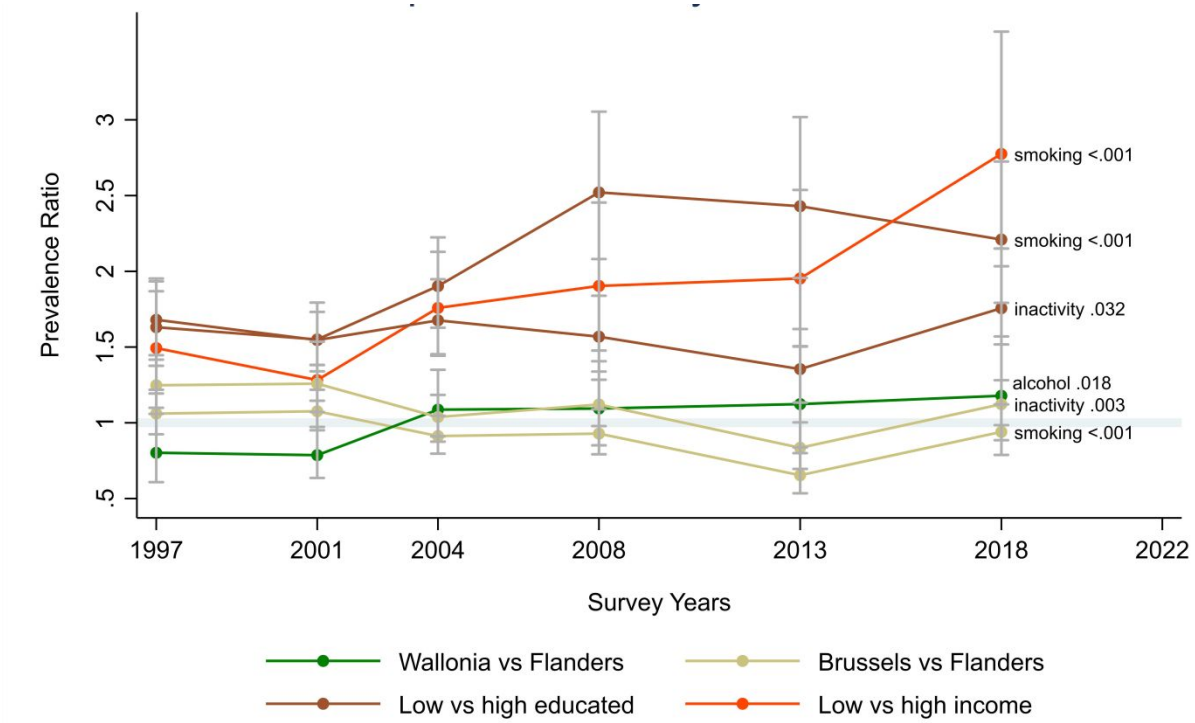
	2013		2018		Relative difference		
	High	Low	High	Low	2013	2018	*p*-change[c]
Metabolic risks							
Overweight, BMI ≥ 25	52.3	43.8	54.5	46.0	1.10 (0.97; 1.24)	1.13 (1.02; 1.25)	0.769
Obesity, BMI ≥ 30	14.4	10.6	20.2	13.2	1.36 (1.01; 1.83)	1.55 (1.21; 1.97)	0.396
High blood pressure	17.6	15.4	20.1	16.9	1.12 (0.87; 1.43)	1.30 (1.07; 1.59)	0.320
High cholesterol levels	19.3	16.7	23.8	16.3	1.11 (0.88; 1.40)	1.57 (1.30; 1.90)	0.024
NCDs							
T2DM	4.3	3.8	5.9	5.3	1.07 (0.65; 1.76)	1.22 (0.83; 1.80)	0.627
CVD	6.0	2.2	5.1	2.7	2.55 (1.39; 4.66)	1.95 (1.21; 3.14)	0.488
Cancer	1.6	1.5	2.8	1.9	1.31 (0.61; 2.80)	1.83 (0.89; 3.76)	0.472
Asthma	5.2	4.8	6.6	4.1	1.06 (0.59; 1.88)	1.75 (1.12; 2.72)	0.261
COPD	7.9	1.6	7.4	2.1	5.63 (3.07; 10.3)	3.73 (2.19; 6.35)	0.403

[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7). [b] Adjusted for age and sex. [c] The *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model.

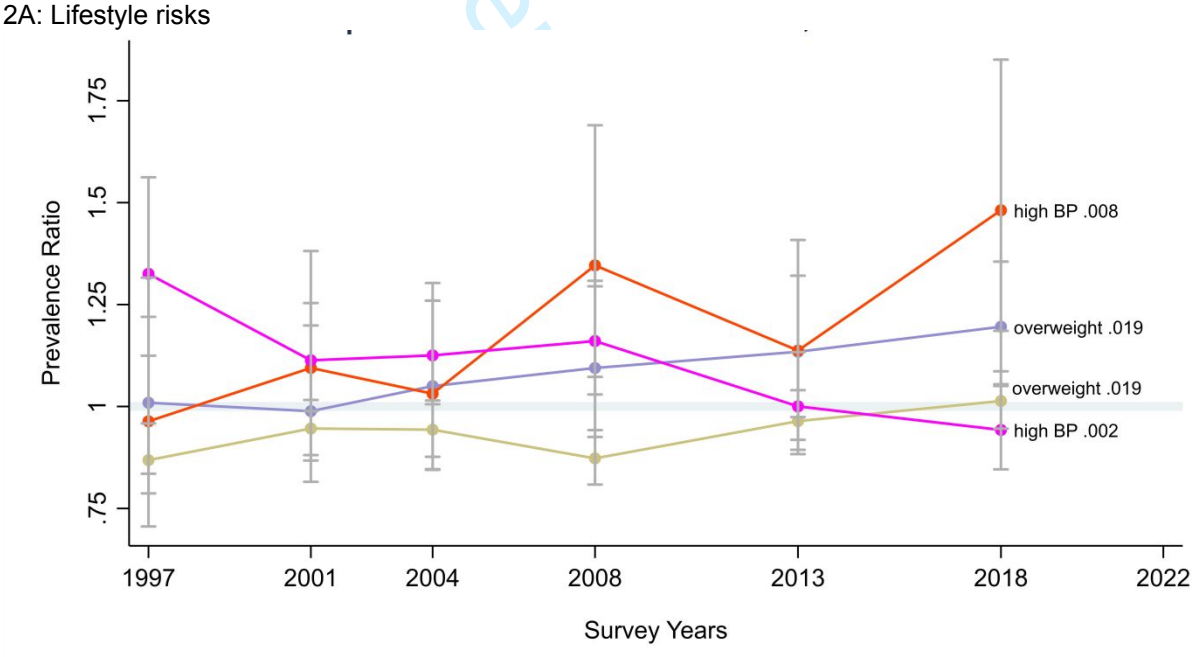
Figure 1 Heatmap of the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle and metabolic risks to non-communicable diseases according to socio-demographic strata in 2018 in Belgium.

Colours depicted the strength of the disparity with the more yellow representing a higher prevalence of poor health in the index group as compared to the reference group, and the more blue a higher prevalence of poor health in the reference group as compared to the index group. Empty boxes represents the non-significant estimates or the non-estimable estimates because too few cases.

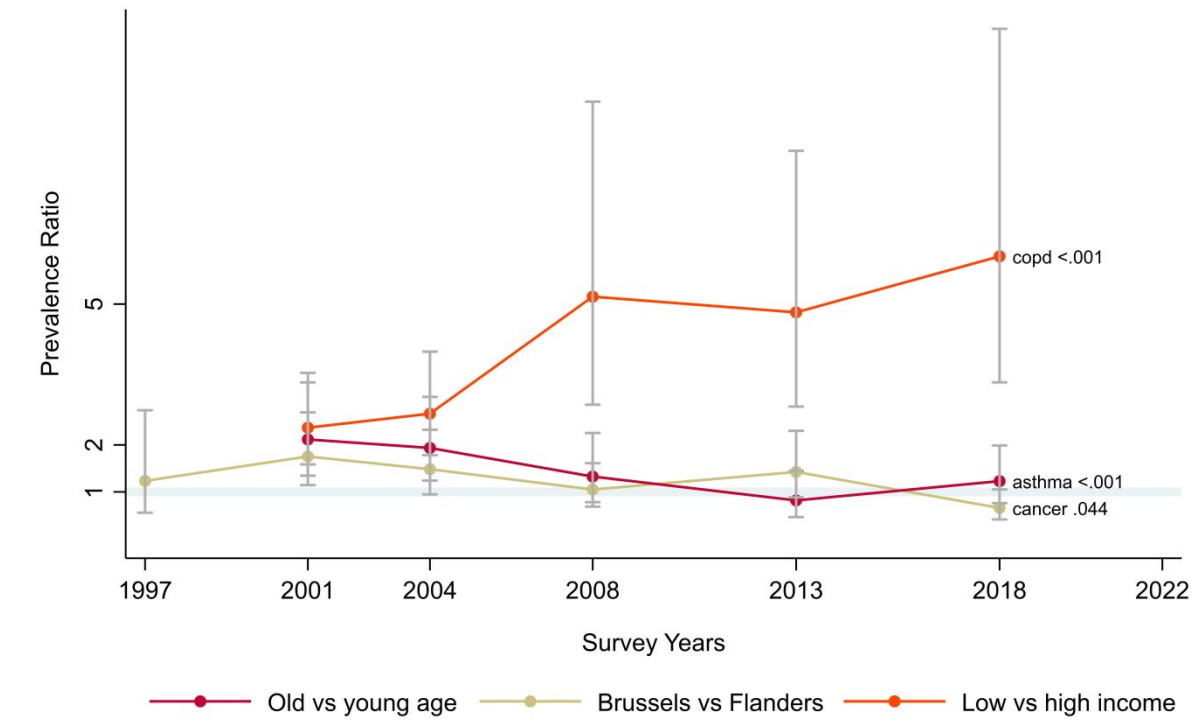
Abbreviations: COPD, chronic obstructive pulmonary disease, also including chronic bronchitis, emphysema in the present analyses; CVD, cardiovascular disease; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus



2A: Lifestyle risks



2B: Metabolic risks



2C: Non-communicable diseases

Figure 2 Significant 20-year time trends in the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle risks to non-communicable diseases according to socio-demographic strata, from 1997 until 2018 in Belgium.

Legend: 75-84 vs 25-34 years; Women vs men; Wallonia vs Flanders; Brussels vs Flanders; Non-Belgian Europeans vs Belgians; Non-Europeans vs Belgians; Low vs high educated; Low vs high income. Grey horizontal gridline indicate the null-value, i.e. no disparity between index and reference group.

Note: Omitted from the graphs are the significant 5-year changes in relative health disparities for diet (i.e. a closing gap for 'non-daily vegetables' and 'daily snacking' between non-Europeans and Belgians, and a widening gap for 'non-daily vegetables' between the low and high income group), for high cholesterol levels and cardiovascular disease (i.e. both reversing relative disparities between Brussels and Flanders, with in 2018 higher prevalence in Flanders).

LEGEND OF SUPPLEMENTARY MATERIALS

Supplementary Table 1 Components and scoring of the lifestyle risk index [a,b].

Abbreviations: SSB, sugar-sweetened beverages

[a] Each lifestyle risk was scored from 1 to 5, with higher points indicating the highest risk. [b] The sum of the components scores resulted in lifestyle risk index range from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement).

Supplementary Tables 2 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised prevalence ratios between distal groups.

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year.

[a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2A. Age-related relative health disparities: adults aged 75-84 years versus 25-34 years (reference)
2B. Sex- related relative health disparities: women vs men (reference)
2C. Region of residence-related relative health disparities: Wallonia vs Flanders (reference)
2D. Region of residence-related relative health disparities: Brussels vs Flanders (reference)
2E. Nationality-related relative health disparities: non-Belgian Europeans vs Belgians (reference)
2F. Nationality-related relative health disparities: non-Europeans vs Belgians (reference)
2G. Education-related relative health disparities: low vs high (reference)
2H. Income-related relative health disparities: Quintile 1 vs Quintile 5 (reference)

Supplementary Tables 3 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised percentage point differences between distal groups.

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year.

[a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3A. Age-related absolute health disparities: adults aged 75-84 years versus 25-34 years (reference)
3B. Sex-related absolute health disparities: women vs men (reference)
3C. Region of residence-related absolute health disparities: Wallonia vs Flanders (reference)
3D. Region of residence-related absolute health disparities: Brussels vs Flanders (reference)
3E. Nationality-related absolute health disparities: non-Belgian Europeans vs Belgians (reference)
3F. Nationality-related absolute health disparities: non-Europeans vs Belgians (reference)
3G. Education-related absolute health disparities: low vs high (reference)
3H. Income-related absolute health disparities: Quintile 1 vs Quintile 5 (reference)

Supplementary Table 4 General characteristics and lifestyle risks (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus low)

Abbreviations: SSB, sugar-sweetened beverages .[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

Supplementary Table 5 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in the individual lifestyle risks of dietary risks, smoking, alcohol and physical inactivity, in 2018.[a]

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risks for smoking: being a current or former smoker; lifestyle risks for alcohol: being a frequent drinker (at least drinking alcohol weekly; and lifestyle risk for physical inactivity: being physically inactive or lightly active.

Supplementary Table 6 Relative health disparities by engagement in individiual lifestyle risks, independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios.[b]

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being physically inactive or lightly active. [b] Adjusted for age, sex and the other lifestyle risks.

Contributorship statement

JP and EM conceptualised and designed the study. JP and EM identified relevant data sources and retrieved data. EM performed the statistical analyses. EM, JP and DS wrote the manuscript, and all revised, read and approved the submitted version. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Competing interests declaration

Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethics approval

The consecutive Belgian Health Interview Surveys have been approved by the Privacy Commission and the Ethical Committee of Ghent University Hospital, which guarantees that the survey procedures are in line with the privacy legislation, and participants gave informed consent before taking part. The current study obtained ethics approval from the Institutional Review Board of the Institute of Tropical Medicine, Antwerp, Belgium (1366/20).

Transparency statement

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if any relevant, registered) have been explained.

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Dissemination declaration

Not applicable.

Patient and Public Involvement Statement

The concept of patient and public involvement of the BHIS was translated to the dissemination phase, *i.e.* in addition to full descriptive reports, main results of the BHIS were disseminated via an interactive and user-friendly data analysis tool promoting dynamic analysis of the aggregated data without the need for statistical skill of programming knowledge.

Data Sharing Statements

Data of the Health Interview Surveys, conducted by Sciensano, are not publicly available, but access to data is possible through request to the Privacy Commission. More information can be retrieved via https://his.wiv-isp.be/SitePages/Home.aspx. Also, publicly available datasets

were utilized in this study: Standardised Procedures for Mortality Analysis – Belgium (SPMA), developed by Sciensano, accessible via https://spma.wiv-isp.be/SitePages/Home.aspx.

SUPPLEMENTARY TABLES

Supplementary Table 1 Components and scoring of the lifestyle risk index [a,b].

Lifestyle risks	Components' scoring	Points
Dietary risks	Four present	5 points
- Non-daily fruit	Three present	4 points
- Non-daily vegetables	Two present	3 points
- Daily SSBs	One present	2 points
- Daily snacking	No dietary risks	1 points
Smoking	Current heavy smoker	5 points
	Current non-heavy smoker or occasional smoker	4 points
	Former smoker quitting < 10 years ago	3 points
	Former smoker quitting ≥ 10 years ago	2 points
	Never smoked	1 points
Alcohol consumption	≥ 22 servings a week	5 points
	15-21 servings a week	4 points
	8-14 servings a week	3 points
	1-7 servings a week	2 points
	Occasional drinkers and abstainers	1 points
Physical inactivity	Sedentary activities	5 points
	Leisure time sport < 4 hours a week or light activities	3 points
	Intensive training or leisure time ≥ 4 hours a week	1 points

Abbreviations: SSB, sugar-sweetened beverages.

[a] Each lifestyle risk was scored from 1 to 5, with higher points indicating the highest risk. [b] The sum of the components scores resulted in lifestyle risk index range from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement).

Supplementary Table 2 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised prevalence ratios between distal groups

2.A Age-related relative health disparities: adults aged 75-84 years versus adults aged 25-34 years (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.64 (0.54; 0.76)	0.53 (0.45; 0.63)	0.142
Non-daily vegetables					0.69 (0.53; 0.90)	0.59 (0.46; 0.75)	0.375
Daily snacking					0.94 (0.78; 1.10)	1.11 (0.93; 1.31)	0.159
Daily SSBs					0.39 (0.29; 0.52)	0.29 (0.21; 0.40)	0.179
Daily smoking	0.24 (0.14; 0.39)	0.25 (0.18; 0.35)	0.25 (0.17; 0.36)	0.18 (0.12; 0.27)	0.36 (0.21; 0.52)	0.22 (0.14; 0.37)	0.875
Excess alcohol	0.84 (0.38; 1.84)	0.51 (0.30; 0.84)	0.61 (0.32; 1.17)	0.55 (0.32; 0.96)	0.90 (0.48; 1.68)	0.34 (0.18; 0.63)	0.148
Leisure time physical inactivity	2.06 (1.75; 2.43)	2.00 (1.76; 2.28)	2.06 (1.72; 2.48)	1.98 (1.64; 2.38)	1.83 (1.45; 2.32)	1.72 (1.41; 2.12)	0.108
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.58 (1.30; 1.91)	1.44 (1.25; 1.66)	1.71 (1.48; 1.97)	1.45 (1.26; 1.66)	1.53 (1.33; 1.75)	1.55 (1.35; 1.78)	0.991
Obesity, BMI ≥ 30 kg/m²	1.76 (1.05; 2.95)	2.53 (1.78; 3.61)	1.76 (1.24; 2.49)	1.81 (1.31; 2.49)	1.50 (1.10; 2.13)	1.61 (1.17; 2.21)	0.069
High blood pressure	9.84 (6.43; 15.06)	10.01 (7.14; 14.04)	10.79 (7.88; 14.77)	10.40 (7.47; 14.48)	17.2 (10.9; 27.2)	13.85 (8.81; 21.8)	0.111
High cholesterol levels					12.9 (8.28; 20.2)	9.16 (6.33; 13.3)	0.244
NCD prevalence							
Asthma		2.12 (1.35; 3.33)	1.94 (1.24; 3.02)	1.33 (0.78; 2.26)	0.81 (0.46; 1.45)	1.23 (0.76; 1.99)	<0.001
Chronic bronchitis, COPD, emphysema		4.21 (2.66; 6.66)	4.06 (2.79; 5.91)	6.09 (3.24; 11.5)		4.99 (2.63; 9.50)	0.428

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.B Sex-related relative health disparities: women versus men (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.76 (0.72; 0.82)	0.75 (0.71; 0.79)	0.531
Non-daily vegetables					0.70 (0.63; 0.78)	0.72 (0.66; 0.79)	0.763
Daily snacking					1.00 (0.93; 1.07)	1.04 (0.96; 1.12)	0.407
Daily SSBs					0.63 (0.57; 0.70)	0.65 (0.58; 0.73)	0.762
Daily smoking	0.60 (0.53; 0.68)	0.70 (0.64; 0.77)	0.73 (0.66; 0.81)	0.79 (0.70; 0.90)	0.75 (0.66; 0.85)	0.68 (0.59; 0.78)	0.110
Excess alcohol	0.44 (0.33; 0.58)	0.54 (0.45; 0.64)	0.46 (0.38; 0.56)	0.65 (0.52; 0.81)	0.57 (0.44; 0.74)	0.57 (0.45; 0.72)	0.054
Leisure time physical inactivity	1.25 (1.14; 1.38)	1.34 (1.25; 1.44)	1.42 (1.29; 1.58)	1.27 (1.14; 1.41)	1.28 (1.13; 1.45)	1.33 (1.20; 1.47)	0.836
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	0.71 (0.66; 0.76)	0.75 (0.71; 0.80)	0.72 (0.68; 0.76)	0.74 (0.70; 0.79)	0.76 (0.71; 0.80)	0.75 (0.71; 0.79)	0.095
Obesity, BMI ≥ 30 kg/m²	0.96 (0.80; 1.16)	1.05 (0.91; 1.20)	1.07 (0.94; 1.23)	1.07 (0.94; 1.23)	1.01 (0.87; 1.18)	0.89 (0.79; 1.01)	0.224
High blood pressure	1.33 (1.12; 1.56)	1.11 (0.99; 1.25)	1.13 (1.01; 1.26)	1.16 (1.03; 1.31)	1.00 (0.88; 1.13)	0.94 (0.85; 1.05)	0.002
High cholesterol levels					0.98 (0.88; 1.11)	0.85 (0.76; 0.95)	0.075
NCD prevalence							
T2DM	1.04 (0.71; 1.52)	0.89 (0.69; 1.14)	0.90 (0.72; 1.12)	0.92 (0.72; 1.18)	0.91 (0.72; 1.16)	0.89 (0.72; 1.09)	0.493
CVD					0.51 (0.39; 0.67)	0.61 (0.48; 0.78)	0.416
Myocardial infarction				0.46 (0.27; 0.78)	0.40 (0.19; 0.83)	0.48 (0.26; 0.90)	
Coronary artery disease				0.53 (0.35; 0.80)	0.48 (0.29; 0.78)	0.58 (0.33; 1.02)	
Other serious heart disease					0.45 (0.30; 0.68)	0.66 (0.49; 0.90)	
Cerebrovascular disease	1.46 (0.72; 2.96)	0.89 (0.48; 1.65)	0.98 (0.55; 1.74)	1.02 (0.59; 1.74)	0.73 (0.40; 1.31)	0.31 (0.16; 0.59)	
Cancer	1.87 (1.00; 3.47)	1.25 (0.86; 1.81)	1.96 (1.26; 3.06)	0.98 (0.64; 1.50)	1.59 (1.06; 2.41)	1.39 (0.95; 2.02)	0.517
Asthma		0.82 (0.63; 1.05)	1.18 (0.92; 1.52)	1.46 (1.09; 1.94)	1.00 (0.75; 1.32)	1.18 (0.92; 1.52)	0.296
Chronic bronchitis, COPD, emphysema		0.90 (0.74; 1.09)	0.92 (0.76; 1.12)	1.00 (0.77; 1.31)	1.15 (0.86; 1.53)	1.02 (0.78; 1.33)	0.328
NCD-specific mortality rate attributable to							
T2DM	0.96 (0.87; 1.07)	0.96 (0.86; 1.07)	1.07 (0.96; 1.19)	0.87 (0.79; 0.97)	0.79 (0.71; 0.88)	0.67 (0.60; 0.75)	0.085
Ischemic heart disease	0.51 (0.49; 0.53)	0.49 (0.47; 0.51)	0.49 (0.47; 0.52)	0.48 (0.46; 0.50)	0.45 (0.43; 0.47)	0.44 (0.42; 0.46)	0.013
Cerebrovascular disease	0.83 (0.79; 0.87)	0.84 (0.79; 0.90)	0.95 (0.89; 1.01)	0.87 (0.81; 0.93)	0.86 (0.81; 0.92)	0.90 (0.84; 0.96)	0.181
Cancer	0.51 (0.50; 0.53)	0.51 (0.50; 0.52)	0.53 (0.51; 0.54)	0.55 (0.54; 0.56)	0.58 (0.56; 0.59)	0.61 (0.59; 0.62)	0.013
Asthma	0.85 (0.67; 1.07)	1.05 (0.83; 1.34)	1.39 (1.04; 1.88)	1.47 (1.04; 2.10)	1.25 (0.89; 1.76)	1.62 (1.09; 2.39)	0.060
Chronic bronchitis, COPD, emphysema	0.27 (0.25; 0.29)	0.29 (0.27; 0.32)	0.31 (0.29; 0.34)	0.35 (0.32; 0.37)	0.43 (0.40; 0.45)	0.46 (0.43; 0.49)	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.C Region of residence-related relative health disparities: Wallonia versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.04 (0.96; 1.12)	1.14 (1.05; 1.23)	0.101
Non-daily vegetables					1.17 (1.01; 1.36)	1.29 (1.13; 1.48)	0.325
Daily snacking					1.00 (0.91; 1.10)	0.88 (0.79; 0.97)	0.050
Daily SSBs					1.12 (0.99; 1.27)	1.10 (0.95; 1.28)	0.909
Daily smoking	1.16 (1.01; 1.34)	1.13 (1.01; 1.27)	1.16 (1.03; 1.32)	1.18 (1.01; 1.37)	1.12 (0.93; 1.29)	1.25 (1.05; 1.48)	0.735
Excess alcohol	0.80 (0.61; 1.06)	0.79 (0.64; 0.97)	1.09 (0.88; 1.35)	1.09 (0.85; 1.41)	1.11 (0.84; 1.51)	1.18 (0.89; 1.57)	0.018
Leisure time physical inactivity	1.40 (1.26; 1.57)	1.41 (1.30; 1.54)	1.46 (1.30; 1.64)	1.39 (1.23; 1.57)	1.16 (1.00; 1.33)	1.45 (1.29; 1.64)	0.741
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.10 (1.01; 1.19)	1.09 (1.03; 1.16)	1.12 (1.05; 1.19)	1.05 (0.98; 1.12)	1.07 (1.00; 1.14)	1.08 (1.01; 1.15)	0.338
Obesity, BMI ≥ 30 kg/m²	1.38 (1.12; 1.71)	1.28 (1.10; 1.50)	1.33 (1.14; 1.55)	1.07 (0.92; 1.25)	1.29 (1.09; 1.52)	1.22 (1.06; 1.42)	0.216
High blood pressure	1.29 (1.07; 1.57)	1.02 (0.89; 1.18)	1.08 (0.96; 1.22)	1.14 (1.00; 1.29)	0.91 (0.79; 1.03)	1.10 (0.97; 1.23)	0.209
High cholesterol levels					0.96 (0.84; 1.10)	1.01 (0.90; 1.14)	0.632
NCD prevalence							
T2DM	1.68 (1.14; 2.48)	1.76 (1.33; 2.32)	1.46 (1.10; 1.94)	1.24 (0.94; 1.63)	1.24 (0.96; 1.61)	1.37 (1.10; 1.71)	0.108
CVD					1.23 (0.92; 1.65)	1.06 (0.82; 1.36)	0.450
Myocardial infarction				1.57 (0.87; 2.83)		1.96 (1.01; 3.83)	
Coronary artery disease				1.30 (0.85; 1.98)	1.53 (0.87; 2.67)	1.28 (0.75; 2.20)	
Other serious heart disease					0.84 (0.57; 1.24)	0.93 (0.67; 1.30)	
Cerebrovascular disease			1.74 (0.95; 3.19)	2.03 (1.09; 3.77)		1.91 (0.97; 3.75)	
Cancer	0.93 (0.47; 1.83)	1.52 (0.99; 2.35)	0.83 (0.53; 1.32)	0.98 (0.63; 1.50)	0.88 (0.57; 1.38)	0.96 (0.66; 1.39)	0.391
Asthma		1.79 (1.35; 2.38)	1.92 (1.44; 2.55)	2.01 (1.45; 2.78)	1.76 (1.29; 2.41)	1.98 (1.52; 2.57)	0.744
Chronic bronchitis, COPD, emphysema		1.62 (1.29; 2.03)	1.67 (1.34; 2.08)	1.57 (1.18; 2.08)	1.67 (1.24; 2.26)	1.63 (1.22; 2.19)	0.892
NCD-specific mortality rate attributable to							
T2DM	1.05 (0.94; 1.17)	1.44 (1.29; 1.62)	1.66 (1.48; 1.85)	1.30 (1.17; 1.45)	1.12 (1.00; 1.24)	1.37 (1.22; 1.53)	1.000
Ischemic heart disease	0.87 (0.84; 0.91)	0.97 (0.93; 1.00)	1.00 (0.96; 1.04)	1.12 (1.07; 1.17)	1.28 (1.23; 1.35)	1.29 (1.23; 1.36)	0.013
Cerebrovascular disease	0.89 (0.85; 0.93)	0.94 (0.90; 0.99)	0.89 (0.84; 0.93)	0.97 (0.92; 1.02)	0.96 (0.91; 1.01)	1.04 (0.98; 1.09)	0.085
Cancer	1.06 (1.03; 1.09)	1.06 (1.04; 1.09)	1.06 (1.04; 1.09)	1.08 (1.05; 1.11)	1.11 (1.07; 1.13)	1.11 (1.08; 1.14)	0.029
Asthma	1.30 (1.01; 1.67)	1.32 (1.02; 1.72)	2.08 (1.49; 2.91)	1.70 (1.17; 2.49)	2.18 (1.47; 3.23)	2.60 (1.66; 4.05)	0.024
Chronic bronchitis, COPD, emphysema	1.08 (1.02; 1.15)	1.14 (1.07; 1.21)	1.18 (1.10; 1.26)	1.32 (1.24; 1.41)	1.33 (1.24; 1.41)	1.23 (1.16; 1.32)	0.085

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.D Region of residence-related relative health disparities: Brussels versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.84 (0.76; 0.92)	0.93 (0.86; 1.01)	0.059
Non-daily vegetables					1.18 (1.01; 1.38)	1.34 (1.18; 1.53)	0.264
Daily snacking					0.74 (0.67; 0.83)	0.72 (0.65; 0.80)	0.603
Daily SSBs					0.80 (0.69; 0.92)	0.77 (0.66; 0.90)	0.697
Daily smoking	1.06 (0.92; 1.22)	1.08 (0.95; 1.22)	0.91 (0.80; 1.05)	0.93 (0.79; 1.09)	0.65 (0.53; 0.80)	0.94 (0.79; 1.12)	<0.001
Excess alcohol	1.01 (0.78; 1.31)	1.06 (0.86; 1.30)	0.88 (0.70; 1.11)	0.77 (0.60; 1.01)	0.98 (0.71; 1.35)	1.31 (0.99; 1.72)	0.634
Leisure time physical inactivity	1.25 (1.10; 1.42)	1.26 (1.15; 1.38)	1.04 (0.91; 1.18)	1.12 (0.98; 1.28)	0.84 (0.70; 1.00)	1.12 (0.98; 1.28)	0.003
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	0.87 (0.79; 0.96)	0.95 (0.88; 1.02)	0.94 (0.88; 1.01)	0.87 (0.81; 0.94)	0.96 (0.89; 1.04)	1.01 (0.95; 1.09)	0.019
Obesity, BMI ≥ 30 kg/m²	0.94 (0.72; 1.23)	1.08 (0.91; 1.29)	1.05 (0.89; 1.24)	0.92 (0.77; 1.09)	1.07 (0.89; 1.29)	1.02 (0.87; 1.18)	0.812
High blood pressure	1.11 (0.91; 1.36)	0.97 (0.83; 1.12)	0.95 (0.84; 1.08)	1.00 (0.87; 1.15)	1.16 (1.00; 1.34)	0.92 (0.81; 1.04)	0.652
High cholesterol levels					1.20 (1.04; 1.39)	0.87 (0.77; 0.99)	0.003
NCD prevalence							
T2DM	1.36 (0.91; 2.05)	1.31 (0.97; 1.78)	1.33 (0.98; 1.80)	1.77 (1.34; 2.33)	1.60 (1.24; 2.08)	1.40 (1.13; 1.75)	0.495
CVD					1.14 (0.81; 1.60)	0.71 (0.53; 0.95)	0.031
Myocardial infarction				2.97 (1.66; 5.34)			
Coronary artery disease				1.57 (1.02; 2.42)	1.15 (0.61; 2.19)	1.42 (0.81; 2.50)	
Other serious heart disease					1.08 (0.68; 1.71)	0.53 (0.36; 0.79)	
Cerebrovascular disease			1.55 (0.84; 2.88)	3.25 (1.77; 6.00)			
Cancer	1.23 (0.56; 2.74)	1.76 (1.14; 2.69)	1.48 (0.95; 2.32)	1.05 (0.69; 1.61)	1.43 (0.88; 2.30)	0.66 (0.41; 1.05)	0.044
Asthma		1.79 (1.35; 2.37)	1.78 (1.31; 2.41)	2.04 (1.45; 2.88)	1.72 (1.18; 2.53)	1.67 (1.28; 2.17)	0.819
Chronic bronchitis, COPD, emphysema		1.55 (1.22; 1.98)	1.43 (1.12; 1.83)	1.57 (1.17; 2.11)	1.30 (0.90; 1.88)	1.26 (0.92; 1.73)	0.791
NCD-specific mortality rate attributable to							
T2DM	0.72 (0.61; 0.86)	0.85 (0.71; 1.02)	0.86 (0.71; 1.04)	1.14 (0.96; 1.36)	1.13 (0.94; 1.36)	1.13 (0.93; 1.38)	0.085
Ischemic heart disease	0.92 (0.87; 0.98)	0.94 (0.89; 1.00)	0.98 (0.92; 1.04)	1.11 (1.03; 1.19)	1.08 (0.99; 1.17)	1.12 (1.02; 1.23)	0.024
Cerebrovascular disease	0.83 (0.78; 0.89)	0.82 (0.76; 0.88)	0.93 (0.86; 1.00)	0.87 (0.80; 0.94)	0.86 (0.79; 0.93)	0.95 (0.86; 1.04)	0.260
Cancer	1.00 (0.96; 1.05)	1.03 (0.98; 1.07)	1.04 (0.99; 1.08)	1.01 (0.97; 1.05)	0.99 (0.95; 1.04)	1.05 (1.00; 1.10)	0.707
Asthma	2.62 (1.78; 3.88)	2.30 (1.52; 3.47)	1.85 (1.06; 3.23)	1.70 (0.92; 3.15)	2.74 (1.38; 5.43)	2.49 (1.09; 5.75)	1.000
Chronic bronchitis, COPD, emphysema	0.99 (0.90; 1.09)	1.08 (0.98; 1.20)	1.01 (0.91; 1.12)	1.07 (0.96; 1.19)	1.25 (1.12; 1.39)	1.18 (1.05; 1.33)	0.133

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.E Nationality-related relative health disparities: non-Belgian Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.94 (0.81; 1.08)	0.89 (0.78; 1.01)	0.704
Non-daily vegetables					1.35 (1.10; 1.67)	1.41 (1.20; 1.65)	0.790
Daily snacking					0.75 (0.60; 0.95)	0.50 (0.36; 0.69)	0.606
Daily SSBs					0.70 (0.56; 0.89)	0.69 (0.53; 0.89)	0.902
Daily smoking	1.01 (0.80; 1.27)	1.01 (0.82; 1.24)	1.00 (0.80; 1.25)	0.90 (0.68; 1.18)	0.99 (0.74; 1.33)	0.94 (0.73; 1.22)	0.580
Excess alcohol	1.64 (1.14; 2.37)	1.29 (0.95; 1.77)	1.33 (0.93; 1.89)	1.09 (0.79; 1.52)	0.83 (0.58; 1.18)	0.91 (0.64; 1.31)	0.265
Leisure time physical inactivity	1.07 (0.90; 1.28)	1.31 (1.14; 1.51)	0.93 (0.74; 1.16)	1.05 (0.83; 1.32)	0.86 (0.64; 1.16)	1.00 (0.81; 1.22)	0.128
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.04 (0.90; 1.22)	1.15 (1.04; 1.28)	1.07 (0.96; 1.19)	0.94 (0.82; 1.09)	0.95 (0.85; 1.07)	1.05 (0.96; 1.15)	0.470
Obesity, BMI ≥ 30 kg/m²	1.32 (0.90; 1.94)	1.11 (0.80; 1.55)	1.35 (1.03; 1.76)	0.92 (0.69; 1.23)	0.93 (0.73; 1.20)	1.00 (0.79; 1.28)	0.191
High blood pressure	0.96 (0.66; 1.39)	0.89 (0.67; 1.17)	1.10 (0.87; 1.37)	0.78 (0.58; 1.05)	0.95 (0.74; 1.21)	1.08 (0.88; 1.31)	0.581
High cholesterol levels					1.04 (0.79; 1.37)	0.99 (0.78; 1.26)	0.905
NCD prevalence							
T2DM	1.45 (0.76; 2.75)	1.44 (0.90; 2.31)	1.25 (0.84; 1.84)	1.47 (0.96; 2.25)	1.07 (0.67; 1.72)	1.04 (0.69; 1.55)	0.240
CVD					0.93 (0.53; 1.66)	1.01 (0.64; 1.60)	0.913
Myocardial infarction							
Coronary artery disease							
Other serious heart disease						0.91 (0.52; 1.57)	
Cerebrovascular disease							
Cancer							
Asthma		1.31 (0.86; 1.99)	1.02 (0.65; 1.59)	0.84 (0.54; 1.30)	0.97 (0.56; 1.69)	0.84 (0.57; 1.25)	0.414
Chronic bronchitis, COPD, emphysema		1.35 (0.96; 1.88)	1.21 (0.82; 1.78)	0.87 (0.52; 1.44)	1.24 (0.74; 2.08)	1.03 (0.60; 1.74)	0.720
NCD-specific mortality attributable to							
T2DM	1.13 (0.61; 2.09)	1.07 (0.55; 2.08)	1.39 (0.74; 2.60)	1.11 (0.57; 2.17)	1.11 (0.52; 2.37)	0.67 (0.26; 1.69)	0.339
Ischemic heart disease	0.74 (0.59; 0.94)	0.99 (0.78; 1.26)	0.93 (0.72; 1.20)	0.86 (0.64; 1.16)	0.96 (0.69; 1.35)	0.54 (0.35; 0.83)	0.707
Cerebrovascular disease	0.74 (0.54; 1.01)	0.95 (0.69; 1.30)	0.74 (0.52; 1.05)	0.88 (0.61; 1.27)	0.91 (0.61; 1.37)	0.54 (0.33; 0.88)	0.848
Cancer	0.80 (0.69; 0.93)	0.87 (0.74; 1.01)	0.87 (0.74; 1.02)	0.83 (0.71; 0.98)	0.83 (0.70; 0.98)	0.47 (0.39; 0.58)	0.436
Asthma	1.50 (0.46; 4.96)	0.98 (0.24; 3.98)	1.01 (0.17; 6.11)	1.65 (0.18; 14.88)	0.91 (0.07; 11.54)	0.97 (0.05; 18.86)	0.452
Chronic bronchitis, COPD, emphysema	1.15 (0.82; 1.60)	1.23 (0.86; 1.76)	1.19 (0.82; 1.74)	1.18 (0.80; 1.75)	0.90 (0.58; 1.38)	0.44 (0.25; 0.77)	0.133

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). NCD mortality rates comparison is between foreigners (all kind) and Belgians. Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.F Nationality-related relative health disparities: non-Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.00 (0.85; 1.18)	0.85 (0.71; 1.02)	0.306
Non-daily vegetables					1.79 (1.45; 2.22)	1.33 (1.09; 1.63)	0.034
Daily snacking					0.63 (0.52; 0.76)	0.68 (0.57; 0.81)	0.037
Daily SSBs					1.06 (0.81; 1.38)	0.81 (0.58; 1.14)	0.194
Daily smoking	0.69 (0.44; 1.10)	0.70 (0.51; 0.95)	0.59 (0.40; 0.89)	0.65 (0.37; 1.14)	0.50 (0.29; 0.87)	0.64 (0.40; 1.03)	0.417
Excess alcohol							
Leisure time physical inactivity	1.35 (1.05; 1.74)	1.40 (1.15; 1.70)	0.78 (0.55; 1.12)	1.19 (0.84; 1.70)	0.65 (0.44; 0.97)	1.11 (0.82; 1.51)	0.136
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.01 (0.84; 1.22)	0.99 (0.82; 1.20)	1.05 (0.85; 1.30)	1.09 (0.93; 1.29)	1.13 (0.97; 1.32)	1.20 (1.05; 1.36)	0.019
Obesity, BMI ≥ 30 kg/m²	0.83 (0.53; 1.31)	1.36 (0.93; 1.99)	1.10 (0.72; 1.69)	0.98 (0.66; 1.46)	1.06 (0.73; 1.56)	1.36 (1.03; 1.80)	0.082
High blood pressure	0.99 (0.62; 1.60)	1.22 (0.79; 1.88)	0.71 (0.50; 1.00)	0.77 (0.50; 1.19)	1.33 (0.92; 1.93)	1.21 (0.89; 1.63)	0.281
High cholesterol levels					0.95 (0.63; 1.42)	1.07 (0.76; 1.50)	0.449
NCD prevalence							
T2DM		3.50 (1.97; 6.23)			2.26 (1.30; 3.92)	2.34 (1.53; 3.56)	0.767
CVD							
Myocardial infarction							
Coronary artery disease							
Other serious heart disease							
Cerebrovascular disease							
Cancer							
Asthma		1.19 (0.68; 2.06)			0.88 (0.48; 1.61)	0.79 (0.47; 1.33)	0.341
Chronic bronchitis, COPD, emphysema		1.01 (0.59; 1.75)	1.08 (0.58; 2.03)				0.703

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.G Education-related relative health disparities: low versus high education level (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.39 (1.26; 1.53)	1.42 (1.29; 1.56)	0.707
Non-daily vegetables					1.67 (1.41; 1.99)	2.05 (1.77; 2.37)	0.130
Daily snacking					0.89 (0.78; 1.00)	0.74 (0.65; 0.84)	0.082
Daily SSBs					1.98 (1.68; 2.32)	2.01 (1.68; 2.41)	0.837
Daily smoking	1.63 (1.38; 1.93)	1.55 (1.34; 1.79)	1.90 (1.63; 2.22)	2.52 (2.08; 3.05)	2.43 (1.96; 3.02)	2.21 (1.79; 2.72)	<0.001
Excess alcohol	0.60 (0.42; 0.86)	0.55 (0.44; 0.68)	0.49 (0.38; 0.62)	0.64 (0.51; 0.81)	0.53 (0.41; 0.67)	0.47 (0.35; 0.62)	0.312
Leisure time physical inactivity	1.68 (1.45; 1.95)	1.55 (1.38; 1.73)	1.68 (1.44; 1.95)	1.57 (1.34; 1.84)	1.35 (1.13; 1.62)	1.76 (1.52; 2.03)	0.032
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.39 (1.25; 1.55)	1.34 (1.23; 1.45)	1.25 (1.15; 1.35)	1.25 (1.15; 1.35)	1.28 (1.19; 1.39)	1.36 (1.26; 1.46)	0.217
Obesity, BMI ≥ 30 kg/m²	1.73 (1.31; 2.29)	2.37 (1.90; 2.95)	2.21 (1.81; 2.71)	2.05 (1.67; 2.51)	2.22 (1.81; 2.73)	1.80 (1.52; 2.13)	0.137
High blood pressure	1.24 (0.98; 1.56)	1.41 (1.17; 1.71)	1.34 (1.15; 1.56)	1.35 (1.15; 1.60)	1.27 (1.08; 1.49)	1.18 (1.03; 1.36)	0.407
High cholesterol levels					1.10 (0.94; 1.28)	1.16 (1.01; 1.33)	0.864
NCD prevalence							
T2DM	2.79 (1.80; 4.31)	1.95 (1.34; 2.85)	2.40 (1.64; 3.52)	2.30 (1.64; 3.25)	1.83 (1.37; 2.44)	1.76 (1.36; 2.28)	0.090
CVD					1.15 (0.77; 1.71)	1.20 (0.90; 1.61)	0.710
Myocardial infarction				1.74 (0.92; 3.27)	2.41 (1.12; 5.19)	2.15 (1.02; 4.53)	
Coronary artery disease				1.30 (0.78; 2.16)	0.66 (0.30; 1.44)	1.36 (0.74; 2.50)	
Other serious heart disease					1.46 (0.90; 2.39)	1.16 (0.79; 1.71)	
Cerebrovascular disease				1.16 (0.60; 2.24)	1.01 (0.43; 2.35)	1.79 (0.93; 3.44)	
Cancer	0.94 (0.44; 1.98)	1.15 (0.68; 1.97)	1.24 (0.74; 2.10)	1.16 (0.69; 1.94)	1.30 (0.75; 2.27)	1.03 (0.66; 1.60)	0.820
Asthma		1.33 (0.96; 1.85)	1.53 (1.11; 2.12)	1.34 (0.94; 1.90)	2.05 (1.47; 2.84)	1.46 (1.07; 1.99)	0.744
Chronic bronchitis, COPD, emphysema		2.26 (1.68; 3.04)	2.64 (1.92; 3.62)	4.36 (2.80; 6.77)	2.78 (1.79; 4.32)	2.75 (1.95; 3.86)	0.232

Analyses were conducted in 1997 in 7,146 individuals (1.5%missing), in 2001 in 8,427 (2.8%missing), in 2004 in 8,796 (2.8%missing), in 2008 in 7,146 (2.7%missing), in 2013 in 7,590 (1.5%missing), and in 2018 in 8,201 (1.9%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.H Income-related relative health disparities: Quintile 1 versus Quintile 5 of income (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.08 (0.96; 1.21)	1.47 (1.30; 1.67)	0.002
Non-daily vegetables					1.14 (0.93; 1.41)	2.72 (2.20; 3.35)	<0.001
Daily snacking					0.85 (0.73; 0.99)	0.68 (0.56; 0.81)	0.074
Daily SSBs					1.79 (1.47; 2.18)	1.51 (1.19; 1.93)	0.247
Daily smoking	1.49 (1.19; 1.87)	1.28 (1.07; 1.54)	1.76 (1.45; 2.13)	1.90 (1.48; 2.45)	1.95 (1.50; 2.54)	2.78 (2.15; 3.58)	<0.001
Excess alcohol	0.69 (0.47; 1.01)	0.40 (0.30; 0.54)	0.50 (0.36; 0.68)	0.60 (0.44; 0.81)	0.49 (0.35; 0.68)	0.51 (0.31; 0.84)	0.576
Leisure time physical inactivity	1.46 (1.20; 1.77)	1.53 (1.32; 1.78)	1.52 (1.27; 1.83)	1.60 (1.30; 1.97)	1.16 (0.93; 1.45)	1.92 (1.57; 2.35)	0.559
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.22 (1.08; 1.38)	1.10 (1.00; 1.23)	1.14 (1.02; 1.27)	1.11 (0.99; 1.24)	1.21 (1.09; 1.34)	1.25 (1.11; 1.39)	0.660
Obesity, BMI ≥ 30 kg/m²	1.46 (1.02; 2.10)	1.43 (1.10; 1.85)	1.73 (1.32; 2.28)	1.69 (1.32; 2.17)	2.00 (1.55; 2.58)	1.64 (1.26; 2.12)	0.430
High blood pressure	0.96 (0.71; 1.32)	1.09 (0.87; 1.38)	1.03 (0.84; 1.26)	1.35 (1.07; 1.69)	1.14 (0.92; 1.41)	1.48 (1.19; 1.85)	0.008
High cholesterol levels					1.34 (1.08; 1.67)	1.35 (1.10; 1.66)	0.867
NCD prevalence							
T2DM	1.60 (0.88; 2.92)	1.84 (1.17; 2.90)	1.93 (0.99; 3.75)	2.44 (1.53; 3.90)	2.37 (1.55; 3.63)	2.13 (1.36; 3.32)	0.539
CVD					2.24 (1.37; 3.66)	1.42 (0.87; 2.31)	0.186
Myocardial infarction							
Coronary artery disease				1.49 (0.75; 2.95)			
Other serious heart disease					1.52 (0.76; 3.02)	1.37 (0.72; 2.60)	
Cerebrovascular disease							
Cancer		1.31 (0.66; 2.58)	1.31 (0.66; 2.61)	0.86 (0.43; 1.74)		2.41 (1.21; 4.79)	0.499
Asthma		1.30 (0.86; 1.96)	3.16 (2.02; 4.93)	1.89 (1.21; 2.95)	1.29 (0.83; 2.02)	2.00 (1.32; 3.03)	0.777
Chronic bronchitis, COPD, emphysema		2.37 (1.59; 3.53)	2.67 (1.78; 3.99)	5.16 (2.86; 9.31)	4.82 (2.82; 8.26)	6.02 (3.33; 10.86)	<0.001

Analyses were conducted in 1997 in 6,915 individuals (5%missing), in 2001 in 7,495 (14%missing), in 2004 in 7,660 (15%missing), in 2008 in 5,894 (20%missing), in 2013 in 6,666(13%missing), and in 2018 in 7,053 (16%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

Supplementary Tables 3 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised percentage point differences between distal groups.

3.A Age-related absolute health disparities: adults aged 75-84 years versus adults aged 25-34 years (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-19.2% (-25.7%; -12.7%)	-25.0% (-30.8%; -19.1%)	0.175
Non-daily vegetables					-8.4% (-14.1%; -2.7%)	-11.3% (-16.1%; -6.5%)	0.383
Daily snacking					-2.7% (-9.3%; 4.9%)	3.5% (-2.9%; 9.9%)	0.186
Diet high in SSBs					-20.9% (-25.9%; -15.8%)	-20.3% (-24.9%; -15.8%)	0.291
Daily smoking	-19.9% (-24.3%; -15.4%)	-21.1% (-25.2%; -17.1%)	-19.6% (-23.9%; -15.3%)	-18.8% (-22.9%; -14.8%)	-13.0% (-17.3%; -8.7%)	-14.3% (-18.1%; -10.5%)	0.840
Excess alcohol	-0.4% (-4.0%; 3.2%)	-3.4% (-6.3%; -0.5%)	-2.4% (-6.1%; 1.3%)	-2.4% (-5.1%; 0.3%)	-0.2% (-2.2%; 1.7%)	-3.2% (-5.1%; -1.3%)	0.075
Leisure time physical inactivity	35.6% (28.1%; 43.1%)	30.6% (24.5%; 36.8%)	31.6% (25.4%; 37.7%)	30.2% (23.5%; 37.0%)	26.1% (18.1%; 34.1%)	21.5% (14.7%; 28.3%)	0.018
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	19.1% (10.7%; 27.4%)	19.3% (12.9%; 25.8%)	24.0% (18.5%; 29.5%)	20.1% (14.1%; 26.1%)	19.9% (13.7%; 26.2%)	20.8% (14.6%; 26.9%)	0.894
Obesity, BMI ≥ 30 kg/m²	4.2% (-0.1%; 8.6%)	11.2% (6.4%; 16.0%)	6.1% (2.5%; 9.7%)	7.7% (3.8%; 11.7%)	5.5% (1.2%; 9.9%)	6.3% (2.1%; 10.6%)	0.048
High blood pressure	26.7% (19.4%; 34.1%)	33.2% (27.5%; 39.0%)	33.0% (28.7%; 37.2%)	32.3% (28.0%; 36.5%)	32.8% (27.9%; 37.7%)	38.7% (33.8%; 43.6%)	0.072
High cholesterol levels					35.4% (30.3%; 40.6%)	35.0% (29.9%; 40.0%)	0.294
NCD prevalence							
Asthma		4.3% (1.2%; 7.4%)	3.3% (1.0%; 5.7%)	1.5% (-1.4%; 4.5%)	-1.0% (-3.6%; 1.7%)		0.017
Chronic bronchitis, COPD, emphysema		10.2% (6.6%; 13.8%)	10.5% (7.3%; 13.7%)	8.1% (5.6%; 10.7%)		6.8% (3.8%; 9.8%)	0.567

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.B sex-related absolute health disparities: women versus men (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-11.8% (-14.6%; -9.0%)	-12.8% (-15.4%; -10.2%)	0.504
Non-daily vegetables					-7.2% (-9.3%; -5.1%)	-7.6% (-9.8%; -5.5%)	0.919
Daily snacking					-0.7% (-2.7%; 2.6%)	1.4% (-1.2%; 4.0%)	0.408
Daily SSBs					-10.3% (-12.6%; -8.0%)	-8.5% (-10.7%; -6.4%)	0.597
Daily smoking	-11.7% (-14.6%; -8.9%)	-8.6% (-10.7%; -6.5%)	-7.6% (-10.0%; -5.3%)	-5.6% (-8.1%; -3.2%)	-6.0% (-8.4%; -3.5%)	-6.9% (-9.2%; -4.7%)	0.075
Excess alcohol	-5.3% (-7.1%; -3.6%)	-5.9% (-7.6%; -4.2%)	-6.8% (-8.4%; -5.2%)	-3.7% (-5.4%; -2.0%)	-3.6% (-5.2%; -2.0%)	-3.4% (-4.8%; -2.1%)	0.067
Leisure time physical inactivity	8.3% (5.1%; 11.5%)	9.6% (7.2%; 12.1%)	10.0% (7.4%; 12.6%)	6.6% (3.8%; 9.5%)	6.4% (3.2%; 9.6%)	8.1% (5.4%; 10.9%)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	-15.4% (-18.6%; -12.1%)	-12.6% (-15.3%; -10.0%)	-14.4% (-17.0%; -11.8%)	-13.9% (-16.8%; -10.9%)	-14.1% (-17.0%; -11.1%)	-14.2% (-17.0%; -11.4%)	0.729
Obesity, BMI ≥ 30 kg/m²	-0.3% (-2.7%; 2.2%)	1.0% (-0.9%; 2.9%)	1.4% (-0.5%; 3.3%)	1.4% (-0.7%; 3.4%)	0.4% (-1.9%; 2.6%)	-1.7% (-3.9%; 0.4%)	0.180
High blood pressure	4.1% (1.7%; 6.5%)	1.8% (-0.2%; 3.8%)	2.1% (0.1%; 4.0%)	2.8% (0.6%; 4.9%)	0.0% (-2.3%; 2.3%)	-1.2% (-3.3%; 1.0%)	0.003
High cholesterol levels					-0.8% (-2.5%; 2.0%)	-3.4% (-5.5%; -1.2%)	0.067
NCD prevalence							
T2DM	0.1% (-1.3%; 1.6%)	-0.5% (-1.5%; 0.6%)	-0.5% (-1.6%; 0.6%)	-0.4% (-1.6%; 0.8%)	-0.8% (-2.0%; 0.9%)	-0.8% (-2.1%; 0.6%)	0.479
CVD					-3.1% (-4.3%; -1.9%)	-2.6% (-3.8%; -1.3%)	0.431
Myocardial infarction				-0.7% (-1.1%; -0.2%)	-1.2% (-2.1%; -0.3%)	-0.7% (-1.4%; -0.1%)	
Coronary artery disease				-1.5% (-2.5%; -0.5%)	-1.1% (-1.8%; -0.4%)	-0.9% (-1.7%; 0.0%)	
Other serious heart disease					-1.8% (-2.7%; -0.9%)	-1.4% (-2.5%; -0.4%)	
Cerebrovascular disease	0.5% (-0.5%; 1.4%)	-0.1% (-0.6%; 0.4%)	0.0% (-0.5%; 0.5%)	0.0% (-0.6%; 0.7%)	-0.4% (-1.1%; 0.3%)	-1.1% (-1.8%; -0.4%)	
Cancer	1.0% (-0.1%; 2.1%)	0.4% (-0.3%; 1.1%)	0.9% (0.3%; 1.5%)	0.0% (-1.1%; 1.0%)	1.0% (0.1%; 1.9%)	0.9% (-0.1%; 1.8%)	0.535
Asthma		-1.0% (-2.2%; 0.2%)	0.7% (-0.4%; 1.8%)	1.6% (0.4%; 2.8%)	0.0% (-1.3%; 1.3%)	1.0% (-0.4%; 2.3%)	0.247
Chronic bronchitis, COPD, emphysema		-0.7% (-2.0%; 0.6%)	-0.5% (-1.8%; 0.7%)	0.0% (-1.2%; 1.1%)	0.6% (-0.6%; 1.8%)	0.1% (-1.1%; 1.2%)	0.282
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	-0.8 (-3.0; 1.5)	-0.8 (-2.8; 1.2)	1.2 (-0.8; 3.2)	-2.52 (-4.4; -0.6)	-3.6 (-5.2; -2.0)	-5.4 (-6.8; -3.9)	0.085
Ischemic heart disease	-114 (-1120; -106)	-110 (-116; -103)	-99 (-105; -93)	-80 (-85.24; -75)	-64 (-67; -59.8)	-53 (-56; -50)	0.009
Cerebrovascular disease	-22 (-27; -16)	-19 (-26; -12)	-5.5 (-12; 0.9)	-11.66 (-17.18; -6.2)	-9.7 (-14; -5.4)	-6.2 (-10; -2.5)	0.133
Cancer	-226 (-235; -217)	-213 (-222; -205)	-191 (-199; -182)	-175 (-183; -167)	-151 (-157; -143.9)	-126 (-132; -119)	0.009
Asthma	-0.6 (-1.6; 0.3)	0.2 (-0.6; 1.0)	0.7 (0.1; 1.3)	0.6 (0.1; 1.1)	0.3 (-0.2; 0.7)	0.4 (0.1; 0.8)	0.452
Chronic bronchitis, COPD, emphysema	-91 (-96; -86)	-74 (-79; -70)	-66 (-71; -62)	-57 (-60; -53)	-40 (-43; -37)	-32 (-34; -29)	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.C Region of residence-related absolute health disparities: Wallonia versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.7% (-1.8%; 5.2%)	5.8% (2.2%; 9.4%)	0.104
Non-daily vegetables					3.3% (0.3%; 6.3%)	6.0% (2.8%; 9.2%)	0.293
Daily snacking					0.2% (-3.4%; 3.8%)	-4.4% (-7.9%; -1.0%)	0.060
Daily SSBs					2.6% (-0.4%; 5.6%)	2.1% (-1.1%; 5.2%)	0.875
Daily smoking	3.7% (0.4%; 7.1%)	3.4% (0.7%; 6.1%)	4.8% (1.8%; 7.8%)	5.5% (2.3%; 8.7%)	4.4% (1.1%; 7.6%)	5.4% (2.5%; 8.4%)	0.155
Excess alcohol	-1.5% (-3.3%; 0.4%)	-2.1% (-4.0%; -0.2%)	1.2% (-0.8%; 3.2%)	1.7% (-0.5%; 3.8%)	1.6% (-0.4%; 3.5%)	1.5% (-0.2%; 3.3%)	0.002
Leisure time physical inactivity	12.0% (8.0%; 16.0%)	13.1% (9.9%; 16.3%)	10.3% (7.1%; 13.5%)	13.0% (9.5%; 16.5%)	8.4% (4.6%; 12.3%)	13.6% (10.0%; 17.2%)	0.333
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	4.1% (0.2%; 8.0%)	4.3% (1.2%; 7.4%)	6.2% (3.1%; 9.3%)	2.7% (-0.7%; 6.1%)	3.5% (0.1%; 6.9%)	4.0% (0.7%; 7.4%)	0.618
Obesity, BMI ≥ 30 kg/m²	4.2% (1.5%; 7.0%)	3.5% (1.3%; 5.7%)	4.3% (2.0%; 6.6%)	1.2% (-1.2%; 3.5%)	4.0% (1.5%; 6.6%)	3.6% (0.9%; 6.2%)	0.287
High blood pressure	3.9% (1.0%; 6.9%)	0.4% (-2.0%; 2.8%)	1.5% (-0.7%; 3.8%)	2.3% (-0.1%; 4.8%)	-1.8% (-4.3%; 0.6%)	1.8% (-0.6%; 4.2%)	0.232
High cholesterol levels					-0.7% (-3.2%; 1.8%)	0.2% (-2.3%; 2.7%)	0.658
NCD prevalence							
T2DM	2.1% (0.5%; 3.7%)	2.4% (1.2%; 3.6%)	2.0% (0.6%; 3.4%)	1.0% (-0.2%; 2.3%)	1.3% (-0.3%; 2.9%)	2.1% (0.6%; 3.6%)	0.126
CVD					1.0% (-0.4%; 2.4%)	0.3% (-1.1%; 1.7%)	0.450
Myocardial infarction				0.4% (-0.1%; 0.8%)	)	0.7% (0.0%; 1.5%)	
Coronary artery disease				0.6% (-0.4%; 1.6%)	0.7% (-0.2%; 1.5%)	0.4% (-0.5%; 1.3%)	
Other serious heart disease					-0.4% (-1.3%; 0.5%)	-0.2% (-1.4%; 0.9%)	
Cerebrovascular disease			0.5% (-0.1%; 1.0%)	0.8% (0.1%; 1.5%)		0.7% (0.0%; 1.4%)	
Cancer	-0.1% (-1.3%; 1.0%)	0.8% (-0.1%; 1.7%)	-0.2% (-0.8%; 0.4%)	-0.1% (-1.1%; 1.0%)	-0.3% (-1.2%; 0.7%)	-0.1% (-1.1%; 0.9%)	0.387
Asthma		2.9% (1.5%; 4.3%)	3.0% (1.7%; 4.2%)	3.1% (1.7%; 4.4%)	2.6% (1.2%; 4.0%)	3.9% (2.3%; 5.6%)	0.740
Chronic bronchitis, COPD, emphysema		3.3% (1.8%; 4.8%)	3.5% (2.0%; 4.9%)	2.0% (0.7%; 3.2%)	2.3% (1.0%; 3.7%)	2.2% (0.9%; 3.5%)	0.943
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	1.1 (-1.3; 3.4)	7.3 (5.1; 10)	11 (8.3; 13)	5.1 (3.1; 7.2)	1.7 (-0.01; 3.3)	4.3 (2.8; 5.9)	1.000
Ischemic heart disease	-22 (-28; -16)	-5.2 (-11; 0.6)	0.1 (-5.5; 5.6)	12 (7.3; 17)	20 (17; 24)	17 (13; 20)	0.024
Cerebrovascular disease	-13 (-18.5; -7.8)	-6.4 (-11; -1.3)	-11 (-16; -6.6)	-2.3 (-6.5; 1.9)	-3.1 (-6.6; 0.3)	2.1 (-1.0; 5)	0.060
Cancer	18 (9.7; 27)	19 (11; 27)	18 (10; 26)	23 (15; 30)	26 (19; 33)	26 (19; 32)	0.051
Asthma	0.9 (0.0; 1.8)	0.9 (0.1; 1.8)	1.7 (0.9; 2.5)	0.9 (0.3; 1.5)	1.0 (0.5; 1.6)	1.0 (0.5; 1.4)	0.411
Chronic bronchitis, COPD, emphysema	5.2 (1.2; 9.2)	7.5 (3.9; 11)	9.0 (5.4; 13)	15 (11; 18)	13 (9.9; 16)	8.4 (5.8; 11)	0.260

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.D Region of residence-related absolute health disparities: Brussels versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-7.2% (-10.9%; -3.4%)	-3.2% (-6.6%; 0.2%)	0.069
Non-daily vegetables					3.5% (0.2%; 6.8%)	7.1% (4.0%; 10.2%)	0.225
Daily snacking					-9.8% (-13.3%; -6.3%)	-10.5% (-13.7%; -7.3%)	0.641
Daily SSBs					-4.6% (-7.4%; -1.7%)	-4.5% (-7.2%; -1.9%)	0.731
Daily smoking	2.5% (-0.7%; 5.8%)	2.9% (0.02%; 5.8%)	2.3% (-0.8%; 5.4%)	2.9% (-0.3%; 6.0%)	-0.8% (-4.3%; 2.6%)	2.1% (-0.6%; 4.8%)	0.365
Excess alcohol	0.4% (-1.6%; 2.4%)	1.1% (-1.1%; 3.4%)	0.7% (-1.4%; 2.7%)	-0.1% (-2.1%; 1.8%)	2.4% (0.1%; 4.7%)	3.0% (1.1%; 4.8%)	0.027
Leisure time physical inactivity	11.2% (6.6%; 15.7%)	8.6% (5.3%; 11.9%)	6.0% (2.5%; 9.4%)	9.8% (6.0%; 13.5%)	5.3% (0.7%; 9.9%)	6.7% (3.2%; 10.2%)	0.315
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	-5.6% (-9.7%; -1.4%)	-3.2% (-6.4%; 0.0%)	-2.2% (-5.4%; 1.0%)	-5.2% (-8.6%; -1.7%)	-0.7% (-4.3%; 3.0%)	1.0% (-2.4%; 4.4%)	0.013
Obesity, BMI ≥ 30 kg/m²	-0.5% (-3.5%; 2.5%)	0.7% (-1.5%; 3.0%)	0.7% (-1.4%; 2.9%)	-0.9% (-3.3%; 1.6%)	1.3% (-1.3%; 4.0%)	0.4% (-2.1%; 2.8%)	0.725
High blood pressure	1.5% (-1.5%; 4.4%)	-0.5% (-2.9%; 2.0%)	-0.8% (-2.9%; 1.3%)	0.1% (-2.4%; 2.5%)	2.9% (0.0%; 5.9%)	-1.5% (-3.8%; 0.8%)	0.647
High cholesterol levels					3.7% (0.7%; 6.8%)	-2.5% (-4.8%; -0.1%)	0.003
NCD prevalence							
T2DM	1.1% (-0.4%; 2.6%)	1.1% (0.0%; 2.2%)	1.4% (-0.1%; 2.8%)	3.2% (1.6%; 4.8%)	3.3% (1.4%; 5.1%)	2.3% (0.7%; 3.8%)	0.460
CVD					0.6% (-1.0%; 2.2%)	-1.5% (-2.8%; -0.3%)	0.030
Myocardial infarction				1.2% (0.5%; 2.0%)			
Coronary artery disease				1.2% (0.0%; 2.4%)	0.7% (0.2%; 1.5%)	0.6% (-0.4%; 1.6%)	
Other serious heart disease					0.2% (-1.0%; 1.4%)	-1.7% (-2.7%; -0.7%)	
Cerebrovascular disease			0.4% (-0.1%; 0.9%)	1.8% (0.9%; 2.7%)			
Cancer	0.4% (-1.2%; 2.0%)	1.2% (0.3%; 2.1%)	0.7% (-0.1%; 1.5%)	0.1% (-0.9%; 1.2%)	-1.2% (-2.5%; 0.0%)	-0.9% (-1.9%; 0.1%)	0.042
Asthma		3.0% (1.6%; 4.4%)	2.5% (1.1%; 3.8%)	3.2% (1.7%; 4.7%)	2.5% (0.6%; 4.3%)	2.7% (1.3%; 4.2%)	0.814
Chronic bronchitis, COPD, emphysema		3.1% (1.5%; 4.8%)	2.2% (0.7%; 3.7%)	2.0% (0.7%; 3.3%)	1.1% (0.4%; 2.5%)	0.9% (-0.3%; 2.1%)	0.181
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	-5.8 (-8.9; -2.8)	-2.5 (-5.3; 0.3)	-2.3 (-5.1; 0.6)	2.4 (-0.8; 5.6)	1.9 (-1.0; 4.7)	1.6 (-1.0; 4.1)	0.133
Ischemic heart disease	-13 (-23; -3.9)	-8.8 (-17.62; 0.1)	-2.9 (-11; 5.8)	11 (3.5; 19)	3.5 (-0.6; 12)	7.0 (1.5; 13)	0.060
Cerebrovascular disease	-20 (-28; -13)	-20 (-27; -13)	-6.9 (-14; 0.4)	-11 (-17; -4.8)	-9.8 (-15; -4.4)	-3.1 (-8.1; 2.0)	0.085
Cancer	1.2 (-12; 14)	8.1 (-4.8; 21)	11 (-1.9; 23)	2.4 (-9.6; 14)	2.0 (-13; 9.3)	11.5 (0.5; 22)	0.707
Asthma	5.0 (3.0; 7.0)	3.7 (1.9; 5.5)	1.3 (0.1; 2.5)	0.9 (-0.1; 1.9)	1.5 (0.5; 2.6)	0.9 (0.1; 1.7)	0.085
Chronic bronchitis, COPD, emphysema	-0.6 (-6.5; 5.3)	4.4 (-1.3; 10)	0.3 (-4.9; 5.6)	3.0 (-2.0; 8.1)	9.8 (4.9; 15)	6.6 (2.0; 11)	0.133

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.E Nationality-related absolute health disparities: non-Belgian Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-2.8% (-9.0%; 3.3%)	-5.2% (-10.4%; 0.0%)	0.708
Non-daily vegetables					6.9% (1.6%; 12.2%)	9.1% (4.2%; 14.0%)	0.696
Daily snacking					-14.2% (-19.0%;-9.4%)	-11.7% (-16.2%;-7.2%)	0.550
Daily SSBs					-6.9% (-10.8%; -2.9%)	-6.5% (-10.3%; -2.7%)	0.922
Daily smoking	0.8% (-5.0%; 6.6%)	1.1% (-4.1%; 6.2%)	1.3% (-4.1%; 6.7%)	-0.1% (-5.7%; 5.5%)	5.5% (-1.0%; 12.0%)	0.8% (-3.6%; 5.2%)	0.683
Excess alcohol	2.2% (-2.6%; 6.9%)	-3.4% (-6.2%; -0.6%)	0.4% (-4.2%; 4.9%)	0.9% (-3.5%; 5.3%)	-1.3% (-4.4%; 1.7%)	-1.1% (-4.0%; 1.7%)	0.552
Leisure time physical inactivity	4.5% (-2.5%; 11.6%)	11.6% (5.4%; 17.9%)	0.5% (-5.5%; 6.5%)	5.1% (-1.9%; 12.0%)	5.3% (-2.7%; 13.2%)	3.5% (-2.3%; 9.3%)	0.650
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.8% (-5.5%; 9.1%)	7.2% (1.6%; 12.7%)	2.9% (-2.6%; 8.4%)	-1.9% (-8.5%; 4.7%)	-2.0% (-7.4%; 3.4%)	2.2% (-2.5%; 7.0%)	0.570
Obesity, BMI ≥ 30 kg/m²	4.0% (-2.2%; 10.2%)	1.4% (-3.5%; 6.3%)	4.6% (-0.2%; 9.5%)	-0.9% (-4.9%; 3.1%)	-0.9% (-4.4%; 2.7%)	0.0% (-4.1%; 4.1%)	0.213
High blood pressure	-0.6% (-5.9%; 4.6%)	-1.9% (-6.1%; 2.4%)	1.8% (-2.5%; 6.1%)	-3.9% (-8.2%; 0.4%)	-0.9% (-5.2%; 3.3%)	1.4% (-2.5%; 5.3%)	0.631
High cholesterol levels					0.8% (-4.5%; 6.1%)	-0.2% (-4.7%; 4.4%)	0.895
NCD prevalence							
T2DM	1.6% (-1.7%; 5.0%)	1.7% (-0.9%; 4.2%)	1.1% (-1.1%; 3.4%)	2.3% (-0.5%; 5.1%)	0.4% (-2.5%; 3.4%)	0.2% (-2.4%; 2.8%)	0.250
CVD					-0.3% (-2.7%; 2.1%)	0.1% (-2.3%; 2.4%)	0.918
Myocardial infarction							
Coronary artery disease							
Other serious heart disease						-0.3% (-2.0%; 1.4%)	
Cerebrovascular disease							
Cancer							
Asthma		1.4% (-1.1%; 4.0%)	0.0% (-1.9%; 2.0%)	-0.7% (-2.4%; 1.0%)	-0.1% (-2.6%; 2.3%)	-0.9% (-2.9%; 1.0%)	0.341
Chronic bronchitis, COPD, emphysema		2.3% (-0.6%; 5.2%)	1.3% (-1.6%; 4.2%)	-0.5% (-2.4%; 1.4%)	1.0% (-1.6%; 3.7%)	0.1% (-2.2%; 2.4%)	0.545
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	2.6 (-0.5; 5.6)	1.2 (-1.6; 3.9)	6.5 (3.5; 9.6)	1.8 (-0.9; 4.6)	1.4 (-1.0; 3.9)	-3.7 (-5.7; -1.7)	0,260
Ischemic heart disease	-42 (-50; -34)	-1.0 (-8.9; 6.9)	-9.0 (-16; -1.6)	-13 (-19; -6.3)	-2.5 (-8.1; 3.1)	-28 (-32; -23)	1.000
Cerebrovascular disease	-24 (-29; -18)	-4.4 (-10; 1.4)	-20 (-25; -14)	-7.5 (-13; -2.5)	-4.2 (-8.6; 0.3)	-21 (-25; -17)	0.707
Cancer	-76 (-89; -63)	-47 (-60; -35)	-43 (-55; -30)	-55 (-68; -43)	-53 (-65; -41)	-156 (-166; -146)	0.707
Asthma	2.3 (0.5; 4.0)	-0.1 (-1.5; 1.4)	0.0 (-1.1; 1.1)	0.8 (-0.1; 1.8)	-0.1 (-0.9; 0.7)	-0.0 (-0.7; 0.6)	0.697
Chronic bronchitis, COPD, emphysema	9.4 (3.9; 15)	12 (7.3; 18)	9.6 (4.8; 14)	8.5 (3.7; 13)	-4.6 (-8.9; -0.3)	-23 (-27; -19)	0.060

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). NCD-specific mortality rates, per 100,000 are comparing all foreigners living in Belgium with Belgians. Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence, and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.F Nationality-related absolute health disparities: non-Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.2% (-7.5%; 7.9%)	-7.1% (-14.6%; 0.3%)	0.304
Non-daily vegetables					15.9% (8.5%; 23.3%)	7.6% (1.5%; 13.6%)	0.050
Daily snacking					-9.7% (-16.4%; -2.9%)	-18.4% (-24.4%;-12.4%)	0.040
Daily SSBs					1.4% (-5.5%; 8.4%)	-4.0% (-9.9%; 1.9%)	0.184
Daily smoking	-5.5% (-13.8%; 2.9%)	-3.6% (-9.7%; 2.6%)	-5.4% (-13.1%; 2.4%)	-4.3% (-13.4%; 4.8%)	-5.3% (-13.0%; 2.4%)	-2.5% (-8.9%; 4.0%)	0.992
Excess alcohol							
Leisure time physical inactivity	26.5% (17.3%; 35.6%)	17.7% (9.0%; 26.3%)	3.3% (-8.0%; 14.5%)	15.8% (4.0%; 27.5%)	2.0% (-7.7%; 11.8%)	13.4% (2.9%; 24.0%)	0.249
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	2.7% (-6.3%; 11.7%)	0.2% (-8.5%; 8.8%)	5.0% (-4.8%; 14.7%)	4.6% (-3.2%; 12.4%)	6.7% (-0.8%; 14.2%)	9.2% (2.7%; 15.7%)	0.048
Obesity, BMI ≥ 30 kg/m²	-1.5% (-6.4%; 3.5%)	4.9% (-1.8%; 11.7%)	2.4% (-4.3%; 9.1%)	-0.1% (-5.8%; 5.7%)	1.2% (-4.8%; 7.2%)	6.0% (0.0%; 12.0%)	0.115
High blood pressure	-0.1% (-6.9%; 6.7%)	3.6% (-4.7%; 11.8%)	-4.6% (-8.9%; -0.4%)	-3.8% (-9.7%; 2.2%)	5.3% (-2.3%; 13.0%)	3.5% (-2.4%; 9.3%)	0.316
High cholesterol levels					-0.9% (-7.7%; 5.8%)	1.1% (-5.1%; 7.4%)	0.461
NCD prevalence							
T2DM		9.2% (2.2%; 16.2%)			7.0% (0.5%; 13.5%)	7.5% (2.5%; 12.6%)	0.788
CVD							
Myocardial infarction							
Coronary artery disease							
Other serious heart disease							
Cerebrovascular disease							
Cancer							
Asthma		0.9% (-2.2%; 4.0%)			-0.6% (-3.0%; 1.9%)	-1.2% (-3.6%; 1.2%)	0.208
Chronic bronchitis, COPD, emphysema		0.1% (-3.5%; 3.6%)	0.6% (-3.6%; 4.8%)				0.260

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.G Education-relative absolute health disparities: low versus high (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					14.5% (10.1%; 18.8%)	15.5% (11.2%; 19.9%)	0.715
Non-daily vegetables					11.1% (7.2%; 15.1%)	17.6% (13.7%; 21.6%)	0.099
Daily snacking					-4.2% (-8.4%; 0.0%)	-9.9% (-13.8%; -6.0%)	0.083
Daily SSBs					14.9% (11.1%; 18.6%)	13.9% (9.9%; 17.9%)	0.926
Daily smoking	11.6% (7.7%; 15.5%)	10.9% (7.7%; 14.1%)	16.4% (12.9%; 19.8%)	20.6% (16.4%; 24.8%)	19.7% (15.3%; 24.1%)	17.3% (13.2%; 21.3%)	<0.001
Excess alcohol	1.3% (-1.0%; 3.6%)	-1.3% (-3.8%; 1.2%)	-2.8% (-5.2%; -0.3%)	-1.6% (-4.1%; 0.8%)	0.2% (-2.4%; 2.7%)	-2.0% (-4.0%; 0.0%)	0.672
Leisure time physical inactivity	19.1% (14.4%; 23.9%)	16.5% (12.7%; 20.3%)	17.4% (13.6%; 21.3%)	17.2% (12.8%; 21.7%)	16.8% (11.3%; 22.3%)	21.5% (16.6%; 26.4%)	0.754
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	15.4% (10.8%; 20.1%)	15.2% (11.5%; 18.9%)	11.7% (8.1%; 15.4%)	12.2% (8.0%; 16.4%)	13.5% (9.3%; 17.6%)	16.5% (12.5%; 20.5%)	0.682
Obesity, BMI ≥ 30 kg/m²	6.4% (3.4%; 9.5%)	10.9% (8.5%; 13.3%)	11.0% (8.5%; 13.6%)	10.8% (7.8%; 13.9%)	12.3% (9.1%; 15.6%)	10.7% (7.3%; 14.0%)	0.246
High blood pressure	3.3% (-0.1%; 6.7%)	5.4% (2.6%; 8.3%)	5.1% (2.6%; 7.6%)	5.2% (2.3%; 8.1%)	4.6% (1.5%; 7.7%)	3.3% (0.6%; 6.1%)	0.729
High cholesterol levels					1.7% (-1.3%; 4.8%)	3.2% (0.2%; 6.2%)	0.765
NCD prevalence							
T2DM	3.6% (2.1%; 5.0%)	2.3% (1.1%; 3.4%)	3.7% (2.3%; 5.1%)	3.7% (2.3%; 5.1%)	3.7% (1.9%; 5.5%)	3.6% (1.9%; 5.3%)	0.158
CVD					0.6% (-1.2%; 2.4%)	1.0% (-0.6%; 2.7%)	0.672
Myocardial infarction				0.5% (0.0%; 1.0%)	1.3% (0.0%; 2.5%)	0.8% (-0.1%; 1.6%)	
Coronary artery disease				0.7% (-0.6%; 1.9%)	-0.7% (-2.1%; 0.7%)	0.5% (-0.4%; 1.3%)	
Other serious heart disease					0.9% (-0.3%; 2.1%)	0.6% (-0.9%; 2.0%)	
Cerebrovascular disease				0.2% (-0.6%; 1.0%)	0.0% (-0.7%; 0.8%)	0.7% (-0.1%; 1.5%)	
Cancer	-0.1% (-1.4%; 1.2%)	0.3% (-0.7%; 1.2%)	0.3% (-0.5%; 1.1%)	0.3% (-0.8%; 1.4%)	0.6% (-0.7%; 1.9%)	0.1% (-1.1%; 1.2%)	0.842
Asthma		1.3% (-0.2%; 2.8%)	1.9% (0.5%; 3.3%)	1.2% (-0.3%; 2.7%)	3.6% (1.8%; 5.4%)	2.2% (0.3%; 4.2%)	0.440
Chronic bronchitis, COPD, emphysema		5.1% (3.4%; 6.9%)	5.8% (4.1%; 7.6%)	5.1% (3.6%; 6.7%)	4.2% (2.4%; 6.0%)	4.5% (2.8%; 6.2%)	0.623

Analyses were conducted in 1997 in 7,146 individuals (1.5%missing), in 2001 in 8,427 (2.8%missing), in 2004 in 8,796 (2.8%missing), in 2008 in 7,146 (2.7%missing), in 2013 in 7,590(1.5%missing), and in 2018 in 8,201 (1.9%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.H Income-related absolute health disparities: Quintile 1 versus Quintile 5 (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					3.3% (-2.0%; 8.7%)	17.4% (11.7%; 23.0%)	0.003
Non-daily vegetables					3.1% (-2.6%; 7.7%)	24.0% (18.8%; 29.3%)	<0.001
Daily snacking					-5.9% (-11.3%; -0.5%)	-12.4% (-17.7%; -7.2%)	0.086
Daily SSBs					12.8% (8.6%; 17.1%)	8.2% (3.3%; 13.1%)	0.208
Daily smoking	9.1% (4.5%; 13.7%)	7.3% (3.1%; 11.5%)	15.1% (10.6%; 19.7%)	15.9% (10.4%; 21.3%)	18.2% (13.1%; 23.2%)	21.2% (15.8%; 26.6%)	<0.001
Excess alcohol	1.3% (-1.6%; 4.3%)	-7.5% (-10.7%; -4.3%)	-2.8% (-5.8%; 0.2%)	-2.0% (-5.3%; 1.4%)	0.5% (-2.7%; 3.6%)	-0.7% (-3.3%; 1.9%)	0.246
Leisure time physical inactivity	13.7% (7.6%; 19.7%)	16.6% (11.6%; 21.7%)	15.2% (10.1%; 20.2%)	18.3% (12.5%; 24.1%)	16.7% (10.4%; 23.0%)	22.0% (15.8%; 28.1%)	0.208
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	9.5% (4.1%; 14.8%)	5.8% (1.0%; 10.6%)	7.5% (2.4%; 12.5%)	6.1% (0.6%; 11.7%)	10.6% (5.4%; 15.9%)	11.4% (5.6%; 17.2%)	0.453
Obesity, BMI ≥ 30 kg/m²	4.7% (0.6%; 8.9%)	4.8% (1.6%; 8.1%)	7.5% (4.1%; 10.9%)	8.6% (4.7%; 12.4%)	10.7% (6.9%; 14.5%)	8.2% (3.7%; 12.7%)	0.358
High blood pressure	-0.6% (-4.9%; 3.6%)	1.4% (-2.3%; 5.0%)	0.5% (-3.0%; 4.1%)	5.6% (1.2%; 10.0%)	2.4% (-1.6%; 6.5%)	8.1% (3.4%; 12.7%)	0.003
High cholesterol levels					5.5% (1.3%; 9.6%)	7.0% (2.3%; 11.7%)	0.240
NCD prevalence							
T2DM	1.5% (-0.4%; 3.5%)	2.4% (0.7%; 4.1%)	2.6% (-0.2%; 5.5%)	3.8% (1.9%; 5.7%)	5.5% (2.9%; 8.2%)	4.8% (2.1%; 7.5%)	0.413
CVD					3.3% (1.1%; 5.5%)	2.3% (-0.7%; 5.3%)	0.228
Myocardial infarction							
Coronary artery disease				1.0% (-0.6%; 2.5%)			
Other serious heart disease					0.9% (-0.7%; 2.4%)	1.3% (-1.3%; 3.8%)	
Cerebrovascular disease							
Cancer		0.5% (-0.7%; 1.7%)	0.4% (-0.6%; 1.3%)	-0.3% (-1.9%; 1.3%)		2.1% (0.3%; 3.9%)	0.486
Asthma		1.3% (-0.7%; 3.2%)	4.7% (2.9%; 6.6%)	2.7% (0.8%; 4.6%)	1.3% (-0.9%; 3.6%)	4.8% (1.7%; 7.9%)	0.382
Chronic bronchitis, COPD, emphysema		5.0% (2.9%; 7.2%)	5.7% (3.4%; 8.0%)	6.8% (4.5%; 9.0%)	5.8% (3.8%; 7.9%)	9.1% (6.2%; 12.0%)	0.005

Analyses were conducted in 1997 in 6,915 individuals (5%missing), in 2001 in 7,495 (14%missing), in 2004 in 7,660 (15%missing), in 2008 in 5,894 (20%missing), in 2013 in 6,666(13%missing), and in 2018 in 7,053 (16%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

Supplementary Table 4 General characteristics and lifestyle risks (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus low) [a].

	Year of the survey					
	2013			2018		
	Engaged in multiple lifestyle risks			Engaged in multiple lifestyle risks		
	Total	High	Low	Total	High	Low
Number of individuals	4,386	975 (21.2%)	1,061 (24.1%)	6,216	1,240 (19.5%)	1,634 (26.5%)
		(%)	(%)		(%)	(%)
Age groups						
25-34 years	18.5	20.2	22.3	19.1	20.8	20.0
35-44 years	17.1	18.7	19.5	15.7	18.8	16.8
45-54 years	20.4	21.5	21.3	19.2	21.0	19.7
55-64 years	20.1	23.2	18.7	21.4	25.3	22.0
65-74 years	14.1	11.7	11.9	15.4	9.9	14.2
75-84 years	9.9	4.7	6.4	9.2	4.1	7.2
Sex, men	48.8	63.7	39.6	48.6	64.6	43.2
Region of residence						
Flanders	57.6	57.2	64.5	56.7	52.8	63.7
Brussels	10.7	7.7	8.6	10.1	10.3	9.5
Wallonia	31.7	35.1	26.9	33.2	36.9	26.8
Nationality						
Belgians	89.4	92.9	92.1	88.6	90.1	88.9
Non-Belgian Europeans	6.4	5.8	5.2	6.6	6.5	5.9
Non-Europeans	4.2	1.3	2.8	4.8	3.4	5.2
Education level						
Low	24.1	23.8	15.1	29.1	20.3	13.0
Intermediate	33.5	40.0	28.8	32.0	41.6	27.0
High	42.4	36.2	56.0	48.4	38.1	60.0
Income level						
Quintile 1	16.6	14.4	8.5	11.8	16.7	8.6
Quintile 2	17.0	16.2	15.3	15.1	15.7	13.3
Quintile 3	21.0	22.7	19.3	19.9	17.9	18.7
Quintile 4	21.0	22.4	24.6	25.9	28.7	24.6
Quintile 5	24.2	24.3	32.3	27.3	21.0	34.8
Lifestyle risks						
Diet						
No daily fruit	43.9	74.6	17.1	44.1	76.1	16.2
No daily vegetables	20.4	35.5	5.6	23.2	40.5	7.9
Daily snacking	37.0	43.0	26.8	34.5	43.2	23.5
Daily SSBs	22.6	37.1	6.6	19.8	40.8	6.2
Four dietary risks present	1.4	5.1	0.0	1.6	6.7	0.0
3 out of 4	9.4	23.8	0.5	9.3	24.7	1.2
2 out of 4	26.1	35.7	5.4	24.4	37.7	5.1
1 out of 4	37.8	27.2	43.8	36.7	24.2	40.1
No dietary risks	25.2	8.2	50.3	28.0	6.6	53.7
Smoking						
Heavy	6.6	28.3	0.0	5.5	24.2	0.0
Occasional/light	15.0	41.1	0.9	15.1	44.8	0.6
Quit < 10years ago	9.7	12.8	1.9	9.0	12.0	2.5

Quit ≥ 10years ago	14.1	9.2	8.9	16.6	9.6	11.5
Never smoked	54.6	8.5	88.3	53.9	9.3	85.4
Alcohol consumption						
≥ 22 servings/week	4.6	16.8	0.0	4.8	19.3	0.0
15-21 servings/week	6.6	15.3	0.0	5.2	13.8	1.0
8-14 servings/week	14.4	21.5	7.0	12.1	17.7	3.3
1-7 servings/week	28.0	21.5	24.2	29.9	20.1	28.2
Abstainer/occasional	46.4	24.8	68.7	48.1	29.1	67.5
Physical inactivity						
Sedentary	27.2	54.6	0.0	28.6	61.3	0.0
Sport < 4hours/light	57.2	41.3	65.2	53.9	35.1	58.8
Sport ≥ 4hours/intensive	15.5	4.1	34.8	17.6	3.6	41.2

Abbreviations: SSB, sugar-sweetened beverages

[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

Supplementary Table 5 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in the individual lifestyle risks of diet, smoking, alcohol and physical activity, in 2018. [a]

	Dietary risks		Smoking		Alcohol		Physical inactivity	
	Yes	No	Yes	No	Yes	No	Yes	No
Number of individuals	5,074 (72%)	2,040 (27%)	3,076 (46%)	4,038 (54%)	3,573 (52%)	3,541 (48%)	5,828 (82%)	1,286 (18%)
Age groups								
25-34 years	20.9	13.2	16.6	20.5	16.5	21.1	16.7	28.4
35-44 years	17.4	14.0	15.5	17.3	15.3	17.7	16.1	18.3
45-54 years	20.8	16.8	18.2	20.9	20.6	18.6	19.9	18.6
55-64 years	20.1	27.2	26.4	18.5	24.0	20.1	22.6	20.0
65-74 years	13.4	18.9	16.7	13.4	16.3	13.4	15.7	11.2
75-84 years	7.4	9.9	6.6	9.5	7.2	9.2	9.1	3.5
Sex, men	51.8	41.9	59.2	40.1	58.8	38.2	45.3	66.4
Region of residence								
Flanders	59.2	58.0	59.2	58.6	61.1	56.4	58.1	62.6
Brussels	8.7	10.3	8.7	9.6	8.7	9.7	9.5	7.5
Wallonia	32.0	31.7	32.1	31.8	30.2	33.9	32.4	29.9
Nationality								
Belgians	90.9	89.0	92.0	88.9	92.8	87.6	90.4	90.0
Non-Belgian Europeans	5.6	7.3	6.1	6.1	5.3	6.9	6.0	6.2
Non-Europeans	3.6	3.7	2.0	5.0	1.9	5.5	3.6	3.7
Education level								
Low	16.9	16.8	18.6	15.3	11.7	22.5	18.6	8.2
Intermediate	33.9	26.4	36.1	28.0	28.3	35.7	32.2	30.0
High	49.2	56.9	45.2	56.7	60.0	41.9	49.2	61.7
Income level								
Quintile 1	11.4	9.9	12.7	9.5	8.5	13.6	12.0	6.2
Quintile 2	15.0	14.7	14.5	15.3	12.3	17.7	15.6	11.5
Quintile 3	18.6	19.7	18.8	19.1	17.6	20.3	19.8	14.8
Quintile 4	27.0	24.7	27.7	25.2	27.1	25.7	26.6	25.3
Quintile 5	27.9	31.1	26.3	30.9	34.5	22.7	26.0	42.1
Behavioral risks								
Dietary risks								
No daily fruits	60.3	0.0	48.4	38.7	44.4	42.0	44.5	37.3
No daily vegetables	31.0	0.0	22.9	21.6	19.8	24.8	23.0	18.5
Daily snacking	48.4	0.0	36.5	33.1	35.5	33.8	34.2	37.1
Daily SSBs	26.2	0.0	22.8	15.3	15.9	21.9	19.2	16.7
4 dietary risks present	2.2	0.0	2.3	0.9	1.4	1.8	1.6	1.4
3 out of 4	12.8	0.0	11.7	7.0	8.2	10.3	9.4	8.2
2 out of 4	33.8	0.0	25.5	23.0	23.2	25.3	25.0	20.2
1 out of 4	51.2	0.0	35.5	37.8	39.0	34.2	36.2	39.2
No dietary risks	0.0	100.0	25.0	31.2	28.2	28.5	27.8	31.1
Smoking								
Heavy	6.8	2.3	12.0	0.0	6.4	4.7	5.9	4.0
Occasional/light	16.8	10.4	32.2	0.0	16.9	12.8	15.4	13.1
Quit < 10yrs ago	8.9	8.9	19.2	0.0	9.2	8.6	8.6	10.6
Quit ≥ 10yrs ago	16.1	19.5	36.7	0.0	21.4	12.2	16.8	18.1
Never smoked	51.4	58.9	0.0	100.0	46.1	61.7	53.4	54.2
Alcohol consumption								

≥ 22 servings/week	5.6	3.3	8.2	2.2	9.5	0.0	4.9	5.3
15-21 servings/week	5.3	4.8	7.1	3.5	9.9	0.0	4.9	6.7
8-14 servings/week	12.3	12.0	15.7	9.2	23.4	0.0	11.4	16.3
1-7 servings/week	29.1	31.8	29.6	30.1	57.1	0.0	29.2	32.9
Abstainer/occasional	47.6	48.1	39.3	55.1	0.0	100.0	49.6	38.8
Physical inactivity								
Sedentary	31.2	21.8	31.1	26.3	22.1	35.5	34.5	0.0
Sport<4hrs/light	52.1	59.1	51.8	56.1	57.5	50.4	65.5	0.0
Sport≥4hrs/intensive	16.7	19.1	17.1	17.6	20.4	14.1	0.0	100.0
Metabolic risks								
Overweight,BMI≥25kg/m^2	52.9	50.8	54.6	50.4	50.6	54.2	54.7	41.1
Obesity,BMI≥30kg/m^2	17.9	16.5	18.1	16.9	15.3	19.9	19.2	9.4
High blood pressure	18.3	24.4	21.5	18.8	19.4	20.7	21.6	12.5
High cholesterol	20.3	23.9	25.2	18.0	22.6	19.9	23.1	12.7
NCD prevalence								
Type 2 diabetes	5.2	10.1	7.6	5.7	4.8	8.5	7.6	1.6
Cardiovascular disease	4.8	6.7	6.6	4.2	4.9	5.7	6.0	2.2
Cancer	2.4	2.7	3.1	2.0	2.2	2.8	2.5	2.3
Asthma	5.8	4.5	5.7	5.2	5.3	5.6	5.6	4.7
Chronic bronchitis, COPD, emphysema	4.0	4.7	6.1	2.6	3.4	5.1	4.6	2.4

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease; SSB, sugar-sweetened beverages

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being inactive or lightly active.

Supplementary Table 6 Relative health disparities by engagement in individiual lifestyle risks [a], independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios [b]

	Diet		Smoking		Alcohol		Physical inactivity	
	At least one vs none dietary risks		Current/former vs never		Frequent vs abstainer/occasional		in-/light active vs very active	
	2013	2018	2013	2018	2013	2018	2013	2018
Metabolic risks								
BMI≥25kg/m²	1.01 (0.93; 1.11)	1.05 (0.98; 1.13)	0.91 (0.85; 0.99)	1.01 (0.94; 1.08)	0.87 (0.80; 0.94)	0.87 (0.81; 0.93)	1.42 (1.25; 1.63)	1.32 (1.18; 1.47)
BMI≥25kg/m²	1.04 (0.84; 1.30)	1.14 (0.97; 1.35)	1.04 (0.85; 1.27)	1.03 (0.88; 1.20)	0.68 (0.55; 0.84)	0.73 (0.62; 0.85)	2.43 (1.60; 3.68)	1.87 (1.40; 2.48)
High BP	0.82 (0.69; 0.97)	0.88 (0.78; 1.01)	1.01 (0.85; 1.19)	1.07 (0.94; 1.22)	0.97 (0.82; 1.15)	0.87 (0.77; 0.98)	1.20 (0.89; 1.60)	1.41 (1.11; 1.81)
High cholesterol	0.84 (0.72; 0.99)	0.96 (0.84; 1.09)	1.11 (0.95; 1.30)	1.30 (1.14; 1.48)	0.99 (0.84; 1.16)	1.02 (0.90; 1.16)	1.10 (0.84; 1.44)	1.55 (1.25; 1.91)
NCD prevalence								
T2DM	0.54 (0.39; 0.76)	0.59 (0.47; 0.75)	1.02 (0.72; 1.43)	1.27 (0.98; 1.65)	0.49 (0.36; 0.68)	0.50 (0.39; 0.65)	1.62 (0.79; 3.29)	3.81 (2.19; 6.64)
CVD	0.96 (0.62; 1.49)	0.81 (0.61; 1.08)	1.63 (1.10; 2.41)	1.39(1.05; 1.84)	0.59 (0.41; 0.86)	0.73 (0.56; 0.95)	2.62 (1.23; 5.55)	2.12(1.31; 3.42)
Cancer	1.37 (0.74; 2.55)	0.98 (0.59; 1.64)	0.97 (0.54; 1.73)	1.77 (1.10; 2.85)	0.64 (0.36; 1.12)	0.79 (0.51; 1.22)	1.26 (0.58; 2.73)	0.80 (0.44; 1.45)
Asthma	1.14 (0.75; 1.72)	1.39 (1.01; 1.92)	0.91 (0.63; 1.32)	1.11 (0.85; 1.45)	0.68 (0.45; 1.02)	0.99 (0.75; 1.30)	1.05 (0.57; 1.93)	1.11 (0.72; 1.71)
Chronic bronchitis, COPD, emphysema	1.02 (0.66; 1.58)	0.90 (0.62; 1.30)	2.40(1.65; 3.49)	2.4 (1.80; 3.43)	0.79 (0.53; 1.17)	0.57 (0.41; 0.77)	3.12 (1.40; 6.98)	1.43(0.85; 2.41)

Abbreviations: BMI, body mass index; BP, blood pressure; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; T2DM, type 2 diabetes mellitus

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being inactive or lightly active. [b] Adjusted for age, sex and the other lifestyle risks.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-8*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	8-9
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8-9
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	If applicable, see footnote of tables
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	If applicable, see footnote of tables

Outcome data	15*	Report numbers of outcome events or summary measures	Tables
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Age-standardised results for meaningful comparison over the years
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Sup Tab 3 absolute risk difference
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	30

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Quantification of disparities in the distribution of lifestyle and metabolic risk factors, prevalence of non-communicable diseases and related-mortality: The Belgian Health Interview Surveys 1997-2018

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Quantification of disparities in the distribution of lifestyle and metabolic risk factors, prevalence of non-communicable diseases and related-mortality: The Belgian Health Interview Surveys 1997-2018

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ABSTRACT

OBJECTIVES Comprehensively measure the trends in health disparities by socio-demographic strata in terms of exposure to lifestyle and metabolic risks, and prevalence and mortality of non-communicable diseases (NCDs) during the last 20 years in Belgium.

DESIGN Cross-sectional analysis of periodic national-representative health interview surveys and vital statistics.

SETTING Population-based study of adult residents in Belgium between 1997-2018.

PARTICIPANTS Adults aged 25-84 years and resident in Belgium in the years 1997 (7,256 adults), 2001 (8,665), 2004 (9,054), 2008 (7,343), 2013 (7,704), and 2018 (8,358).

MAIN OUTCOME MEASURE Age-standardised prevalence rates of modifiable lifestyle risks (poor diet, smoking, excessive alcohol use and leisure-time physical inactivity), metabolic risks (high body mass index (BMI), blood pressure and cholesterol levels), and major NCDs (type 2 diabetes (T2DM), cardiovascular diseases (CVD), cancer, asthma and chronic obstructive pulmonary disease (COPD)), with their relative health disparities across strata by age, sex, region of residence, nationality, education and income level, and according to high versus low engagement in the four lifestyle risks, calculated from a survey-weighted Cox regression with time equals one, and adjusting for age.

RESULTS Greater avoidable disparities were observed between extremes of education and income strata. The most marked disparities were found for exposure to lifestyle risks, except excessive alcohol use, prevalence of high BMI as well as T2DM, asthma and COPD, with disparities of daily smoking and COPD worsening over time. Still, NCD-specific mortality rates were significantly higher among men (except asthma), residents of Wallonia and Brussels (except cerebrovascular disease), and among the native Belgians (except T2DM and asthma). High engagement in lifestyle risks was generally observed for men, residents of the region Wallonia, and among lower education and income strata. This subgroup (20%) had a worse health profile as compared with those who had a low-risk lifestyle (25%), shown by prevalence ratios varying between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD, asthma and COPD.

CONCLUSIONS Improving population health, including promoting greater health equity, requires approaches to be tailored to high-risk groups with actions tackling driving root causes of disparities seen by social factors and unhealthy lifestyle.

KEYWORDS

Lifestyle risks –metabolic risk factors – overweight – type 2 diabetes – cardiovascular disease – socio-demographic factors – disparities

ARTICLE SUMMARY

Strengths and limitations of this study

- The identification of the lower education and lower income groups as vulnerable within the Belgian population and the quantification of their health disparity gaps according to their root causes is essential to support equitable health promotion programmes and preventive strategies aiming at more health gains for all.
- We used data of the Belgian Health Interview Surveys, the best available nationally relevant epidemiological evidence from Belgium over the last 20 years, to study disparities in health from lifestyle and metabolic risks to non-communicable disease outcomes.
- From the socio-demographic sources of health disparities, only ageing, an inevitable part of life, poses an unavoidable risk factor for non-communicable diseases, and therefore equitable health policies for Belgium should account for the general profile of the high-risk groups, as identified by this study i.e. residents with a non-Belgian origin, and the lower education and lower income groups.
- The self-reported lifestyle, metabolic risks and prevalence of common non-communicable diseases were likely to be underestimates; as reporting of them is subjected to more than only their actual presence.
- The cross-sectional survey design cannot rule out the possibility of 'reverse causation' where those with prevalent non-communicable disease did show to have less lifestyle risks.

INTRODUCTION

Chronic non-communicable diseases (NCDs), including type 2 diabetes mellitus (T2DM), cardiovascular diseases (CVD), cancer, and respiratory diseases, are the leading causes of morbidity and mortality in Europe with over 90% of all deaths attributed to NCDs, and 86% in Belgium.[1] The onset of NCDs is primarily driven by four major lifestyle risks: unhealthy diets, tobacco use, alcohol use and physical inactivity, all of which are modifiable.[2] These lifestyle risks are the main cause of the rising prevalence of metabolic risks such as high body mass index (BMI), high blood pressure, hyperglycaemia, and hypercholesterolemia leading to the onset of NCDs and a major population health burden.[2]

Monitoring risks and disease prevalence in the population is essential for public health planning. It is particularly relevant for identifying health disparities and less favoured population subgroups, given the urgent need to address health equity, as acknowledged by the World Health Organisation (WHO),[3,4] the European Union (EU),[4,5] and state members such as Belgium.[6,7] Variables such as age,[8] sex,[9] geographical region,[10] nationality[11,12] and socio-economic status (SES)[10,13] are well-known indicators of health disparities at the population level, as characterised in the EU.[10] In Belgium, health disparities have been consistently monitored over the years for region and educational level, with overall less prevalent NCDs risks and outcomes for residents of Flanders and the higher educated.[14,15]

While these socio-demographic risk factors are non-modifiable (*e.g.* age and sex) or difficult to change (*e.g.* SES), other risk factors, such as lifestyle choices and associated metabolic conditions, offer an additional opportunity for NCD risk stratification. Such a risk stratification assessment is likely to be the most effective in primary care settings either using risk charts, like WHO CVD risk charts,[16] and/or clinical knowledge,[17,18] including an emphasis on the assessment of risk factors susceptible to be improved.[19] In particular, healthier lifestyle choices prior to diagnosis have been shown to be strongly associated with a lower incidence of multi-morbidity of cardiometabolic diseases and cancer,[20] implying that lifestyle-based interventions can, when appropriately accounting for SES, indirectly address disparities in the pursuit of health equity. Lifestyle choices, however, tend to cluster, *i.e.* most individuals engage in multiple lifestyle risks: poor diet, smoking, excess alcohol and physical inactivity,[21] with this accumulation of lifestyle risks having strong implications for living a longer life in good health.[22,23] Defining health disparities in terms of engagement to multiple lifestyle risks offers an additional perspective into identifying high-risk stratum for priority action. The comprehensive understanding of

who is at risk and which lifestyle risks more frequently cluster would certainly support tailored health promotion programmes, aiming at more health gains.

To identify and quantify all relevant health disparities in Belgium, this study aims to provide a clear and comprehensive overview of the health status, from lifestyle risks to NCDs, by relevant population strata of socio-demographic factors as well as by engagement in multiple lifestyle risks, using nationally relevant epidemiological evidence from Belgium over the last 20 years.

METHODS

Data sources

Belgian Health Interview Surveys (BHIS)

The BHIS is a cross-sectional study, conducted by Sciensano, carried out periodically every four to five years since 1997 and including approximately a sample of 10,000 participants per survey wave, representative of Belgian residents. Briefly, participants were selected from the Belgian national population register through a multistage stratified population sampling involving a geographical stratification according to the regions, and subsequently, a selection of municipalities within provinces, households within municipalities, and a maximum of four respondents within households was applied. Data were collected through face-to-face interview at the participant's home covering demographics, specific diseases and conditions, and nutritional status, and a self-administered questionnaire covering more sensitive topics, such as health behaviours and lifestyle. Survey weights were designed and applied to ensure the representativeness of the sample in terms of age, sex and province. Further details on the BHIS are described elsewhere.[24-26] The BHIS was authorised by an independent administrative authority protecting privacy and personal data, and was approved by the ethical committee of Ghent University Hospital. The pseudonymised data from Sciensano was shared with the Institute of Tropical Medicine (ITM) Antwerp through a secure data transfer platform applying data encryption. Ethical clearance for the present analyses was obtained from the Institutional Review Board of ITM after revision of the research protocol num. 1366/20, 23/03/2020.

The present analyses included adults aged between 25 and 84 years. Participants younger than 25 years were excluded from the analysis since a large proportion achieved their highest educational level by the age of 25, and aged 85 years and older since a large proportion of them are institutionalised

and the surveys did not include these people. The final sample included 7,256 adults in the year 1997, 8,665 in 2001, 9,054 in 2004, 7,343 in 2008, 7,704 in 2013 and 8,358 in 2018.

Standardised Procedures for Mortality Analysis (SPMA)

SPMA, operational since the early 1990s, was developed by Sciensano with the aim to facilitate the use of vital statistics data for public health policy and scientific research.[27] From 1998 up to 2017, cause-specific mortality data were coded by the ICD-10 using the initial cause of death only, and grouped by age, sex, region of residence and nationality. Data from 1998 was used as a proxy for the year 1997 so that cause-specific mortality could be coded using ICD-10 for all years included in the analyses, and similarly, data from 2017 as a proxy for the year 2018.

Patient and Public involvement

As a secondary data analysis of the BHIS, this study did not involve patients/participants or the public in the design, conduct or dissemination plans.

Health outcomes measures

Lifestyle risks

Data on dietary habits, smoking status, alcohol consumption, and physical activity were self-reported in the BHIS. Consumption of fruits (excluding juice) and vegetables (including salad, and excluding potatoes or juice) was assessed based on questions related to their daily intake. A non-daily consumer was defined as a participant reporting, at the time of the interview, a frequency of 4-6 times a week or less. Similarly, daily consumption of sweet or salty snacks and sugar-sweetened beverages (SSBs) was assessed based on a consumption frequency of one serving or more a day. Current smoking was defined as smoking at least 100 cigarettes in lifetime and currently a daily smoker. Alcohol consumption was assessed based on questions related to consumption frequency and the average number of drinks across weekdays and during weekends, and excess was defined as drinking more than 15 and 22 servings per week for women and men, respectively, following WHO indicators. For physical inactivity, a dichotomous categorical variable was created to differentiate between having sufficient physical activity and being at risk of physical inactivity during leisure time based on a description of the leisure time activities: hard training and competitive sports more than once week,

jogging and other recreational sports or gardening at least four hours a week; jogging and other recreational sports or gardening at most four hours a week; walking, bicycling or other light activities at least four hours a week; walking, bicycling or other light activities at most four hours a week; or reading, watching TV or other sedentary activities, following WHO indicators.

Clustering of the lifestyle risks was summarised as a composite index (Supplementary Table 1). Each lifestyle risk factor was scored from 1 to 5, with higher points indicating the highest risk, as follows: Dietary risks (non-daily fruit , non-daily vegetables, daily snacks and daily SSBs, four present = 5, three = 4, two = 3, one = 2, none = 1); Smoking (current heavy smoker = 5, current non-heavy/occasional smoker = 4, former smoker quitting < 10 years ago = 3, former smoker quitting ≥ 10 years ago = 2, never smoked = 1); Alcohol consumption (≥ 22 servings a week = 5, 15-21 = 4, 8-14 = 3, 1-7 = 2, occasional drinkers/abstainers = 1); Physical inactivity (sedentary activities = 5, leisure time sport < 4 hour a week or light activities = 3, intensive training or leisure time sport ≥ 4 hours a week = 1). The index ranged from 4 to 20, and was for the analyses further categorised into high engagement (12-20) versus low (4-7). Lifestyle risk index was calculated for the years 2013 and 2018, as dietary data were not available for previous years.

Metabolic risks

BMI was calculated as self-reported body weight divided by self-reported body height squared, using BMI ≥ 25 kg/m^2 for overweight and ≥ 30 kg/m^2 for obesity. Information on prevalent high blood pressure (systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg) and high cholesterol levels (total cholesterol ≥ 190 mg/dl) was self-reported by providing participants with a list of clinical conditions for which they had to specify whether they had each clinical condition in the past 12 months.

Prevalence of NCDs

Similarly, data on the prevalence of NCDs were self-reported collected using a list of chronic diseases for which participants had to specify whether they had each chronic disease in the past 12 months. This study reported on the prevalence of T2DM (ICD-10: E11), myocardial infarction (MI) (ICD-10: I21-I22), coronary artery disease (ICD-10: I20), cerebrovascular disease (ICD-10: I60-I69), other serious heart diseases (ICD-10: I30-I52), cancer (ICD-10: C00-D49), asthma (ICD-10: J45-J46) and chronic bronchitis/chronic obstructive pulmonary disease (COPD) or emphysema (ICD-10: J40-44, J47).

NCDs-specific mortality

Using the pre-defined procedures accessible from SPMA, age-standardised mortality rates per 100,000 were retrieved using ICD-10 codes for T2DM (E10-E14), coronary artery disease (I20-I25), cerebrovascular disease (I60-I69), cancer (C00-D48), asthma (J45-J46) and chronic lower respiratory diseases (J40-J44, J47) were obtained with comparisons made by sex, region and nationality.

Population stratification

To describe potential health disparities across the Belgian population, the following socio-demographic determinants of health were selected: 10-year age group, sex, region of residence, nationality, education and income. Educational level was based on the highest level of education attained in the household and was recoded into three categories: low (primary education or less), intermediate (lower and higher secondary education), and high (higher education). Income level was based on the household's total available income and recoded into five quintiles. Additionally, the population was further stratified by lifestyle risk index: high versus low engagement in lifestyle risks, as an additional layer of potential health disparities.

Data analyses

Annual descriptive statistics were represented as weighted proportions of the characteristics of the survey participants as a whole per survey year. Age-standardised prevalence rates were computed by levels of the population stratification variables using direct standardisation with the Belgian population of 2018 used as reference. Health disparities were calculated by direct comparison between population strata: age (oldest, *i.e.* aged 75-84 years, vs youngest, *i.e.* aged 25-34 years, group), sex (women vs men), region (Walloon vs Flanders, Brussels vs Flanders), nationality (non-Belgian Europeans vs Belgians, non-Europeans vs Belgians), educational level (low vs high), income (low vs high), and engagement in lifestyle risks (high vs low). The disparities by age for metabolic risk and NCD prevalence were mainly included to assess their time-trends, *i.e.* narrowing disparities over time would suggest their onset occurred at a sooner age than before.

Health disparities were reported as prevalence ratios (PR),widely known as relative risks (RR), between the age-standardised prevalence between two levels of the population stratification variables;

with the estimated PRs and their uncertainty (95% confidence intervals (CI)) calculated using a survey-weighted Cox regression model with time equals one, and adjusting for age. The 20-year trend was tested by including an interaction term between time and the population stratification variable in the models, and *p*-values for this interaction term were reported. We only analysed outcomes for which at least 20 survey participants in any specific strata reported having the outcome of interest. Additionally, we measured health disparities by socio-demographic factors in absolute terms, using prevalence differences, commonly known as risk differences (RD), between two levels of the population stratification variables, calculated from a survey-weighted logistic regression and using the STATA postestimation command adjrr.[28] To explore the role of individual lifestyle risks, independently of others, relative health disparities were estimated for having that lifestyle risk versus not (reference).

Clustering of lifestyle risks was described using Spearman's rank correlation coefficients (P) with *p*-values adjusted for multiple testing according to Sidak. Such clustering was quantified using prevalence odds ratios, as estimated from a survey-weighted generalised ordered logistic regression model using the gologit2 command in STATA with the autofit function that identifies the partial proportional odds model that appropriately fits the data[29], with separate models for each lifestyle risk related to the other risks. To enhance interpretation of results, we only presented prevalence odds ratios and their 95% CI for the extremes, *i.e.* estimates belonging to the comparisons between a score of 5 (high engagement in a lifestyle risk) versus 1 (low; reference), for having a higher score than 1 on the lifestyle risk of interest.

All analyses were conducted using STATA/SE 16, and a *p*-value of 0.05 was considered as statistically significant with no adjustment for multiple comparisons for quantification of health disparities.

RESULTS

An overview of the general characteristics of the study population across the six available surveys is presented in TABLE 1, including prevalence estimates for the lifestyle and metabolic risks, chronic diseases and NCD-specific mortality.

Relative health disparities by socio-demographic population strata

For all population strata, the relative health disparities were generally more pronounced for lifestyle risks and NCDs (FIGURE 1; and Supplementary Tables 2).

Exposure to lifestyle risks was observed to be generally higher in young adults and among men (except for daily snacking and leisure-time physical inactivity), residents of Wallonia compared to those of Flanders (except for daily snacking), Belgian nationals (except for non-daily vegetables and leisure-time physical inactivity), the lower education and the lower income group (except for daily snacking and excessive alcohol use). Relative disparities in lifestyle risks were the largest for daily smoking by age (PR: 0.22, 95%CI: 0.14, 0.37), educational level (PR: 2.21, 95%CI: 1.79, 2.72) and income level (PR: 2.78, 95%CI: 1.77, 2.37) as well as for non-daily vegetables by educational level (PR: 2.05, 95%CI: 1.77, 2.37) and income level (PR: 2.72, 95%CI: 2.20, 3.35). Over time, the health disadvantages in lifestyle risks were decreasing for Brussels, as significantly seen for daily smoking and leisure-time physical inactivity, while increasing for the lower education and lower income groups for daily smoking (Figure 2A).

Moreover, the prevalence of overweight and obesity was observed to be significantly higher with advanced age groups, among men (only overweight), among residents of Wallonia, non-European residents, and the lower education and lower income groups, with significantly increasing disparities for the non-Europeans reaching a prevalence ratio of 1.20 (95%CI: 1.05, 1.36) for overweight in 2018 (Figure 2B). Disparities were the largest for obesity by educational level (PR: 1.80, 95%CI: 1.52, 2.13), followed by income level (PR: 1.64, 95%CI: 1.26, 2.12) and age (PR: 1.61, 95%CI: 1.17, 2.21) as well as nationality (PR for non-Europeans: 1.36, 95%CI: 1.03, 1.80). A significantly higher prevalence of the metabolic risks of high blood pressure and high cholesterol levels was observed for advanced age, men (only cholesterol levels), and the lower education and lower income groups, presenting for the low income groups an increase in the relative disparities up to a prevalence ratio of 1.48 (95%CI: 1.19, 1.85) in 2018 (Figure 2B).

The NCD prevalence was significantly higher with advanced age, among men (except for asthma), among residents of Wallonia and Brussels (except for cerebrovascular disease), among the low educated (except for CVD and cancer), and the lower income groups (except for CVD), with over 20 years' time reducing disparities in age for asthma and in Brussels for cancer, but worsening disparities by income levels for chronic bronchitis, COPD or emphysema (Figure 2C). Relative disparities in NCD prevalence were the largest for T2DM by nationality (PR for non-Europeans: 2.34, 95%CI: 1.53, 3.56) and by income (PR: 2.13, 95%CI: 1.36, 3.32) as well as for chronic bronchitis, COPD and emphysema.

The NCD-specific mortality rates were significantly higher among men (except for asthma), residents of Wallonia and Brussels as compared to those of Flanders (except for cerebrovascular disease), and among the native Belgians (except for T2DM and asthma).

Absolute health disparities by socio-demographic population strata

Measuring this on an absolute scale did not alter conclusions (Supplementary Tables 3). Similarly, when using absolute differences, health disparities were the most pronounced for age, education and income strata, with the highest disparities seen for lifestyle and metabolic risks, but not for prevalent NCDs related to their low prevalence in the general population. In particular, absolute disparities in lifestyle risks were the largest for dietary risks by age (RD non-daily fruit: -25%, 95%CI: -31, -19; RD daily SSBs: -20%, 95%CI: -25, 16), by income (RD non-daily vegetables: 24%, 95%CI: 19, 29) as well as for leisure-time physical inactivity by age (RD: 22%, 95%CI: 15, 28), by education (22%, 95%CI: 17, 26) and income (22%, 95%CI: 16, 28) and for daily smoking by income (RD: 21%, 95%CI: 16, 28). Moreover, large absolute disparities for overweight were observed for age (RD: 21%, 95%CI: 15, 27), sex (RD: -14%, 95%CI: -17, -11), nationality (RD for non-Europeans: 9.2%, 95%CI: 3, 16), educational level (RD: 17%, 95%CI: 13, 21), and income level (RD: 11%, 95%CI: 6, 17), while lower than 5% for other metabolic risks and NCD prevalence, except for income groups (RD high blood pressure 8.1%, 95%CI: 3.4, 13; RD high cholesterol: 7.0, 95%CI: 2.3, 12; chronic bronchitis, COPD or emphysema: 9.1%, 95%CI: 6.2, 12) and for non-European and diabetes (RD: 7.5%, 95%CI: 2.5, 13).

Clustering of lifestyle risks

One-fifth was engaged in multiple lifestyle risks of poor diet, smoking, excessive alcohol use and physical inactivity, while one-fourth reported an overall healthy lifestyle (Supplementary Table 4). High engagement in multiple lifestyle risks was most frequent among men (65%), residents of Wallonia (37%), the lower education (62%) and the lower income strata (17%) with their multiple risks mainly characterised by non-daily intakes of fruit (76%), daily snacking (43%), current smoking (69%) and physical inactivity (61%), but no distinct pattern of alcohol consumption.

Belgian residents with at least one dietary risk were slightly more likely to be physically inactive, heavy smokers, and heavy drinkers, with former or current smokers also more likely to be heavy drinkers and physically inactive, but heavy drinkers less likely to be physically inactive (Supplementary Table 5).

The odds of having at least one dietary risk was higher for heavy smokers (OR 3.17; 95%CI 2.54, 3.95; TABLE 2), and for the physically inactive (OR 1.45; 95%CI: 1.24, 1.69). Similarly, the odds of being a former or current smoker was higher when having four dietary risks (OR 2.84; 95%CI: 1.87, 4.25), for heavy drinkers (OR 4.75; 95%CI: 3.61, 6.25), and for the physically inactive (OR 1.39; 95%CI: 1.18, 1.64). The odds of being a frequent (at least weekly) drinker was only higher for heavy smokers (OR 2.45, 95%CI: 1.95, 3.08). Lastly, the odds of being at most light physically active was higher for heavy smokers (OR 2.17; 95%CI: 1.73, 2.72), but lower for heavy drinkers (OR 0.60; 95%CI 0.46, 0.78).

The prevalence of metabolic risks and NCDs were higher among individuals with high engagement in multiple lifestyle risks (TABLE 3). In 2018, relative disparities were significantly varying between 1.13 (95%CI: 1.02, 1.25) and 1.57 (95%CI: 1.30, 1.90) for metabolic risks, and between 1.75 (95%CI: 1.12, 2.72) and 3.73 (95%CI: 2.19, 6.35) for CVD, asthma and COPD, with only high cholesterol levels significantly higher in 2018 than in 2013. Focussing on individual lifestyle risks, the prevalence of high BMI, T2DM, and CVD was more frequently reported for abstainers/occasional drinkers and the non-physically active, independently of age, sex and other lifestyle risks, with the prevalence of T2DM also more frequently reported when having none dietary risks, and of CVD and COPD more frequently for former and current smokers (Supplementary Table 6).

DISCUSSION

Using nationally representative data of Belgium, we identified the population strata where health disparities are present, and we traced the evolution of these disparities over 20 years. Older age, lower education, and lower income strata were the most affected by unfavourable health. For the latter two strata, we also observed a greater prevalence of engagement in multiple lifestyle risks, with their disparities worsening over time. Multiple lifestyle risks were also more prevalent in men, and the region of Wallonia. Still, NCD-specific mortality rates were significantly higher among men (except for asthma), residents of Wallonia, and Brussels (except for cerebrovascular disease), and among native Belgians (except for T2DM and asthma).

The socio-economic distribution of health as reported in this study corroborates earlier surveillance findings from western countries, including Belgium,[14,15] as operationalised by highest educational attainment. The inverse education-health gradients are a long-lasting universal phenomenon in Europe with widening disparities for common chronic diseases,[30] self-assessed

health,[31] and mortality[32]. Following earlier observations,[33] results of the present study also confirmed that at present engagement in lifestyle risks remained more frequent for the low educated, and because of the mediating role of health illiteracy, *i.e.* insufficient knowledge, motivation and competence to make appropriate health decisions, likely to persist.[34,35] Using education as a single indicator of socio-economic position at the individual level, however, captures only the knowledge-related assets of the socio-economic stratification, disregarding the full understanding of the existing health disparities by ranks in a society.[36] In our study, health disparities by education resemble well those by income, though slightly more pronounced for income. This suggests that both the social and financial resources provided by education and income, respectively, play a key role in a healthy lifestyle, and thereby delaying the onset of metabolic conditions and NCDs.

We used the most simple absolute and relative measures of disparities in health to illustrate the existing disparities in Belgium, and in this way avoid the value-laden of an arbitrary choice. Our findings might be limited by participants' self-reporting. Reporting risks and diseases is subjected to not only the actual presence of it, but also participant-related characteristics like health knowledge, ability to recall, willingness to report, and in case of health problem, frequency of contact with physician and disadvantages experienced in everyday life. This shortcoming of self-reports has been acknowledged by the first Belgian Health Examination Survey (BELHES), conducted for the first time by Sciensano in 2018.[37] Early findings of the BELHES showed that one-third of the population suffers from high blood pressure, half from high cholesterol levels and one-tenth from T2DM, while according to the self-reports only 15%, 20% and 6%, respectively.[38] This potential bias might differentially affect our population strata, with a misclassification likely to occur to a larger extent in the most disadvantaged group, leading to an underestimation of the true disparity. Besides, our findings provide a general profile of the high-risk groups, and therefore cannot be directly extrapolated to all individuals belonging to certain strata, for example within the low educated prevalence of risks and outcomes might differ not only by age group and sex[30], but also by background psychosocial factors, such as marital status, household composition, social support and job strain, that may operate in the pathway between socio-demographic factors and NCD outcomes.[39] Furthermore, the present study could not address the differential mortality by SES indicators because of the impossibility of individual linkage of census data with the most recent BHIS, as previously done.[40]

In cross-sectional studies, there is a potential bias for reverse causality bias, potentially explaining our contra-intuitive finding of a higher reported T2DM prevalence when having none dietary risks and being abstainers/occasional drinker, since among those with T2DM around 60% of them followed a diet for this condition, as also inquired by the BHIS. While excessive alcohol use (*i.e.* drinking very high amounts of alcohol weekly) is a well-recognised risk factor for NCDs, the light-to-moderate levels of alcohol consumption remain controversial.[41] In fact, zero consumption is nowadays ever more regarded as the consumption amount fitting a healthy lifestyle, since estimated protective effects for some health conditions at low levels are outweighed by increased risks of other health-related harms, including cancer.[42]

Our study implies that over a wide range of risk and health indicators important population strata to target are the elderly, the low educated, the low income strata, and the immigrants, of which only the former is an unfortunately unavoidable disparity difficult to argue to be unjust.[43] Narrowing the disparities by socio-economic position and nationality should be the focus of health policy programmes, likely with interventions based on the principles of proportionate universalism,[44] *i.e.* a universal action with a targeted intervention component tailored to tackle the driving root causes either simultaneously or sequentially, with due consideration to the upstream determinants of health that may lie outside the health sector (e.g. illiteracy, unemployment, the barrier to healthcare consumption).[45]

CONCLUSION

In conclusion, health status is not only a product of individual choice but also related to the population strata where a person belongs to, with this defined particularly by the socio-demographic factors influencing lifestyle. In addition, the tendency of lifestyle risks to cluster strengthens the need for health promotion programmes that tailor multiple targets and aim at reaching the socio-economic disadvantaged for narrowing health disparities.

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TABLES & FIGURES

TABLE 1 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to survey year.

	Year of the survey						
	1997	**2001**	**2004**	**2008**	**2013**	**2018**	*p*-trend[a]
Number of individuals	7,256	8,665	9,054	7,343	7,704	8,358	
	(%)	(%)	(%)	(%)	(%)	(%)	
Socio-demographic factors							
Age groups							<0.001
25-34 years	26.1	20.6	19.8	18.8	18.5	19.1	
35-44 years	21.0	19.5	19.1	18.3	17.1	15.7	
45-54 years	20.1	19.4	19.6	20.2	20.4	19.2	
55-64 years	15.7	16.9	17.5	19.0	20.1	21.4	
65-74 years	12.1	14.8	15.9	13.8	14.1	15.4	
75-84 years	4.9	8.8	8.9	9.9	9.9	9.2	
Sex, men	49.7	48.4	48.3	48.2	48.8	48.6	0.236
Region of residence							0.650
Flanders	57.8	58.4	58.3	58.8	57.6	56.7	
Brussels	10.7	9.9	10.0	10.3	10.7	10.1	
Wallonia	31.6	31.7	31.7	30.9	31.7	33.2	
Nationality							<0.001
Belgians	90.8	93.2	92.0	91.4	89.4	88.6	
Non-Belgian Europeans	5.6	4.6	5.0	5.9	6.4	6.6	
Non-Europeans	3.5	2.2	2.9	2.7	4.2	4.8	
Educational level							<0.001
Low	33.7	37.2	33.5	28.8	24.1	29.1	
Intermediate	32.5	30.2	30.8	32.7	33.5	32.0	
High	33.8	32.5	35.7	38.5	42.4	48.4	
Income level							<0.001
Quintile 1	20.4	20.2	19.4	17.9	16.6	11.8	
Quintile 2	19.7	19.0	18.9	17.8	17.0	15.1	
Quintile 3	22.2	19.6	20.0	21.3	21.0	19.9	
Quintile 4	19.6	20.8	19.9	16.8	21.0	25.9	
Quintile 5	18.1	20.4	21.8	26.2	24.2	27.3	
Lifestyle risks [b]							
Dietary risks							
No daily fruits					43.9	44.1	0.810
No daily vegetables					20.4	23.2	0.004
Daily snacking					37.0	34.5	0.027
Daily SSBs					22.6	19.8	0.008
Daily smoking	25.1	23.5	23.4	20.5	19.2	16.1	<0.001
Excessive alcohol use	7.1	9.7	9.0	8.2	6.8	6.2	<0.001
Leisure time physical inactivity	35.1	36.8	28.1	29.4	28.2	29.0	<0.001
Metabolic risks [b]							
Overweight, BMI ≥ 25kg/m²	45.4	48.8	48.1	50.9	51.7	52.7	<0.001
Obesity, BMI ≥ 30kg/m²	12.1	13.6	14.2	15.1	15.2	17.4	<0.001
High blood pressure	12.9	16.7	17.8	18.6	19.2	20.5	<0.001
High cholesterol					19.1	20.2	0.334
NCD prevalence [b]							
Type 2 diabetes mellitus	3.3	4.0	5.0	4.9	6.4	6.9	<0.001

Cardiovascular diseases					4.6	5.3	0.203
Myocardial infarction				0.8	1.1	0.8	0.845
Coronary heart disease				2.4	1.5	1.3	<0.001
Heart disease					2.3	3.5	0.002
Cerebrovascular disease	0.9	0.7	0.8	1.2	1.0	0.9	0.766
Cancer	1.5	1.9	1.4	2.5	2.3	2.8	0.001
Asthma		4.8	4.4	4.3	4.5	5.7	0.071
chronic bronchitis/COPD or emphysema		6.5	6.3	4.3	4.3	4.4	<0.001
NCD-related mortality rates (per 100,000) attributed to							
Diabetes	19.3	16.7	17.1	16.4	12.8	10.6	0.024
Coronary artery disease	159.5	137.4	124.2	92.9	67.5	55.9	0.009
Cerebrovascular disease	90.0	79.2	73.4	60.5	48.1	42.8	0.009
Cancer	378	351	330	324	303	274	0.060
Asthma	4.63	3.96	2.33	1.34	1.25	0.87	0.009
Chronic bronchitis/COPD or emphysema	64.5	54.7	50.2	46.9	43.1	38.0	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease.
[a] *p*-trend calculated using the p-value of corrected weighted Pearson chi square statistic for socio-demographic factors, the p-value of the time term in a survey-weighted logistic regression for lifestyle and metabolic risks and NCD prevalence, and the p-value of Mann-Kendall trend test for NCD-related mortality rates. [b] Self-reported prevalence of lifestyle and metabolic risks and NCDs.
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TABLE 2 Clustering of lifestyle risks in the Belgian population, aged 25-84 years, in 2013 and 2018 [a].

Clustered with		Dietary risks At least one dietary risk	Smoking Former or current smoking	Excessive alcohol use At least weekly drinking	Physical inactivity At most lightly active
Diet	ρ (*p*-value)				
	No dietary risks		Reference	Reference	Reference
	Four dietary risks		2.82 (1.87; 4.25)	0.94 (0.61; 1.45)	1.08 (0.58; 2.00)
Smoking	ρ (*p*-value)	0.160 (<0.001)			
	Never smoked	Reference		Reference	Reference
	Heavy smokers	3.17 (2.54; 3.95)		2.45 (1.95; 3.08)	2.17 (1.73; 2.73)
Alcohol	ρ (*p*-value)	0.003 (0.9980)	0.189 (<0.001)		
	Abstainers/occasional	Reference	Reference		Reference
	Heavy drinkers	1.03 (0.83; 1.28)	4.75 (3.61; 6.25)		0.60 (0.46; 0.78)
Physical inactivity	ρ (*p*-value)	0.122 (<0.001)	0.071 (<0.001)	-0.128 (<0.001)	
	Very active	Reference	Reference	Reference	
	Sedentary	1.45 (1.24; 1.69)	1.39 (1.18; 1.64)	0.36 (0.30; 0.43)	

[a] Clustering described using ρ, Spearman rank correlation coefficient with *p*-value adjusted for multiple testing according to Sidak, and quantified using prevalence odds ratios with 95% confidence intervals for the extremes, *i.e.* estimates belonging to the comparisons between high engagement in a lifestyle risk versus low engagement (reference), for having a higher score than 1 on the lifestyle risk of interest.

TABLE 3 Prevalence (weighted %) of and relative disparities (age-standardised prevalence ratios) in health from metabolic risks to NCDs according to the level of engagement in multiple lifestyle risks for the Belgian population, aged 25-84 years. [a,b]

	2013		2018		Relative difference		
	High	Low	High	Low	2013	2018	*p*-change[c]
Metabolic risks							
Overweight, BMI ≥ 25	52.3	43.8	54.5	46.0	1.10 (0.97; 1.24)	1.13 (1.02; 1.25)	0.769
Obesity, BMI ≥ 30	14.4	10.6	20.2	13.2	1.36 (1.01; 1.83)	1.55 (1.21; 1.97)	0.396
High blood pressure	17.6	15.4	20.1	16.9	1.12 (0.87; 1.43)	1.30 (1.07; 1.59)	0.320
High cholesterol levels	19.3	16.7	23.8	16.3	1.11 (0.88; 1.40)	1.57 (1.30; 1.90)	0.024
NCDs							
T2DM	4.3	3.8	5.9	5.3	1.07 (0.65; 1.76)	1.22 (0.83; 1.80)	0.627
CVD	6.0	2.2	5.1	2.7	2.55 (1.39; 4.66)	1.95 (1.21; 3.14)	0.488
Cancer	1.6	1.5	2.8	1.9	1.31 (0.61; 2.80)	1.83 (0.89; 3.76)	0.472
Asthma	5.2	4.8	6.6	4.1	1.06 (0.59; 1.88)	1.75 (1.12; 2.72)	0.261
COPD	7.9	1.6	7.4	2.1	5.63 (3.07; 10.3)	3.73 (2.19; 6.35)	0.403

[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7). [b] Adjusted for age and sex. [c] The *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model.

LEGEND OF FIGURES

Figure 1 Heatmap of the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle and metabolic risks to non-communicable diseases according to socio-demographic strata in 2018 in Belgium.

Colours depicted the strength of the disparity with the more yellow representing a higher prevalence of poor health in the index group as compared to the reference group, and the more blue a higher prevalence of poor health in the reference group as compared to the index group. Empty boxes represents the non-significant estimates or the non-estimable estimates because too few cases.

Abbreviations: COPD, chronic obstructive pulmonary disease, also including chronic bronchitis, emphysema in the present analyses; CVD, cardiovascular disease; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus

Figure 2 Significant 20-year time trends in the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle risks to non-communicable diseases according to socio-demographic strata, from 1997 until 2018 in Belgium.

Legend: 75-84 vs 25-34 years; Women vs men; Wallonia vs Flanders; Brussels vs Flanders; Non-Belgian Europeans vs Belgians; Non-Europeans vs Belgians; Low vs high educated; Low vs high income. Grey horizontal gridline indicate the null-value, i.e. no disparity between index and reference group.

Note: Omitted from the graphs are the significant 5-year changes in relative health disparities for diet (i.e. a closing gap for 'non-daily vegetables' and 'daily snacking' between non-Europeans and Belgians, and a widening gap for 'non-daily vegetables' between the low and high income group), for high cholesterol levels and cardiovascular disease (i.e. both reversing relative disparities between Brussels and Flanders, with in 2018 higher prevalence in Flanders).

2A: Lifestyle risks
2B: Metabolic risks
2C: Non-communicable diseases

LEGEND OF SUPPLEMENTARY MATERIALS

Supplementary Table 1 Components and scoring of the lifestyle risk index [a,b].

Abbreviations: SSB, sugar-sweetened beverages

[a] Each lifestyle risk was scored from 1 to 5, with higher points indicating the highest risk. [b] The sum of the components scores resulted in lifestyle risk index range from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement).

Supplementary Tables 2 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised prevalence ratios between distal groups.

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year.

[a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2A. Age-related relative health disparities: adults aged 75-84 years versus 25-34 years (reference)
2B. Sex- related relative health disparities: women vs men (reference)
2C. Region of residence-related relative health disparities: Wallonia vs Flanders (reference)
2D. Region of residence-related relative health disparities: Brussels vs Flanders (reference)
2E. Nationality-related relative health disparities: non-Belgian Europeans vs Belgians (reference)
2F. Nationality-related relative health disparities: non-Europeans vs Belgians (reference)
2G. Education-related relative health disparities: low vs high (reference)
2H. Income-related relative health disparities: Quintile 1 vs Quintile 5 (reference)

Supplementary Tables 3 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised percentage point differences between distal groups.

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year.

[a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3A. Age-related absolute health disparities: adults aged 75-84 years versus 25-34 years (reference)

3B. Sex-related absolute health disparities: women vs men (reference)

3C. Region of residence-related absolute health disparities: Wallonia vs Flanders (reference)

3D. Region of residence-related absolute health disparities: Brussels vs Flanders (reference)

3E. Nationality-related absolute health disparities: non-Belgian Europeans vs Belgians (reference)

3F. Nationality-related absolute health disparities: non-Europeans vs Belgians (reference)

3G. Education-related absolute health disparities: low vs high (reference)

3H. Income-related absolute health disparities: Quintile 1 vs Quintile 5 (reference)

Supplementary Table 4 General characteristics and lifestyle risks (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus low)

Abbreviations: SSB, sugar-sweetened beverages .[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

Supplementary Table 5 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in the individual lifestyle risks of dietary risks, smoking, alcohol and physical inactivity, in 2018.[a]

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risks for smoking: being a current or former smoker; lifestyle risks for alcohol: being a frequent drinker (at least drinking alcohol weekly; and lifestyle risk for physical inactivity: being physically inactive or lightly active.

Supplementary Table 6 Relative health disparities by engagement in individiual lifestyle risks, independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios.[b]

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being physically inactive or lightly active. [b] Adjusted for age, sex and the other lifestyle risks.

Contributorship statement

JP and EM conceptualised and designed the study. JP and EM identified relevant data sources and retrieved data. EM performed the statistical analyses. EM, JP and DS wrote the manuscript, and all revised, read and approved the submitted version. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Competing interests declaration

Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethics approval

The consecutive Belgian Health Interview Surveys have been approved by the Privacy Commission and the Ethical Committee of Ghent University Hospital, which guarantees that the survey procedures are in line with the privacy legislation, and participants gave informed consent before taking part. The current study obtained ethics approval from the Institutional Review Board of the Institute of Tropical Medicine, Antwerp, Belgium (1366/20).

Transparency statement

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if any relevant, registered) have been explained.

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Dissemination declaration

Not applicable.

Patient and Public Involvement Statement

As a secondary data analysis of the BHIS, this study did not involve patients/participants or the public in the design, conduct or dissemination plans.

Data Sharing Statements

Data of the Health Interview Surveys, conducted by Sciensano, are not publicly available, but access to data is possible through request to the Privacy Commission. More information can be retrieved via https://his.wiv-isp.be/SitePages/Home.aspx. Also, publicly available datasets were utilized in this study: Standardised Procedures for Mortality Analysis – Belgium (SPMA), developed by Sciensano, accessible via https://spma.wiv-isp.be/SitePages/Home.aspx.

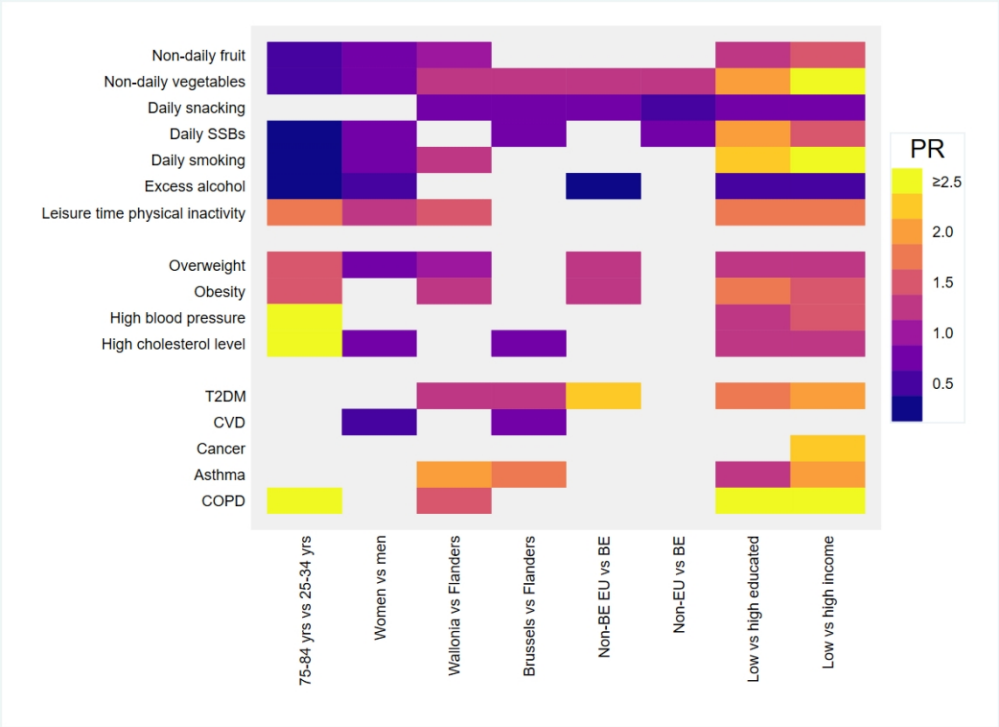

Figure 1 Heatmap of the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle and metabolic risks to non-communicable diseases according to socio-demographic strata in 2018 in Belgium.
Colours depicted the strength of the disparity with the more yellow representing a higher prevalence of poor health in the index group as compared to the reference group, and the more blue a higher prevalence of poor health in the reference group as compared to the index group. Empty boxes represents the non-significant estimates or the non-estimable estimates because too few cases.
Abbreviations: COPD, chronic obstructive pulmonary disease, also including chronic bronchitis, emphysema in the present analyses; CVD, cardiovascular disease; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus

419x304mm (72 x 72 DPI)

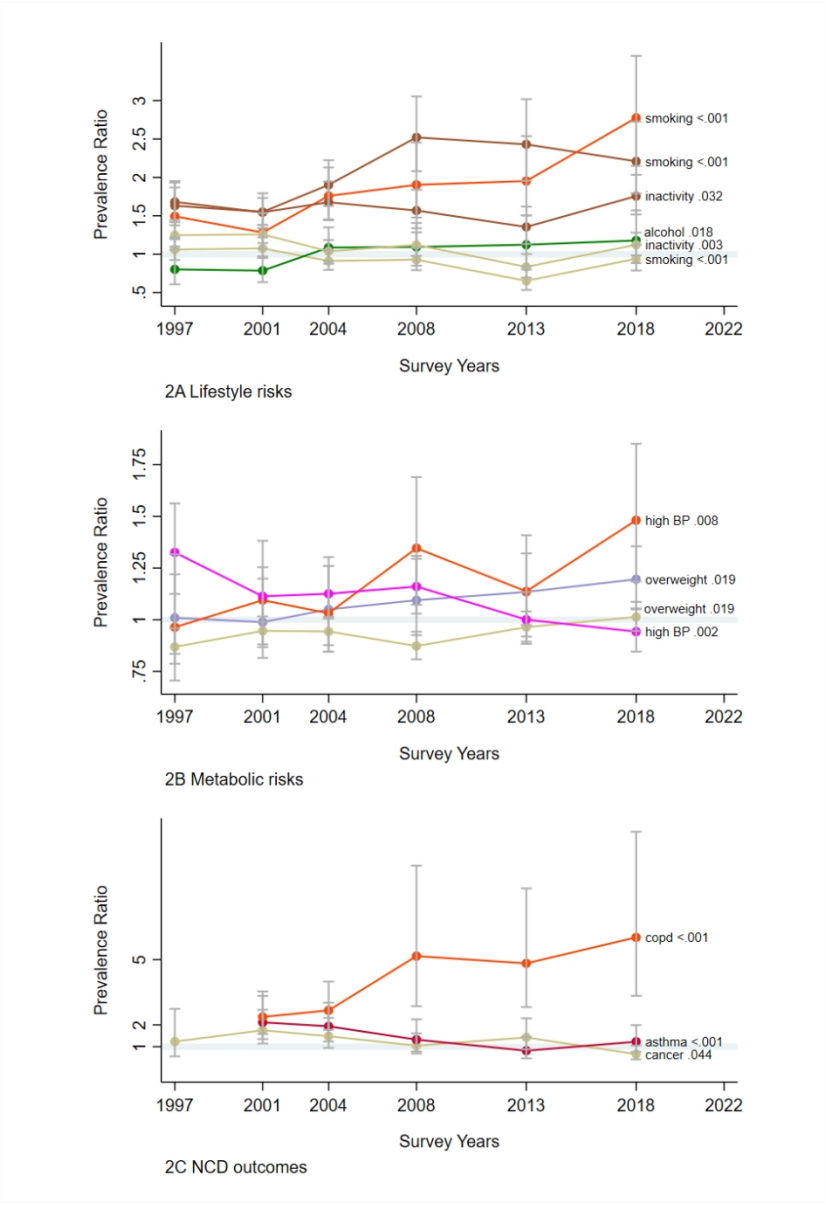

Figure 2 Significant 20-year time trends in the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle risks to non-communicable diseases according to socio-demographic strata, from 1997 until 2018 in Belgium.
Legend: 75-84 vs 25-34 years; Women vs men; Wallonia vs Flanders; Brussels vs Flanders; Non-Belgian Europeans vs Belgians; Non-Europeans vs Belgians; Low vs high educated; Low vs high income. Grey horizontal gridline indicate the null-value, i.e. no disparity between index and reference group.
Note: Omitted from the graphs are the significant 5-year changes in relative health disparities for diet (i.e. a closing gap for 'non-daily vegetables' and 'daily snacking' between non-Europeans and Belgians, and a widening gap for 'non-daily vegetables' between the low and high income group), for high cholesterol levels and cardiovascular disease (i.e. both reversing relative disparities between Brussels and Flanders, with in 2018 higher prevalence in Flanders).

340x494mm (72 x 72 DPI)

SUPPLEMENTARY TABLES

Supplementary Table 1 Components and scoring of the lifestyle risk index [a,b].

Lifestyle risks	Components' scoring	Points
Dietary risks	Four present	5 points
- Non-daily fruit	Three present	4 points
- Non-daily vegetables	Two present	3 points
- Daily SSBs	One present	2 points
- Daily snacking	No dietary risks	1 points
Smoking	Current heavy smoker	5 points
	Current non-heavy smoker or occasional smoker	4 points
	Former smoker quitting < 10 years ago	3 points
	Former smoker quitting ≥ 10 years ago	2 points
	Never smoked	1 points
Alcohol consumption	≥ 22 servings a week	5 points
	15-21 servings a week	4 points
	8-14 servings a week	3 points
	1-7 servings a week	2 points
	Occasional drinkers and abstainers	1 points
Physical inactivity	Sedentary activities	5 points
	Leisure time sport < 4 hours a week or light activities	3 points
	Intensive training or leisure time ≥ 4 hours a week	1 points

Abbreviations: SSB, sugar-sweetened beverages.
[a] Each lifestyle risk was scored from 1 to 5, with higher points indicating the highest risk. [b] The sum of the components scores resulted in lifestyle risk index range from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement).

Supplementary Table 2 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised prevalence ratios between distal groups

2.A Age-related relative health disparities: adults aged 75-84 years versus adults aged 25-34 years (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.64 (0.54; 0.76)	0.53 (0.45; 0.63)	0.142
Non-daily vegetables					0.69 (0.53; 0.90)	0.59 (0.46; 0.75)	0.375
Daily snacking					0.91 (0.78; 1.10)	1.11 (0.93; 1.31)	0.159
Daily SSBs					0.39 (0.29; 0.52)	0.29 (0.21; 0.40)	0.179
Daily smoking	0.24 (0.14; 0.39)	0.25 (0.18; 0.35)	0.25 (0.17; 0.36)	0.18 (0.12; 0.27)	0.36 (0.21; 0.52)	0.22 (0.14; 0.37)	0.875
Excess alcohol	0.84 (0.38; 1.84)	0.51 (0.30; 0.84)	0.61 (0.32; 1.17)	0.55 (0.32; 0.96)	0.90 (0.48; 1.68)	0.34 (0.18; 0.63)	0.148
Leisure time physical inactivity	2.06 (1.75; 2.43)	2.00 (1.76; 2.28)	2.06 (1.72; 2.48)	1.98 (1.64; 2.38)	1.83 (1.45; 2.32)	1.72 (1.41; 2.12)	0.108
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.58 (1.30; 1.91)	1.44 (1.25; 1.66)	1.71 (1.48; 1.97)	1.45 (1.26; 1.66)	1.53 (1.33; 1.75)	1.55 (1.35; 1.78)	0.991
Obesity, BMI ≥ 30 kg/m²	1.76 (1.05; 2.95)	2.53 (1.78; 3.61)	1.76 (1.24; 2.49)	1.81 (1.31; 2.49)	1.53 (1.10; 2.13)	1.61 (1.17; 2.21)	0.069
High blood pressure	9.84 (6.43; 15.06)	10.01 (7.14; 14.04)	10.79 (7.88; 14.77)	10.40 (7.47; 14.48)	17.2 (10.9; 27.2)	13.85 (8.81; 21.8)	0.111
High cholesterol levels					12.9 (8.28; 20.2)	9.16 (6.33; 13.3)	0.244
NCD prevalence							
Asthma		2.12 (1.35; 3.33)	1.94 (1.24; 3.02)	1.33 (0.78; 2.26)	0.8 (0.46; 1.45)	1.23 (0.76; 1.99)	<0.001
Chronic bronchitis, COPD, emphysema		4.21 (2.66; 6.66)	4.06 (2.79; 5.91)	6.09 (3.24; 11.5)		4.99 (2.63; 9.50)	0.428

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.B Sex-related relative health disparities: women versus men (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.78 (0.72; 0.82)	0.75 (0.71; 0.79)	0.531
Non-daily vegetables					0.70 (0.63; 0.78)	0.72 (0.66; 0.79)	0.763
Daily snacking					1.00 (0.93; 1.07)	1.04 (0.96; 1.12)	0.407
Daily SSBs					0.63 (0.57; 0.70)	0.65 (0.58; 0.73)	0.762
Daily smoking	0.60 (0.53; 0.68)	0.70 (0.64; 0.77)	0.73 (0.66; 0.81)	0.79 (0.70; 0.90)	0.75 (0.66; 0.85)	0.68 (0.59; 0.78)	0.110
Excess alcohol	0.44 (0.33; 0.58)	0.54 (0.45; 0.64)	0.46 (0.38; 0.56)	0.65 (0.52; 0.81)	0.57 (0.44; 0.74)	0.57 (0.45; 0.72)	0.054
Leisure time physical inactivity	1.25 (1.14; 1.38)	1.34 (1.25; 1.44)	1.42 (1.29; 1.58)	1.27 (1.14; 1.41)	1.28 (1.13; 1.45)	1.33 (1.20; 1.47)	0.836
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	0.71 (0.66; 0.76)	0.75 (0.71; 0.80)	0.72 (0.68; 0.76)	0.74 (0.70; 0.79)	0.75 (0.71; 0.80)	0.75 (0.71; 0.79)	0.095
Obesity, BMI ≥ 30 kg/m²	0.96 (0.80; 1.16)	1.05 (0.91; 1.20)	1.07 (0.94; 1.23)	1.07 (0.94; 1.23)	1.01 (0.87; 1.18)	0.89 (0.79; 1.01)	0.224
High blood pressure	1.33 (1.12; 1.56)	1.11 (0.99; 1.25)	1.13 (1.01; 1.26)	1.16 (1.03; 1.31)	1.00 (0.88; 1.13)	0.94 (0.85; 1.05)	0.002
High cholesterol levels					0.99 (0.88; 1.11)	0.85 (0.76; 0.95)	0.075
NCD prevalence							
T2DM	1.04 (0.71; 1.52)	0.89 (0.69; 1.14)	0.90 (0.72; 1.12)	0.92 (0.72; 1.18)	0.91 (0.72; 1.16)	0.89 (0.72; 1.09)	0.493
CVD					0.51 (0.39; 0.67)	0.61 (0.48; 0.78)	0.416
Myocardial infarction				0.46 (0.27; 0.78)	0.40 (0.19; 0.83)	0.48 (0.26; 0.90)	
Coronary artery disease				0.53 (0.35; 0.80)	0.48 (0.29; 0.78)	0.58 (0.33; 1.02)	
Other serious heart disease					0.45 (0.30; 0.68)	0.66 (0.49; 0.90)	
Cerebrovascular disease	1.46 (0.72; 2.96)	0.89 (0.48; 1.65)	0.98 (0.55; 1.74)	1.02 (0.59; 1.74)	0.73 (0.40; 1.31)	0.31 (0.16; 0.59)	
Cancer	1.87 (1.00; 3.47)	1.25 (0.86; 1.81)	1.96 (1.26; 3.06)	0.98 (0.64; 1.50)	1.59 (1.06; 2.41)	1.39 (0.95; 2.02)	0.517
Asthma		0.82 (0.63; 1.05)	1.18 (0.92; 1.52)	1.46 (1.09; 1.94)	1.00 (0.75; 1.32)	1.18 (0.92; 1.52)	0.296
Chronic bronchitis, COPD, emphysema		0.90 (0.74; 1.09)	0.92 (0.76; 1.12)	1.00 (0.77; 1.31)	1.15 (0.86; 1.53)	1.02 (0.78; 1.33)	0.328
NCD-specific mortality rate attributable to							
T2DM	0.96 (0.87; 1.07)	0.96 (0.86; 1.07)	1.07 (0.96; 1.19)	0.87 (0.79; 0.97)	0.79 (0.71; 0.88)	0.67 (0.60; 0.75)	0.085
Ischemic heart disease	0.51 (0.49; 0.53)	0.49 (0.47; 0.51)	0.49 (0.47; 0.52)	0.48 (0.46; 0.50)	0.45 (0.43; 0.47)	0.44 (0.42; 0.46)	0.013
Cerebrovascular disease	0.83 (0.79; 0.87)	0.84 (0.79; 0.90)	0.95 (0.89; 1.01)	0.87 (0.81; 0.93)	0.86 (0.81; 0.92)	0.90 (0.84; 0.96)	0.181
Cancer	0.51 (0.50; 0.53)	0.51 (0.50; 0.52)	0.53 (0.51; 0.54)	0.55 (0.54; 0.56)	0.58 (0.56; 0.59)	0.61 (0.59; 0.62)	0.013
Asthma	0.85 (0.67; 1.07)	1.05 (0.83; 1.34)	1.39 (1.04; 1.88)	1.47 (1.04; 2.10)	1.25 (0.89; 1.76)	1.62 (1.09; 2.39)	0.060
Chronic bronchitis, COPD, emphysema	0.27 (0.25; 0.29)	0.29 (0.27; 0.32)	0.31 (0.29; 0.34)	0.35 (0.32; 0.37)	0.43 (0.40; 0.45)	0.46 (0.43; 0.49)	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.C Region of residence-related relative health disparities: Wallonia versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.04 (0.96; 1.12)	1.14 (1.05; 1.23)	0.101
Non-daily vegetables					1.14 (1.01; 1.36)	1.29 (1.13; 1.48)	0.325
Daily snacking					1.08 (0.91; 1.10)	0.88 (0.79; 0.97)	0.050
Daily SSBs					1.14 (0.99; 1.27)	1.10 (0.95; 1.28)	0.909
Daily smoking	1.16 (1.01; 1.34)	1.13 (1.01; 1.27)	1.16 (1.03; 1.32)	1.18 (1.01; 1.37)	1.10 (0.93; 1.29)	1.25 (1.05; 1.48)	0.735
Excess alcohol	0.80 (0.61; 1.06)	0.79 (0.64; 0.97)	1.09 (0.88; 1.35)	1.09 (0.85; 1.41)	1.11 (0.84; 1.51)	1.18 (0.89; 1.57)	0.018
Leisure time physical inactivity	1.40 (1.26; 1.57)	1.41 (1.30; 1.54)	1.46 (1.30; 1.64)	1.39 (1.23; 1.57)	1.16 (1.00; 1.33)	1.45 (1.29; 1.64)	0.741
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.10 (1.01; 1.19)	1.09 (1.03; 1.16)	1.12 (1.05; 1.19)	1.05 (0.98; 1.12)	1.07 (1.00; 1.14)	1.08 (1.01; 1.15)	0.338
Obesity, BMI ≥ 30 kg/m²	1.38 (1.12; 1.71)	1.28 (1.10; 1.50)	1.33 (1.14; 1.55)	1.07 (0.92; 1.25)	1.28 (1.09; 1.52)	1.22 (1.06; 1.42)	0.216
High blood pressure	1.29 (1.07; 1.57)	1.02 (0.89; 1.18)	1.08 (0.96; 1.22)	1.14 (1.00; 1.29)	0.91 (0.79; 1.03)	1.10 (0.97; 1.23)	0.209
High cholesterol levels					0.96 (0.84; 1.10)	1.01 (0.90; 1.14)	0.632
NCD prevalence							
T2DM	1.68 (1.14; 2.48)	1.76 (1.33; 2.32)	1.46 (1.10; 1.94)	1.24 (0.94; 1.63)	1.24 (0.96; 1.61)	1.37 (1.10; 1.71)	0.108
CVD					1.22 (0.92; 1.65)	1.06 (0.82; 1.36)	0.450
Myocardial infarction				1.57 (0.87; 2.83)		1.96 (1.01; 3.83)	
Coronary artery disease				1.30 (0.85; 1.98)	1.53 (0.87; 2.67)	1.28 (0.75; 2.20)	
Other serious heart disease					0.88 (0.57; 1.24)	0.93 (0.67; 1.30)	
Cerebrovascular disease			1.74 (0.95; 3.19)	2.03 (1.09; 3.77)		1.91 (0.97; 3.75)	
Cancer	0.93 (0.47; 1.83)	1.52 (0.99; 2.35)	0.83 (0.53; 1.32)	0.98 (0.63; 1.50)	0.88 (0.57; 1.38)	0.96 (0.66; 1.39)	0.391
Asthma		1.79 (1.35; 2.38)	1.92 (1.44; 2.55)	2.01 (1.45; 2.78)	1.76 (1.29; 2.41)	1.98 (1.52; 2.57)	0.744
Chronic bronchitis, COPD, emphysema		1.62 (1.29; 2.03)	1.67 (1.34; 2.08)	1.57 (1.18; 2.08)	1.67 (1.24; 2.26)	1.63 (1.22; 2.19)	0.892
NCD-specific mortality rate attributable to							
T2DM	1.05 (0.94; 1.17)	1.44 (1.29; 1.62)	1.66 (1.48; 1.85)	1.30 (1.17; 1.45)	1.12 (1.00; 1.24)	1.37 (1.22; 1.53)	1.000
Ischemic heart disease	0.87 (0.84; 0.91)	0.97 (0.93; 1.00)	1.00 (0.96; 1.04)	1.12 (1.07; 1.17)	1.29 (1.23; 1.35)	1.29 (1.23; 1.36)	0.013
Cerebrovascular disease	0.89 (0.85; 0.93)	0.94 (0.90; 0.99)	0.89 (0.84; 0.93)	0.97 (0.92; 1.02)	0.96 (0.91; 1.01)	1.04 (0.98; 1.09)	0.085
Cancer	1.06 (1.03; 1.09)	1.06 (1.04; 1.09)	1.06 (1.04; 1.09)	1.08 (1.05; 1.11)	1.10 (1.07; 1.13)	1.11 (1.08; 1.14)	0.029
Asthma	1.30 (1.01; 1.67)	1.32 (1.02; 1.72)	2.08 (1.49; 2.91)	1.70 (1.17; 2.49)	2.18 (1.47; 3.23)	2.60 (1.66; 4.05)	0.024
Chronic bronchitis, COPD, emphysema	1.08 (1.02; 1.15)	1.14 (1.07; 1.21)	1.18 (1.10; 1.26)	1.32 (1.24; 1.41)	1.30 (1.24; 1.41)	1.23 (1.16; 1.32)	0.085

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.D Region of residence-related relative health disparities: Brussels versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.84 (0.76; 0.92)	0.93 (0.86; 1.01)	0.059
Non-daily vegetables					1.18 (1.01; 1.38)	1.34 (1.18; 1.53)	0.264
Daily snacking					0.74 (0.67; 0.83)	0.72 (0.65; 0.80)	0.603
Daily SSBs					0.80 (0.69; 0.92)	0.77 (0.66; 0.90)	0.697
Daily smoking	1.06 (0.92; 1.22)	1.08 (0.95; 1.22)	0.91 (0.80; 1.05)	0.93 (0.79; 1.09)	0.65 (0.53; 0.80)	0.94 (0.79; 1.12)	<0.001
Excess alcohol	1.01 (0.78; 1.31)	1.06 (0.86; 1.30)	0.88 (0.70; 1.11)	0.77 (0.60; 1.01)	0.98 (0.71; 1.35)	1.31 (0.99; 1.72)	0.634
Leisure time physical inactivity	1.25 (1.10; 1.42)	1.26 (1.15; 1.38)	1.04 (0.91; 1.18)	1.12 (0.98; 1.28)	0.84 (0.70; 1.00)	1.12 (0.98; 1.28)	0.003
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	0.87 (0.79; 0.96)	0.95 (0.88; 1.02)	0.94 (0.88; 1.01)	0.87 (0.81; 0.94)	0.96 (0.89; 1.04)	1.01 (0.95; 1.09)	0.019
Obesity, BMI ≥ 30 kg/m²	0.94 (0.72; 1.23)	1.08 (0.91; 1.29)	1.05 (0.89; 1.24)	0.92 (0.77; 1.09)	1.07 (0.89; 1.29)	1.02 (0.87; 1.18)	0.812
High blood pressure	1.11 (0.91; 1.36)	0.97 (0.83; 1.12)	0.95 (0.84; 1.08)	1.00 (0.87; 1.15)	1.16 (1.00; 1.34)	0.92 (0.81; 1.04)	0.652
High cholesterol levels					1.20 (1.04; 1.39)	0.87 (0.77; 0.99)	0.003
NCD prevalence							
T2DM	1.36 (0.91; 2.05)	1.31 (0.97; 1.78)	1.33 (0.98; 1.80)	1.77 (1.34; 2.33)	1.60 (1.24; 2.08)	1.40 (1.13; 1.75)	0.495
CVD					1.14 (0.81; 1.60)	0.71 (0.53; 0.95)	0.031
Myocardial infarction				2.97 (1.66; 5.34)			
Coronary artery disease				1.57 (1.02; 2.42)	1.15 (0.61; 2.19)	1.42 (0.81; 2.50)	
Other serious heart disease					1.08 (0.68; 1.71)	0.53 (0.36; 0.79)	
Cerebrovascular disease			1.55 (0.84; 2.88)	3.25 (1.77; 6.00)			
Cancer	1.23 (0.56; 2.74)	1.76 (1.14; 2.69)	1.48 (0.95; 2.32)	1.05 (0.69; 1.61)	1.43 (0.88; 2.30)	0.66 (0.41; 1.05)	0.044
Asthma		1.79 (1.35; 2.37)	1.78 (1.31; 2.41)	2.04 (1.45; 2.88)	1.72 (1.18; 2.53)	1.67 (1.28; 2.17)	0.819
Chronic bronchitis, COPD, emphysema		1.55 (1.22; 1.98)	1.43 (1.12; 1.83)	1.57 (1.17; 2.11)	1.30 (0.90; 1.88)	1.26 (0.92; 1.73)	0.791
NCD-specific mortality rate attributable to							
T2DM	0.72 (0.61; 0.86)	0.85 (0.71; 1.02)	0.86 (0.71; 1.04)	1.14 (0.96; 1.36)	1.13 (0.94; 1.36)	1.13 (0.93; 1.38)	0.085
Ischemic heart disease	0.92 (0.87; 0.98)	0.94 (0.89; 1.00)	0.98 (0.92; 1.04)	1.11 (1.03; 1.19)	1.08 (0.99; 1.17)	1.12 (1.02; 1.23)	0.024
Cerebrovascular disease	0.83 (0.78; 0.89)	0.82 (0.76; 0.88)	0.93 (0.86; 1.00)	0.87 (0.80; 0.94)	0.86 (0.79; 0.93)	0.95 (0.86; 1.04)	0.260
Cancer	1.00 (0.96; 1.05)	1.03 (0.98; 1.07)	1.04 (0.99; 1.08)	1.01 (0.97; 1.05)	0.99 (0.95; 1.04)	1.05 (1.00; 1.10)	0.707
Asthma	2.62 (1.78; 3.88)	2.30 (1.52; 3.47)	1.85 (1.06; 3.23)	1.70 (0.92; 3.15)	2.74 (1.38; 5.43)	2.49 (1.09; 5.75)	1.000
Chronic bronchitis, COPD, emphysema	0.99 (0.90; 1.09)	1.08 (0.98; 1.20)	1.01 (0.91; 1.12)	1.07 (0.96; 1.19)	1.25 (1.12; 1.39)	1.18 (1.05; 1.33)	0.133

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.E Nationality-related relative health disparities: non-Belgian Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.94 (0.81; 1.08)	0.89 (0.78; 1.01)	0.704
Non-daily vegetables					1.35 (1.10; 1.67)	1.41 (1.20; 1.65)	0.790
Daily snacking					0.75 (0.60; 0.95)	0.50 (0.36; 0.69)	0.606
Daily SSBs					0.70 (0.56; 0.89)	0.69 (0.53; 0.89)	0.902
Daily smoking	1.01 (0.80; 1.27)	1.01 (0.82; 1.24)	1.00 (0.80; 1.25)	0.90 (0.68; 1.18)	0.99 (0.74; 1.33)	0.94 (0.73; 1.22)	0.580
Excess alcohol	1.64 (1.14; 2.37)	1.29 (0.95; 1.77)	1.33 (0.93; 1.89)	1.09 (0.79; 1.52)	0.83 (0.58; 1.18)	0.91 (0.64; 1.31)	0.265
Leisure time physical inactivity	1.07 (0.90; 1.28)	1.31 (1.14; 1.51)	0.93 (0.74; 1.16)	1.05 (0.83; 1.32)	0.86 (0.64; 1.16)	1.00 (0.81; 1.22)	0.128
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.04 (0.90; 1.22)	1.15 (1.04; 1.28)	1.07 (0.96; 1.19)	0.94 (0.82; 1.09)	0.95 (0.85; 1.07)	1.05 (0.96; 1.15)	0.470
Obesity, BMI ≥ 30 kg/m²	1.32 (0.90; 1.94)	1.11 (0.80; 1.55)	1.35 (1.03; 1.76)	0.92 (0.69; 1.23)	0.93 (0.73; 1.20)	1.00 (0.79; 1.28)	0.191
High blood pressure	0.96 (0.66; 1.39)	0.89 (0.67; 1.17)	1.10 (0.87; 1.37)	0.78 (0.58; 1.05)	0.95 (0.74; 1.21)	1.08 (0.88; 1.31)	0.581
High cholesterol levels					1.04 (0.79; 1.37)	0.99 (0.78; 1.26)	0.905
NCD prevalence							
T2DM	1.45 (0.76; 2.75)	1.44 (0.90; 2.31)	1.25 (0.84; 1.84)	1.47 (0.96; 2.25)	1.07 (0.67; 1.72)	1.04 (0.69; 1.55)	0.240
CVD					0.93 (0.53; 1.66)	1.01 (0.64; 1.60)	0.913
Myocardial infarction							
Coronary artery disease							
Other serious heart disease						0.91 (0.52; 1.57)	
Cerebrovascular disease							
Cancer							
Asthma		1.31 (0.86; 1.99)	1.02 (0.65; 1.59)	0.84 (0.54; 1.30)	0.97 (0.56; 1.69)	0.84 (0.57; 1.25)	0.414
Chronic bronchitis, COPD, emphysema		1.35 (0.96; 1.88)	1.21 (0.82; 1.78)	0.87 (0.52; 1.44)	1.24 (0.74; 2.08)	1.03 (0.60; 1.74)	0.720
NCD-specific mortality attributable to							
T2DM	1.13 (0.61; 2.09)	1.07 (0.55; 2.08)	1.39 (0.74; 2.60)	1.11 (0.57; 2.17)	1.11 (0.52; 2.37)	0.67 (0.26; 1.69)	0.339
Ischemic heart disease	0.74 (0.59; 0.94)	0.99 (0.78; 1.26)	0.93 (0.72; 1.20)	0.86 (0.64; 1.16)	0.96 (0.69; 1.35)	0.54 (0.35; 0.83)	0.707
Cerebrovascular disease	0.74 (0.54; 1.01)	0.95 (0.69; 1.30)	0.74 (0.52; 1.05)	0.88 (0.61; 1.27)	0.91 (0.61; 1.37)	0.54 (0.33; 0.88)	0.848
Cancer	0.80 (0.69; 0.93)	0.87 (0.74; 1.01)	0.87 (0.74; 1.02)	0.83 (0.71; 0.98)	0.83 (0.70; 0.98)	0.47 (0.39; 0.58)	0.436
Asthma	1.50 (0.46; 4.96)	0.98 (0.24; 3.98)	1.01 (0.17; 6.11)	1.65 (0.18; 14.88)	0.91 (0.07; 11.54)	0.97 (0.05; 18.86)	0.452
Chronic bronchitis, COPD, emphysema	1.15 (0.82; 1.60)	1.23 (0.86; 1.76)	1.19 (0.82; 1.74)	1.18 (0.80; 1.75)	0.90 (0.58; 1.38)	0.44 (0.25; 0.77)	0.133

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27% missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). NCD mortality rates comparison is between foreigners (all kind) and Belgians. Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.F Nationality-related relative health disparities: non-Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.00 (0.85; 1.18)	0.85 (0.71; 1.02)	0.306
Non-daily vegetables					1.79 (1.45; 2.22)	1.33 (1.09; 1.63)	0.034
Daily snacking					0.63 (0.52; 0.76)	0.68 (0.57; 0.81)	0.037
Daily SSBs					1.06 (0.81; 1.38)	0.81 (0.58; 1.14)	0.194
Daily smoking	0.69 (0.44; 1.10)	0.70 (0.51; 0.95)	0.59 (0.40; 0.89)	0.65 (0.37; 1.14)	0.50 (0.29; 0.87)	0.64 (0.40; 1.03)	0.417
Excess alcohol							
Leisure time physical inactivity	1.35 (1.05; 1.74)	1.40 (1.15; 1.70)	0.78 (0.55; 1.12)	1.19 (0.84; 1.70)	0.65 (0.44; 0.97)	1.11 (0.82; 1.51)	0.136
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.01 (0.84; 1.22)	0.99 (0.82; 1.20)	1.05 (0.85; 1.30)	1.09 (0.93; 1.29)	1.13 (0.97; 1.32)	1.20 (1.05; 1.36)	0.019
Obesity, BMI ≥ 30 kg/m²	0.83 (0.53; 1.31)	1.36 (0.93; 1.99)	1.10 (0.72; 1.69)	0.98 (0.66; 1.46)	1.06 (0.73; 1.56)	1.36 (1.03; 1.80)	0.082
High blood pressure	0.99 (0.62; 1.60)	1.22 (0.79; 1.88)	0.71 (0.50; 1.00)	0.77 (0.50; 1.19)	1.33 (0.92; 1.93)	1.21 (0.89; 1.63)	0.281
High cholesterol levels					0.95 (0.63; 1.42)	1.07 (0.76; 1.50)	0.449
NCD prevalence							
T2DM		3.50 (1.97; 6.23)			2.26 (1.30; 3.92)	2.34 (1.53; 3.56)	0.767
CVD							
Myocardial infarction							
Coronary artery disease							
Other serious heart disease							
Cerebrovascular disease							
Cancer							
Asthma		1.19 (0.68; 2.06)			0.88 (0.48; 1.61)	0.79 (0.47; 1.33)	0.341
Chronic bronchitis, COPD, emphysema		1.01 (0.59; 1.75)	1.08 (0.58; 2.03)				0.703

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.G Education-related relative health disparities: low versus high education level (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.39 (1.26; 1.53)	1.42 (1.29; 1.56)	0.707
Non-daily vegetables					1.67 (1.41; 1.99)	2.05 (1.77; 2.37)	0.130
Daily snacking					0.89 (0.78; 1.00)	0.74 (0.65; 0.84)	0.082
Daily SSBs					1.98 (1.68; 2.32)	2.01 (1.68; 2.41)	0.837
Daily smoking	1.63 (1.38; 1.93)	1.55 (1.34; 1.79)	1.90 (1.63; 2.22)	2.52 (2.08; 3.05)	2.43 (1.96; 3.02)	2.21 (1.79; 2.72)	<0.001
Excess alcohol	0.60 (0.42; 0.86)	0.55 (0.44; 0.68)	0.49 (0.38; 0.62)	0.64 (0.51; 0.81)	0.53 (0.41; 0.67)	0.47 (0.35; 0.62)	0.312
Leisure time physical inactivity	1.68 (1.45; 1.95)	1.55 (1.38; 1.73)	1.68 (1.44; 1.95)	1.57 (1.34; 1.84)	1.35 (1.13; 1.62)	1.76 (1.52; 2.03)	0.032
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.39 (1.25; 1.55)	1.34 (1.23; 1.45)	1.25 (1.15; 1.35)	1.25 (1.15; 1.35)	1.28 (1.19; 1.39)	1.36 (1.26; 1.46)	0.217
Obesity, BMI ≥ 30 kg/m²	1.73 (1.31; 2.29)	2.37 (1.90; 2.95)	2.21 (1.81; 2.71)	2.05 (1.67; 2.51)	2.22 (1.81; 2.73)	1.80 (1.52; 2.13)	0.137
High blood pressure	1.24 (0.98; 1.56)	1.41 (1.17; 1.71)	1.34 (1.15; 1.56)	1.35 (1.15; 1.60)	1.27 (1.08; 1.49)	1.18 (1.03; 1.36)	0.407
High cholesterol levels					1.10 (0.94; 1.28)	1.16 (1.01; 1.33)	0.864
NCD prevalence							
T2DM	2.79 (1.80; 4.31)	1.95 (1.34; 2.85)	2.40 (1.64; 3.52)	2.30 (1.64; 3.25)	1.83 (1.37; 2.44)	1.76 (1.36; 2.28)	0.090
CVD					1.15 (0.77; 1.71)	1.20 (0.90; 1.61)	0.710
Myocardial infarction				1.74 (0.92; 3.27)	2.41 (1.12; 5.19)	2.15 (1.02; 4.53)	
Coronary artery disease				1.30 (0.78; 2.16)	0.66 (0.30; 1.44)	1.36 (0.74; 2.50)	
Other serious heart disease					1.46 (0.90; 2.39)	1.16 (0.79; 1.71)	
Cerebrovascular disease				1.16 (0.60; 2.24)	1.01 (0.43; 2.35)	1.79 (0.93; 3.44)	
Cancer	0.94 (0.44; 1.98)	1.15 (0.68; 1.97)	1.24 (0.74; 2.10)	1.16 (0.69; 1.94)	1.30 (0.75; 2.27)	1.03 (0.66; 1.60)	0.820
Asthma		1.33 (0.96; 1.85)	1.53 (1.11; 2.12)	1.34 (0.94; 1.90)	2.05 (1.47; 2.84)	1.46 (1.07; 1.99)	0.744
Chronic bronchitis, COPD, emphysema		2.26 (1.68; 3.04)	2.64 (1.92; 3.62)	4.36 (2.80; 6.77)	2.78 (1.79; 4.32)	2.75 (1.95; 3.86)	0.232

Analyses were conducted in 1997 in 7,146 individuals (1.5%missing), in 2001 in 8,427 (2.8%missing), in 2004 in 8,796 (2.8%missing), in 2008 in 7,146 (2.7%missing), in 2013 in 7,590 (1.5%missing), and in 2018 in 8,201 (1.9%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.H Income-related relative health disparities: Quintile 1 versus Quintile 5 of income (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.08 (0.96; 1.21)	1.47 (1.30; 1.67)	0.002
Non-daily vegetables					1.14 (0.93; 1.41)	2.72 (2.20; 3.35)	<0.001
Daily snacking					0.85 (0.73; 0.99)	0.68 (0.56; 0.81)	0.074
Daily SSBs					1.79 (1.47; 2.18)	1.51 (1.19; 1.93)	0.247
Daily smoking	1.49 (1.19; 1.87)	1.28 (1.07; 1.54)	1.76 (1.45; 2.13)	1.90 (1.48; 2.45)	1.95 (1.50; 2.54)	2.78 (2.15; 3.58)	<0.001
Excess alcohol	0.69 (0.47; 1.01)	0.40 (0.30; 0.54)	0.50 (0.36; 0.68)	0.60 (0.44; 0.81)	0.49 (0.35; 0.68)	0.51 (0.31; 0.84)	0.576
Leisure time physical inactivity	1.46 (1.20; 1.77)	1.53 (1.32; 1.78)	1.52 (1.27; 1.83)	1.60 (1.30; 1.97)	1.16 (0.93; 1.45)	1.92 (1.57; 2.35)	0.559
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.22 (1.08; 1.38)	1.10 (1.00; 1.23)	1.14 (1.02; 1.27)	1.11 (0.99; 1.24)	1.21 (1.09; 1.34)	1.25 (1.11; 1.39)	0.660
Obesity, BMI ≥ 30 kg/m²	1.46 (1.02; 2.10)	1.43 (1.10; 1.85)	1.73 (1.32; 2.28)	1.69 (1.32; 2.17)	2.00 (1.55; 2.58)	1.64 (1.26; 2.12)	0.430
High blood pressure	0.96 (0.71; 1.32)	1.09 (0.87; 1.38)	1.03 (0.84; 1.26)	1.35 (1.07; 1.69)	1.14 (0.92; 1.41)	1.48 (1.19; 1.85)	0.008
High cholesterol levels					1.34 (1.08; 1.67)	1.35 (1.10; 1.66)	0.867
NCD prevalence							
T2DM	1.60 (0.88; 2.92)	1.84 (1.17; 2.90)	1.93 (0.99; 3.75)	2.44 (1.53; 3.90)	2.37 (1.55; 3.63)	2.13 (1.36; 3.32)	0.539
CVD					2.24 (1.37; 3.66)	1.42 (0.87; 2.31)	0.186
Myocardial infarction							
Coronary artery disease				1.49 (0.75; 2.95)			
Other serious heart disease					1.52 (0.76; 3.02)	1.37 (0.72; 2.60)	
Cerebrovascular disease							
Cancer		1.31 (0.66; 2.58)	1.31 (0.66; 2.61)	0.86 (0.43; 1.74)		2.41 (1.21; 4.79)	0.499
Asthma		1.30 (0.86; 1.96)	3.16 (2.02; 4.93)	1.89 (1.21; 2.95)	1.29 (0.83; 2.02)	2.00 (1.32; 3.03)	0.777
Chronic bronchitis, COPD, emphysema		2.37 (1.59; 3.53)	2.67 (1.78; 3.99)	5.16 (2.86; 9.31)	4.82 (2.82; 8.26)	6.02 (3.33; 10.86)	<0.001

Analyses were conducted in 1997 in 6,915 individuals (5%missing), in 2001 in 7,495 (14%missing), in 2004 in 7,660 (15%missing), in 2008 in 5,894 (20%missing), in 2013 in 6,666 (13%missing), and in 2018 in 7,053 (16%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

Supplementary Tables 3 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised percentage point differences between distal groups.

3.A Age-related absolute health disparities: adults aged 75-84 years versus adults aged 25-34 years (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-19.2% (-25.7%; -12.7%)	-25.0% (-30.8%; -19.1%)	0.175
Non-daily vegetables					-8.4% (-14.1%; -2.7%)	-11.3% (-16.1%; -6.5%)	0.383
Daily snacking					-2.7% (-9.3%; 4.9%)	3.5% (-2.9%; 9.9%)	0.186
Diet high in SSBs					-20.9% (-25.9%; -15.8%)	-20.3% (-24.9%; -15.8%)	0.291
Daily smoking	-19.9% (-24.3%; -15.4%)	-21.1% (-25.2%; -17.1%)	-19.6% (-23.9%; -15.3%)	-18.8% (-22.9%; -14.8%)	-13.0% (-17.3%; -8.7%)	-14.3% (-18.1%; -10.5%)	0.840
Excess alcohol	-0.4% (-4.0%; 3.2%)	-3.4% (-6.3%; -0.5%)	-2.4% (-6.1%; 1.3%)	-2.4% (-5.1%; 0.3%)	-0.2% (-2.2%; 1.7%)	-3.2% (-5.1%; -1.3%)	0.075
Leisure time physical inactivity	35.6% (28.1%; 43.1%)	30.6% (24.5%; 36.8%)	31.6% (25.4%; 37.7%)	30.2% (23.5%; 37.0%)	26.1% (18.1%; 34.1%)	21.5% (14.7%; 28.3%)	0.018
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	19.1% (10.7%; 27.4%)	19.3% (12.9%; 25.8%)	24.0% (18.5%; 29.5%)	20.1% (14.1%; 26.1%)	19.9% (13.7%; 26.2%)	20.8% (14.6%; 26.9%)	0.894
Obesity, BMI ≥ 30 kg/m²	4.2% (-0.1%; 8.6%)	11.2% (6.4%; 16.0%)	6.1% (2.5%; 9.7%)	7.7% (3.8%; 11.7%)	5.5% (1.2%; 9.9%)	6.3% (2.1%; 10.6%)	0.048
High blood pressure	26.7% (19.4%; 34.1%)	33.2% (27.5%; 39.0%)	33.0% (28.7%; 37.2%)	32.3% (28.0%; 36.5%)	32.8% (27.9%; 37.7%)	38.7% (33.8%; 43.6%)	0.072
High cholesterol levels					35.4% (30.3%; 40.6%)	35.0% (29.9%; 40.0%)	0.294
NCD prevalence							
Asthma		4.3% (1.2%; 7.4%)	3.3% (1.0%; 5.7%)	1.5% (-1.4%; 4.5%)	-1.0% (-3.6%; 1.7%)		0.017
Chronic bronchitis, COPD, emphysema		10.2% (6.6%; 13.8%)	10.5% (7.3%; 13.7%)	8.1% (5.6%; 10.7%)		6.8% (3.8%; 9.8%)	0.567

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.B sex-related absolute health disparities: women versus men (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-11.8% (-14.6%; -9.0%)	-12.8% (-15.4%; -10.2%)	0.504
Non-daily vegetables					-7.2% (-9.3%; -5.1%)	-7.6% (-9.8%; -5.5%)	0.919
Daily snacking					-0.1% (-2.7%; 2.6%)	1.4% (-1.2%; 4.0%)	0.408
Daily SSBs					-10.3% (-12.6%; -8.0%)	-8.5% (-10.7%; -6.4%)	0.597
Daily smoking	-11.7% (-14.6%; -8.9%)	-8.6% (-10.7%; -6.5%)	-7.6% (-10.0%; -5.3%)	-5.6% (-8.1%; -3.2%)	-6.0% (-8.4%; -3.5%)	-6.9% (-9.2%; -4.7%)	0.075
Excess alcohol	-5.3% (-7.1%; -3.6%)	-5.9% (-7.6%; -4.2%)	-6.8% (-8.4%; -5.2%)	-3.7% (-5.4%; -2.0%)	-3.6% (-5.2%; -2.0%)	-3.4% (-4.8%; -2.1%)	0.067
Leisure time physical inactivity	8.3% (5.1%; 11.5%)	9.6% (7.2%; 12.1%)	10.0% (7.4%; 12.6%)	6.6% (3.8%; 9.5%)	6.4% (3.2%; 9.6%)	8.1% (5.4%; 10.9%)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	-15.4% (-18.6%; -12.1%)	-12.6% (-15.3%; -10.0%)	-14.4% (-17.0%; -11.8%)	-13.9% (-16.8%; -10.9%)	-14.1% (-17.0%; -11.1%)	-14.2% (-17.0%; -11.4%)	0.729
Obesity, BMI ≥ 30 kg/m²	-0.3% (-2.7%; 2.2%)	1.0% (-0.9%; 2.9%)	1.4% (-0.5%; 3.3%)	1.4% (-0.7%; 3.4%)	0.4% (-1.9%; 2.6%)	-1.7% (-3.9%; 0.4%)	0.180
High blood pressure	4.1% (1.7%; 6.5%)	1.8% (-0.2%; 3.8%)	2.1% (0.1%; 4.0%)	2.8% (0.6%; 4.9%)	0.0% (-2.3%; 2.3%)	-1.2% (-3.3%; 1.0%)	0.003
High cholesterol levels					-0.2% (-2.5%; 2.0%)	-3.4% (-5.5%; -1.2%)	0.067
NCD prevalence							
T2DM	0.1% (-1.3%; 1.6%)	-0.5% (-1.5%; 0.6%)	-0.5% (-1.6%; 0.6%)	-0.4% (-1.6%; 0.8%)	-0.6% (-2.0%; 0.9%)	-0.8% (-2.1%; 0.6%)	0.479
CVD					-3.1% (-4.3%; -1.9%)	-2.6% (-3.8%; -1.3%)	0.431
Myocardial infarction				-0.7% (-1.1%; -0.2%)	-1.2% (-2.1%; -0.3%)	-0.7% (-1.4%; -0.1%)	
Coronary artery disease				-1.5% (-2.5%; -0.5%)	-1.1% (-1.8%; -0.4%)	-0.9% (-1.7%; 0.0%)	
Other serious heart disease					-1.8% (-2.7%; -0.9%)	-1.4% (-2.5%; -0.4%)	
Cerebrovascular disease	0.5% (-0.5%; 1.4%)	-0.1% (-0.6%; 0.4%)	0.0% (-0.5%; 0.5%)	0.0% (-0.6%; 0.7%)	-0.4% (-1.1%; 0.3%)	-1.1% (-1.8%; -0.4%)	
Cancer	1.0% (-0.1%; 2.1%)	0.4% (-0.3%; 1.1%)	0.9% (0.3%; 1.5%)	0.0% (-1.1%; 1.0%)	1.0% (0.1%; 1.9%)	0.9% (-0.1%; 1.8%)	0.535
Asthma		-1.0% (-2.2%; 0.2%)	0.7% (-0.4%; 1.8%)	1.6% (0.4%; 2.8%)	0.0% (-1.3%; 1.3%)	1.0% (-0.4%; 2.3%)	0.247
Chronic bronchitis, COPD, emphysema		-0.7% (-2.0%; 0.6%)	-0.5% (-1.8%; 0.7%)	0.0% (-1.2%; 1.1%)	0.6% (-0.6%; 1.8%)	0.1% (-1.1%; 1.2%)	0.282
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	-0.8 (-3.0; 1.5)	-0.8 (-2.8; 1.2)	1.2 (-0.8; 3.2)	-2.52 (-4.4; -0.6)	-3.6 (-5.2; -2.0)	-5.4 (-6.8; -3.9)	0.085
Ischemic heart disease	-114 (-1120; -106)	-110 (-116; -103)	-99 (-105; -93)	-80 (-85.24; -75)	-64 (-67; -59.8)	-53 (-56; -50)	0.009
Cerebrovascular disease	-22 (-27; -16)	-19 (-26; -12)	-5.5 (-12; 0.9)	-11.66 (-17.18; -6.2)	-9.7 (-14; -5.4)	-6.2 (-10; -2.5)	0.133
Cancer	-226 (-235; -217)	-213 (-222; -205)	-191 (-199; -182)	-175 (-183; -167)	-141 (-157; -143.9)	-126 (-132; -119)	0.009
Asthma	-0.6 (-1.6; 0.3)	0.2 (-0.6; 1.0)	0.7 (0.1; 1.3)	0.6 (0.1; 1.1)	0.3 (-0.2; 0.7)	0.4 (0.1; 0.8)	0.452
Chronic bronchitis, COPD, emphysema	-91 (-96; -86)	-74 (-79; -70)	-66 (-71; -62)	-57 (-60; -53)	-40 (-43; -37)	-32 (-34; -29)	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.C Region of residence-related absolute health disparities: Wallonia versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.7% (-1.8%; 5.2%)	5.8% (2.2%; 9.4%)	0.104
Non-daily vegetables					3.3% (0.3%; 6.3%)	6.0% (2.8%; 9.2%)	0.293
Daily snacking					0.2% (-3.4%; 3.8%)	-4.4% (-7.9%; -1.0%)	0.060
Daily SSBs					2.6% (-0.4%; 5.6%)	2.1% (-1.1%; 5.2%)	0.875
Daily smoking	3.7% (0.4%; 7.1%)	3.4% (0.7%; 6.1%)	4.8% (1.8%; 7.8%)	5.5% (2.3%; 8.7%)	4.4% (1.1%; 7.6%)	5.4% (2.5%; 8.4%)	0.155
Excess alcohol	-1.5% (-3.3%; 0.4%)	-2.1% (-4.0%; -0.2%)	1.2% (-0.8%; 3.2%)	1.7% (-0.5%; 3.8%)	1.6% (-0.4%; 3.5%)	1.5% (-0.2%; 3.3%)	0.002
Leisure time physical inactivity	12.0% (8.0%; 16.0%)	13.1% (9.9%; 16.3%)	10.3% (7.1%; 13.5%)	13.0% (9.5%; 16.5%)	8.4% (4.6%; 12.3%)	13.6% (10.0%; 17.2%)	0.333
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	4.1% (0.2%; 8.0%)	4.3% (1.2%; 7.4%)	6.2% (3.1%; 9.3%)	2.7% (-0.7%; 6.1%)	3.5% (0.1%; 6.9%)	4.0% (0.7%; 7.4%)	0.618
Obesity, BMI ≥ 30 kg/m²	4.2% (1.5%; 7.0%)	3.5% (1.3%; 5.7%)	4.3% (2.0%; 6.6%)	1.2% (-1.2%; 3.5%)	4.0% (1.5%; 6.6%)	3.6% (0.9%; 6.2%)	0.287
High blood pressure	3.9% (1.0%; 6.9%)	0.4% (-2.0%; 2.8%)	1.5% (-0.7%; 3.8%)	2.3% (-0.1%; 4.8%)	-1.8% (-4.3%; 0.6%)	1.8% (-0.6%; 4.2%)	0.232
High cholesterol levels					-0.7% (-3.2%; 1.8%)	0.2% (-2.3%; 2.7%)	0.658
NCD prevalence							
T2DM	2.1% (0.5%; 3.7%)	2.4% (1.2%; 3.6%)	2.0% (0.6%; 3.4%)	1.0% (-0.2%; 2.3%)	1.3% (-0.3%; 2.9%)	2.1% (0.6%; 3.6%)	0.126
CVD					1.0% (-0.4%; 2.4%)	0.3% (-1.1%; 1.7%)	0.450
Myocardial infarction				0.4% (-0.1%; 0.8%)	)	0.7% (0.0%; 1.5%)	
Coronary artery disease				0.6% (-0.4%; 1.6%)	0.7% (-0.2%; 1.5%)	0.4% (-0.5%; 1.3%)	
Other serious heart disease					-0.4% (-1.3%; 0.5%)	-0.2% (-1.4%; 0.9%)	
Cerebrovascular disease			0.5% (-0.1%; 1.0%)	0.8% (0.1%; 1.5%)		0.7% (0.0%; 1.4%)	
Cancer	-0.1% (-1.3%; 1.0%)	0.8% (-0.1%; 1.7%)	-0.2% (-0.8%; 0.4%)	-0.1% (-1.1%; 1.0%)	-0.3% (-1.2%; 0.7%)	-0.1% (-1.1%; 0.9%)	0.387
Asthma		2.9% (1.5%; 4.3%)	3.0% (1.7%; 4.2%)	3.1% (1.7%; 4.4%)	2.6% (1.2%; 4.0%)	3.9% (2.3%; 5.6%)	0.740
Chronic bronchitis, COPD, emphysema		3.3% (1.8%; 4.8%)	3.5% (2.0%; 4.9%)	2.0% (0.7%; 3.2%)	2.3% (1.0%; 3.7%)	2.2% (0.9%; 3.5%)	0.943
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	1.1 (-1.3; 3.4)	7.3 (5.1; 10)	11 (8.3; 13)	5.1 (3.1; 7.2)	1.7 (-0.01; 3.3)	4.3 (2.8; 5.9)	1.000
Ischemic heart disease	-22 (-28; -16)	-5.2 (-11; 0.6)	0.1 (-5.5; 5.6)	12 (7.3; 17)	20 (17; 24)	17 (13; 20)	0.024
Cerebrovascular disease	-13 (-18.5; -7.8)	-6.4 (-11; -1.3)	-11 (-16; -6.6)	-2.3 (-6.5; 1.9)	-3.1 (-6.6; 0.3)	2.1 (-1.0; 5)	0.060
Cancer	18 (9.7; 27)	19 (11; 27)	18 (10; 26)	23 (15; 30)	26 (19; 33)	26 (19; 32)	0.051
Asthma	0.9 (0.0; 1.8)	0.9 (0.1; 1.8)	1.7 (0.9; 2.5)	0.9 (0.3; 1.5)	1.0 (0.5; 1.6)	1.0 (0.5; 1.4)	0.411
Chronic bronchitis, COPD, emphysema	5.2 (1.2; 9.2)	7.5 (3.9; 11)	9.0 (5.4; 13)	15 (11; 18)	13 (9.9; 16)	8.4 (5.8; 11)	0.260

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.D Region of residence-related absolute health disparities: Brussels versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-7.2% (-10.9%; -3.4%)	-3.2% (-6.6%; 0.2%)	0.069
Non-daily vegetables					3.5% (0.2%; 6.8%)	7.1% (4.0%; 10.2%)	0.225
Daily snacking					-9.8% (-13.3%; -6.3%)	-10.5% (-13.7%; -7.3%)	0.641
Daily SSBs					-4.6% (-7.4%; -1.7%)	-4.5% (-7.2%; -1.9%)	0.731
Daily smoking	2.5% (-0.7%; 5.8%)	2.9% (0.02%; 5.8%)	2.3% (-0.8%; 5.4%)	2.9% (-0.3%; 6.0%)	-0.8% (-4.3%; 2.6%)	2.1% (-0.6%; 4.8%)	0.365
Excess alcohol	0.4% (-1.6%; 2.4%)	1.1% (-1.1%; 3.4%)	0.7% (-1.4%; 2.7%)	-0.1% (-2.1%; 1.8%)	2.4% (0.1%; 4.7%)	3.0% (1.1%; 4.8%)	0.027
Leisure time physical inactivity	11.2% (6.6%; 15.7%)	8.6% (5.3%; 11.9%)	6.0% (2.5%; 9.4%)	9.8% (6.0%; 13.5%)	5.3% (0.7%; 9.9%)	6.7% (3.2%; 10.2%)	0.315
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	-5.6% (-9.7%; -1.4%)	-3.2% (-6.4%; 0.0%)	-2.2% (-5.4%; 1.0%)	-5.2% (-8.6%; -1.7%)	-0.7% (-4.3%; 3.0%)	1.0% (-2.4%; 4.4%)	0.013
Obesity, BMI ≥ 30 kg/m²	-0.5% (-3.5%; 2.5%)	0.7% (-1.5%; 3.0%)	0.7% (-1.4%; 2.9%)	-0.9% (-3.3%; 1.6%)	1.3% (-1.3%; 4.0%)	0.4% (-2.1%; 2.8%)	0.725
High blood pressure	1.5% (-1.5%; 4.4%)	-0.5% (-2.9%; 2.0%)	-0.8% (-2.9%; 1.3%)	0.1% (-2.4%; 2.5%)	2.9% (0.0%; 5.9%)	-1.5% (-3.8%; 0.8%)	0.647
High cholesterol levels					3.7% (0.7%; 6.8%)	-2.5% (-4.8%; -0.1%)	0.003
NCD prevalence							
T2DM	1.1% (-0.4%; 2.6%)	1.1% (0.0%; 2.2%)	1.4% (-0.1%; 2.8%)	3.2% (1.6%; 4.8%)	3.3% (1.4%; 5.1%)	2.3% (0.7%; 3.8%)	0.460
CVD					0.6% (-1.0%; 2.2%)	-1.5% (-2.8%; -0.3%)	0.030
Myocardial infarction				1.2% (0.5%; 2.0%)			
Coronary artery disease				1.2% (0.0%; 2.4%)	0.7% (-0.2%; 1.5%)	0.6% (-0.4%; 1.6%)	
Other serious heart disease					0.2% (-1.0%; 1.4%)	-1.7% (-2.7%; -0.7%)	
Cerebrovascular disease			0.4% (-0.1%; 0.9%)	1.8% (0.9%; 2.7%)			
Cancer	0.4% (-1.2%; 2.0%)	1.2% (0.3%; 2.1%)	0.7% (-0.1%; 1.5%)	0.1% (-0.9%; 1.2%)	-1.2% (-2.5%; 0.0%)	-0.9% (-1.9%; 0.1%)	0.042
Asthma		3.0% (1.6%; 4.4%)	2.5% (1.1%; 3.8%)	3.2% (1.7%; 4.7%)	2.5% (0.6%; 4.3%)	2.7% (1.3%; 4.2%)	0.814
Chronic bronchitis, COPD, emphysema		3.1% (1.5%; 4.8%)	2.2% (0.7%; 3.7%)	2.0% (0.7%; 3.3%)	1.1% (0.4%; 2.5%)	0.9% (-0.3%; 2.1%)	0.181
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	-5.8 (-8.9; -2.8)	-2.5 (-5.3; 0.3)	-2.3 (-5.1; 0.6)	2.4 (-0.8; 5.6)	4.9 (-1.0; 4.7)	1.6 (-1.0; 4.1)	0.133
Ischemic heart disease	-13 (-23; -3.9)	-8.8 (-17.62; 0.1)	-2.9 (-11; 5.8)	11 (3.5; 19)	5.5 (-0.6; 12)	7.0 (1.5; 13)	0.060
Cerebrovascular disease	-20 (-28; -13)	-20 (-27; -13)	-6.9 (-14; 0.4)	-11 (-17; -4.8)	-9.8 (-15; -4.4)	-3.1 (-8.1; 2.0)	0.085
Cancer	1.2 (-12; 14)	8.1 (-4.8; 21)	11 (-1.9; 23)	2.4 (-9.6; 14)	2.0 (-13; 9.3)	11.5 (0.5; 22)	0.707
Asthma	5.0 (3.0; 7.0)	3.7 (1.9; 5.5)	1.3 (0.1; 2.5)	0.9 (-0.1; 1.9)	1.5 (0.5; 2.6)	0.9 (0.1; 1.7)	0.085
Chronic bronchitis, COPD, emphysema	-0.6 (-6.5; 5.3)	4.4 (-1.3; 10)	0.3 (-4.9; 5.6)	3.0 (-2.0; 8.1)	9.8 (4.9; 15)	6.6 (2.0; 11)	0.133

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.E Nationality-related absolute health disparities: non-Belgian Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-2.6% (-9.0%; 3.3%)	-5.2% (-10.4%; 0.0%)	0.708
Non-daily vegetables					6.9% (1.6%; 12.2%)	9.1% (4.2%; 14.0%)	0.696
Daily snacking					-14.2% (-19.0%;-9.4%)	-11.7% (-16.2%;-7.2%)	0.550
Daily SSBs					-6.9% (-10.8%; -2.9%)	-6.5% (-10.3%; -2.7%)	0.922
Daily smoking	0.8% (-5.0%; 6.6%)	1.1% (-4.1%; 6.2%)	1.3% (-4.1%; 6.7%)	-0.1% (-5.7%; 5.5%)	5.5% (-1.0%; 12.0%)	0.8% (-3.6%; 5.2%)	0.683
Excess alcohol	2.2% (-2.6%; 6.9%)	-3.4% (-6.2%; -0.6%)	0.4% (-4.2%; 4.9%)	0.9% (-3.5%; 5.3%)	-1.3% (-4.4%; 1.7%)	-1.1% (-4.0%; 1.7%)	0.552
Leisure time physical inactivity	4.5% (-2.5%; 11.6%)	11.6% (5.4%; 17.9%)	0.5% (-5.5%; 6.5%)	5.1% (-1.9%; 12.0%)	5.3% (-2.7%; 13.2%)	3.5% (-2.3%; 9.3%)	0.650
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.8% (-5.5%; 9.1%)	7.2% (1.6%; 12.7%)	2.9% (-2.6%; 8.4%)	-1.9% (-8.5%; 4.7%)	-2.0% (-7.4%; 3.4%)	2.2% (-2.5%; 7.0%)	0.570
Obesity, BMI ≥ 30 kg/m²	4.0% (-2.2%; 10.2%)	1.4% (-3.5%; 6.3%)	4.6% (-0.2%; 9.5%)	-0.9% (-4.9%; 3.1%)	-0.9% (-4.4%; 2.7%)	0.0% (-4.1%; 4.1%)	0.213
High blood pressure	-0.6% (-5.9%; 4.6%)	-1.9% (-6.1%; 2.4%)	1.8% (-2.5%; 6.1%)	-3.9% (-8.2%; 0.4%)	-0.9% (-5.2%; 3.3%)	1.4% (-2.5%; 5.3%)	0.631
High cholesterol levels					0.8% (-4.5%; 6.1%)	-0.2% (-4.7%; 4.4%)	0.895
NCD prevalence							
T2DM	1.6% (-1.7%; 5.0%)	1.7% (-0.9%; 4.2%)	1.1% (-1.1%; 3.4%)	2.3% (-0.5%; 5.1%)	0.4% (-2.5%; 3.4%)	0.2% (-2.4%; 2.8%)	0.250
CVD					-0.3% (-2.7%; 2.1%)	0.1% (-2.3%; 2.4%)	0.918
Myocardial infarction							
Coronary artery disease							
Other serious heart disease						-0.3% (-2.0%; 1.4%)	
Cerebrovascular disease							
Cancer							
Asthma		1.4% (-1.1%; 4.0%)	0.0% (-1.9%; 2.0%)	-0.7% (-2.4%; 1.0%)	-0.1% (-2.6%; 2.3%)	-0.9% (-2.9%; 1.0%)	0.341
Chronic bronchitis, COPD, emphysema		2.3% (-0.6%; 5.2%)	1.3% (-1.6%; 4.2%)	-0.5% (-2.4%; 1.4%)	1.0% (-1.6%; 3.7%)	0.1% (-2.2%; 2.4%)	0.545
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	2.6 (-0.5; 5.6)	1.2 (-1.6; 3.9)	6.5 (3.5; 9.6)	1.8 (-0.9; 4.6)	1.4 (-1.0; 3.9)	-3.7 (-5.7; -1.7)	0,260
Ischemic heart disease	-42 (-50; -34)	-1.0 (-8.9; 6.9)	-9.0 (-16; -1.6)	-13 (-19; -6.3)	-2.5 (-8.1; 3.1)	-28 (-32; -23)	1.000
Cerebrovascular disease	-24 (-29; -18)	-4.4 (-10; 1.4)	-20 (-25; -14)	-7.5 (-13; -2.5)	-4.2 (-8.6; 0.3)	-21 (-25; -17)	0.707
Cancer	-76 (-89; -63)	-47 (-60; -35)	-43 (-55; -30)	-55 (-68; -43)	-53 (-65; -41)	-156 (-166; -146)	0.707
Asthma	2.3 (0.5; 4.0)	-0.1 (-1.5; 1.4)	0.0 (-1.1; 1.1)	0.8 (-0.1; 1.8)	-0.1 (-0.9; 0.7)	-0.0 (-0.7; 0.6)	0.697
Chronic bronchitis, COPD, emphysema	9.4 (3.9; 15)	12 (7.3; 18)	9.6 (4.8; 14)	8.5 (3.7; 13)	-4.6 (-8.9; -0.3)	-23 (-27; -19)	0.060

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). NCD-specific mortality rates, per 100,000 are comparing all foreigners living in Belgium with Belgians. Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence, and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.F Nationality-related absolute health disparities: non-Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.2% (-7.5%; 7.9%)	-7.1% (-14.6%; 0.3%)	0.304
Non-daily vegetables					15.9% (8.5%; 23.3%)	7.6% (1.5%; 13.6%)	0.050
Daily snacking					-9.7% (-16.4%; -2.9%)	-18.4% (-24.4%;-12.4%)	0.040
Daily SSBs					1.4% (-5.5%; 8.4%)	-4.0% (-9.9%; 1.9%)	0.184
Daily smoking	-5.5% (-13.8%; 2.9%)	-3.6% (-9.7%; 2.6%)	-5.4% (-13.1%; 2.4%)	-4.3% (-13.4%; 4.8%)	-5.3% (-13.0%; 2.4%)	-2.5% (-8.9%; 4.0%)	0.992
Excess alcohol							
Leisure time physical inactivity	26.5% (17.3%; 35.6%)	17.7% (9.0%; 26.3%)	3.3% (-8.0%; 14.5%)	15.8% (4.0%; 27.5%)	2.0% (-7.7%; 11.8%)	13.4% (2.9%; 24.0%)	0.249
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	2.7% (-6.3%; 11.7%)	0.2% (-8.5%; 8.8%)	5.0% (-4.8%; 14.7%)	4.6% (-3.2%; 12.4%)	6.7% (-0.8%; 14.2%)	9.2% (2.7%; 15.7%)	0.048
Obesity, BMI ≥ 30 kg/m²	-1.5% (-6.4%; 3.5%)	4.9% (-1.8%; 11.7%)	2.4% (-4.3%; 9.1%)	-0.1% (-5.8%; 5.7%)	1.2% (-4.8%; 7.2%)	6.0% (0.0%; 12.0%)	0.115
High blood pressure	-0.1% (-6.9%; 6.7%)	3.6% (-4.7%; 11.8%)	-4.6% (-8.9%; -0.4%)	-3.8% (-9.7%; 2.2%)	5.3% (-2.3%; 13.0%)	3.5% (-2.4%; 9.3%)	0.316
High cholesterol levels					-0.9% (-7.7%; 5.8%)	1.1% (-5.1%; 7.4%)	0.461
NCD prevalence							
T2DM		9.2% (2.2%; 16.2%)			7.0% (0.5%; 13.5%)	7.5% (2.5%; 12.6%)	0.788
CVD							
Myocardial infarction							
Coronary artery disease							
Other serious heart disease							
Cerebrovascular disease							
Cancer							
Asthma		0.9% (-2.2%; 4.0%)			-0.6% (-3.0%; 1.9%)	-1.2% (-3.6%; 1.2%)	0.208
Chronic bronchitis, COPD, emphysema		0.1% (-3.5%; 3.6%)	0.6% (-3.6%; 4.8%)				0.260

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.G Education-related absolute health disparities: low versus high (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					14.5% (10.1%; 18.8%)	15.5% (11.2%; 19.9%)	0.715
Non-daily vegetables					11.1% (7.2%; 15.1%)	17.6% (13.7%; 21.6%)	0.099
Daily snacking					-4.2% (-8.4%; 0.0%)	-9.9% (-13.8%; -6.0%)	0.083
Daily SSBs					14.9% (11.1%; 18.6%)	13.9% (9.9%; 17.9%)	0.926
Daily smoking	11.6% (7.7%; 15.5%)	10.9% (7.7%; 14.1%)	16.4% (12.9%; 19.8%)	20.6% (16.4%; 24.8%)	19.7% (15.3%; 24.1%)	17.3% (13.2%; 21.3%)	<0.001
Excess alcohol	1.3% (-1.0%; 3.6%)	-1.3% (-3.8%; 1.2%)	-2.8% (-5.2%; -0.3%)	-1.6% (-4.1%; 0.8%)	0.2% (-2.4%; 2.7%)	-2.0% (-4.0%; 0.0%)	0.672
Leisure time physical inactivity	19.1% (14.4%; 23.9%)	16.5% (12.7%; 20.3%)	17.4% (13.6%; 21.3%)	17.2% (12.8%; 21.7%)	16.8% (11.3%; 22.3%)	21.5% (16.6%; 26.4%)	0.754
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	15.4% (10.8%; 20.1%)	15.2% (11.5%; 18.9%)	11.7% (8.1%; 15.4%)	12.2% (8.0%; 16.4%)	13.5% (9.3%; 17.6%)	16.5% (12.5%; 20.5%)	0.682
Obesity, BMI ≥ 30 kg/m²	6.4% (3.4%; 9.5%)	10.9% (8.5%; 13.3%)	11.0% (8.5%; 13.6%)	10.8% (7.8%; 13.9%)	12.3% (9.1%; 15.6%)	10.7% (7.3%; 14.0%)	0.246
High blood pressure	3.3% (-0.1%; 6.7%)	5.4% (2.6%; 8.3%)	5.1% (2.6%; 7.6%)	5.2% (2.3%; 8.1%)	4.6% (1.5%; 7.7%)	3.3% (0.6%; 6.1%)	0.729
High cholesterol levels					1.7% (-1.3%; 4.8%)	3.2% (0.2%; 6.2%)	0.765
NCD prevalence							
T2DM	3.6% (2.1%; 5.0%)	2.3% (1.1%; 3.4%)	3.7% (2.3%; 5.1%)	3.7% (2.3%; 5.1%)	3.7% (1.9%; 5.5%)	3.6% (1.9%; 5.3%)	0.158
CVD					0.6% (-1.2%; 2.4%)	1.0% (-0.6%; 2.7%)	0.672
Myocardial infarction				0.5% (0.0%; 1.0%)	1.3% (0.0%; 2.5%)	0.8% (-0.1%; 1.6%)	
Coronary artery disease				0.7% (-0.6%; 1.9%)	-0.7% (-2.1%; 0.7%)	0.5% (-0.4%; 1.3%)	
Other serious heart disease					0.9% (-0.3%; 2.1%)	0.6% (-0.9%; 2.0%)	
Cerebrovascular disease				0.2% (-0.6%; 1.0%)	0.0% (-0.7%; 0.8%)	0.7% (-0.1%; 1.5%)	
Cancer	-0.1% (-1.4%; 1.2%)	0.3% (-0.7%; 1.2%)	0.3% (-0.5%; 1.1%)	0.3% (-0.8%; 1.4%)	0.6% (-0.7%; 1.9%)	0.1% (-1.1%; 1.2%)	0.842
Asthma		1.3% (-0.2%; 2.8%)	1.9% (0.5%; 3.3%)	1.2% (-0.3%; 2.7%)	3.6% (1.8%; 5.4%)	2.2% (0.3%; 4.2%)	0.440
Chronic bronchitis, COPD, emphysema		5.1% (3.4%; 6.9%)	5.8% (4.1%; 7.6%)	5.1% (3.6%; 6.7%)	4.2% (2.4%; 6.0%)	4.5% (2.8%; 6.2%)	0.623

Analyses were conducted in 1997 in 7,146 individuals (1.5%missing), in 2001 in 8,427 (2.8%missing), in 2004 in 8,796 (2.8%missing), in 2008 in 7,146 (2.7%missing), in 2013 in 7,590(1.5%missing), and in 2018 in 8,201 (1.9%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.H Income-related absolute health disparities: Quintile 1 versus Quintile 5 (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					3.3% (-2.0%; 8.7%)	17.4% (11.7%; 23.0%)	0.003
Non-daily vegetables					3.1% (-2.6%; 7.7%)	24.0% (18.8%; 29.3%)	<0.001
Daily snacking					-5.9% (-11.3%; -0.5%)	-12.4% (-17.7%; -7.2%)	0.086
Daily SSBs					12.8% (8.4%; 17.1%)	8.2% (3.3%; 13.1%)	0.208
Daily smoking	9.1% (4.5%; 13.7%)	7.3% (3.1%; 11.5%)	15.1% (10.6%; 19.7%)	15.9% (10.4%; 21.3%)	18.2% (13.1%; 23.2%)	21.2% (15.8%; 26.6%)	<0.001
Excess alcohol	1.3% (-1.6%; 4.3%)	-7.5% (-10.7%; -4.3%)	-2.8% (-5.8%; 0.2%)	-2.0% (-5.3%; 1.4%)	0.5% (-2.7%; 3.6%)	-0.7% (-3.3%; 1.9%)	0.246
Leisure time physical inactivity	13.7% (7.6%; 19.7%)	16.6% (11.6%; 21.7%)	15.2% (10.1%; 20.2%)	18.3% (12.5%; 24.1%)	16.7% (10.4%; 23.0%)	22.0% (15.8%; 28.1%)	0.208
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	9.5% (4.1%; 14.8%)	5.8% (1.0%; 10.6%)	7.5% (2.4%; 12.5%)	6.1% (0.6%; 11.7%)	10.6% (5.4%; 15.9%)	11.4% (5.6%; 17.2%)	0.453
Obesity, BMI ≥ 30 kg/m²	4.7% (0.6%; 8.9%)	4.8% (1.6%; 8.1%)	7.5% (4.1%; 10.9%)	8.6% (4.7%; 12.4%)	10.7% (6.9%; 14.5%)	8.2% (3.7%; 12.7%)	0.358
High blood pressure	-0.6% (-4.9%; 3.6%)	1.4% (-2.3%; 5.0%)	0.5% (-3.0%; 4.1%)	5.6% (1.2%; 10.0%)	2.4% (-1.6%; 6.5%)	8.1% (3.4%; 12.7%)	0.003
High cholesterol levels					5.5% (1.3%; 9.6%)	7.0% (2.3%; 11.7%)	0.240
NCD prevalence							
T2DM	1.5% (-0.4%; 3.5%)	2.4% (0.7%; 4.1%)	2.6% (-0.2%; 5.5%)	3.8% (1.9%; 5.7%)	5.5% (2.9%; 8.2%)	4.8% (2.1%; 7.5%)	0.413
CVD					3.3% (1.1%; 5.5%)	2.3% (-0.7%; 5.3%)	0.228
Myocardial infarction							
Coronary artery disease				1.0% (-0.6%; 2.5%)			
Other serious heart disease					0.9% (-0.7%; 2.4%)	1.3% (-1.3%; 3.8%)	
Cerebrovascular disease							
Cancer		0.5% (-0.7%; 1.7%)	0.4% (-0.6%; 1.3%)	-0.3% (-1.9%; 1.3%)		2.1% (0.3%; 3.9%)	0.486
Asthma		1.3% (-0.7%; 3.2%)	4.7% (2.9%; 6.6%)	2.7% (0.8%; 4.6%)	1.3% (-0.9%; 3.6%)	4.8% (1.7%; 7.9%)	0.382
Chronic bronchitis, COPD, emphysema		5.0% (2.9%; 7.2%)	5.7% (3.4%; 8.0%)	6.8% (4.5%; 9.0%)	5.8% (3.8%; 7.9%)	9.1% (6.2%; 12.0%)	0.005

Analyses were conducted in 1997 in 6,915 individuals (5%missing), in 2001 in 7,495 (14%missing), in 2004 in 7,660 (15%missing), in 2008 in 5,894 (20%missing), in 2013 in 6,666(13%missing), and in 2018 in 7,053 (16%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

Supplementary Table 4 General characteristics and lifestyle risks (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus low) [a].

	Year of the survey					
	2013			2018		
	Engaged in multiple lifestyle risks			Engaged in multiple lifestyle risks		
	Total	High	Low	Total	High	Low
Number of individuals	4,386	975 (21.2%)	1,061 (24.1%)	6,216	1,240 (19.5%)	1,634 (26.5%)
		(%)	(%)		(%)	(%)
Age groups						
25-34 years	18.5	20.2	22.3	19.1	20.8	20.0
35-44 years	17.1	18.7	19.5	15.7	18.8	16.8
45-54 years	20.4	21.5	21.3	19.2	21.0	19.7
55-64 years	20.1	23.2	18.7	21.4	25.3	22.0
65-74 years	14.1	11.7	11.9	15.4	9.9	14.2
75-84 years	9.9	4.7	6.4	9.2	4.1	7.2
Sex, men	48.8	63.7	39.6	48.6	64.6	43.2
Region of residence						
Flanders	57.6	57.2	64.5	56.7	52.8	63.7
Brussels	10.7	7.7	8.6	10.1	10.3	9.5
Wallonia	31.7	35.1	26.9	33.2	36.9	26.8
Nationality						
Belgians	89.4	92.9	92.1	88.6	90.1	88.9
Non-Belgian Europeans	6.4	5.8	5.2	6.6	6.5	5.9
Non-Europeans	4.2	1.3	2.8	4.8	3.4	5.2
Education level						
Low	24.1	23.8	15.1	29.1	20.3	13.0
Intermediate	33.5	40.0	28.8	32.0	41.6	27.0
High	42.4	36.2	56.0	48.4	38.1	60.0
Income level						
Quintile 1	16.6	14.4	8.5	11.8	16.7	8.6
Quintile 2	17.0	16.2	15.3	15.1	15.7	13.3
Quintile 3	21.0	22.7	19.3	19.9	17.9	18.7
Quintile 4	21.0	22.4	24.6	25.9	28.7	24.6
Quintile 5	24.2	24.3	32.3	27.3	21.0	34.8
Lifestyle risks						
Diet						
No daily fruit	43.9	74.6	17.1	44.1	76.1	16.2
No daily vegetables	20.4	35.5	5.6	23.2	40.5	7.9
Daily snacking	37.0	43.0	26.8	34.5	43.2	23.5
Daily SSBs	22.6	37.1	6.6	19.8	40.8	6.2
Four dietary risks present	1.4	5.1	0.0	1.6	6.7	0.0
3 out of 4	9.4	23.8	0.5	9.3	24.7	1.2
2 out of 4	26.1	35.7	5.4	24.4	37.7	5.1
1 out of 4	37.8	27.2	43.8	36.7	24.2	40.1
No dietary risks	25.2	8.2	50.3	28.0	6.6	53.7
Smoking						
Heavy	6.6	28.3	0.0	5.5	24.2	0.0
Occasional/light	15.0	41.1	0.9	15.1	44.8	0.6
Quit < 10years ago	9.7	12.8	1.9	9.0	12.0	2.5

Quit ≥ 10years ago	14.1	9.2	8.9	16.6	9.6	11.5
Never smoked	54.6	8.5	88.3	53.9	9.3	85.4
Alcohol consumption						
≥ 22 servings/week	4.6	16.8	0.0	4.8	19.3	0.0
15-21 servings/week	6.6	15.3	0.0	5.2	13.8	1.0
8-14 servings/week	14.4	21.5	7.0	12.1	17.7	3.3
1-7 servings/week	28.0	21.5	24.2	29.9	20.1	28.2
Abstainer/occasional	46.4	24.8	68.7	48.1	29.1	67.5
Physical inactivity						
Sedentary	27.2	54.6	0.0	28.6	61.3	0.0
Sport < 4hours/light	57.2	41.3	65.2	53.9	35.1	58.8
Sport ≥ 4hours/intensive	15.5	4.1	34.8	17.6	3.6	41.2

Abbreviations: SSB, sugar-sweetened beverages

[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

Supplementary Table 5 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in the individual lifestyle risks of diet, smoking, alcohol and physical activity, in 2018. [a]

	Dietary risks		Smoking		Alcohol		Physical inactivity	
	Yes	No	Yes	No	Yes	No	Yes	No
Number of individuals	5,074 (72%)	2,040 (27%)	3,076 (46%)	4,038 (54%)	3,573 (52%)	3,541 (48%)	5,828 (82%)	1,286 (18%)
Age groups								
25-34 years	20.9	13.2	16.6	20.5	16.5	21.1	16.7	28.4
35-44 years	17.4	14.0	15.5	17.3	15.3	17.7	16.1	18.3
45-54 years	20.8	16.8	18.2	20.9	20.6	18.6	19.9	18.6
55-64 years	20.1	27.2	26.4	18.5	24.0	20.1	22.6	20.0
65-74 years	13.4	18.9	16.7	13.4	16.3	13.4	15.7	11.2
75-84 years	7.4	9.9	6.6	9.5	7.2	9.2	9.1	3.5
Sex, men	51.8	41.9	59.2	40.1	58.8	38.2	45.3	66.4
Region of residence								
Flanders	59.2	58.0	59.2	58.6	61.1	56.4	58.1	62.6
Brussels	8.7	10.3	8.7	9.6	8.7	9.7	9.5	7.5
Wallonia	32.0	31.7	32.1	31.8	30.2	33.9	32.4	29.9
Nationality								
Belgians	90.9	89.0	92.0	88.9	92.8	87.6	90.4	90.0
Non-Belgian Europeans	5.6	7.3	6.1	6.1	5.3	6.9	6.0	6.2
Non-Europeans	3.6	3.7	2.0	5.0	1.9	5.5	3.6	3.7
Education level								
Low	16.9	16.8	18.6	15.3	11.7	22.5	18.6	8.2
Intermediate	33.9	26.4	36.1	28.0	28.3	35.7	32.2	30.0
High	49.2	56.9	45.2	56.7	60.0	41.9	49.2	61.7
Income level								
Quintile 1	11.4	9.9	12.7	9.5	8.5	13.6	12.0	6.2
Quintile 2	15.0	14.7	14.5	15.3	12.3	17.7	15.6	11.5
Quintile 3	18.6	19.7	18.8	19.1	17.6	20.3	19.8	14.8
Quintile 4	27.0	24.7	27.7	25.2	27.1	25.7	26.6	25.3
Quintile 5	27.9	31.1	26.3	30.9	34.5	22.7	26.0	42.1
Behavioral risks								
Dietary risks								
No daily fruits	60.3	0.0	48.4	38.7	44.4	42.0	44.5	37.3
No daily vegetables	31.0	0.0	22.9	21.6	19.8	24.8	23.0	18.5
Daily snacking	48.4	0.0	36.5	33.1	35.5	33.8	34.2	37.1
Daily SSBs	26.2	0.0	22.8	15.3	15.9	21.9	19.2	16.7
4 dietary risks present	2.2	0.0	2.3	0.9	1.4	1.8	1.6	1.4
3 out of 4	12.8	0.0	11.7	7.0	8.2	10.3	9.4	8.2
2 out of 4	33.8	0.0	25.5	23.0	23.2	25.3	25.0	20.2
1 out of 4	51.2	0.0	35.5	37.8	39.0	34.2	36.2	39.2
No dietary risks	0.0	100.0	25.0	31.2	28.2	28.5	27.8	31.1
Smoking								
Heavy	6.8	2.3	12.0	0.0	6.4	4.7	5.9	4.0
Occasional/light	16.8	10.4	32.2	0.0	16.9	12.8	15.4	13.1
Quit < 10yrs ago	8.9	8.9	19.2	0.0	9.2	8.6	8.6	10.6
Quit ≥ 10yrs ago	16.1	19.5	36.7	0.0	21.4	12.2	16.8	18.1
Never smoked	51.4	58.9	0.0	100.0	46.1	61.7	53.4	54.2
Alcohol consumption								

≥ 22 servings/week	5.6	3.3	8.2	2.2	9.5	0.0	4.9	5.3
15-21 servings/week	5.3	4.8	7.1	3.5	9.9	0.0	4.9	6.7
8-14 servings/week	12.3	12.0	15.7	9.2	23.4	0.0	11.4	16.3
1-7 servings/week	29.1	31.8	29.6	30.1	57.1	0.0	29.2	32.9
Abstainer/occasional	47.6	48.1	39.3	55.1	0.0	100.0	49.6	38.8
Physical inactivity								
Sedentary	31.2	21.8	31.1	26.3	22.1	35.5	34.5	0.0
Sport<4hrs/light	52.1	59.1	51.8	56.1	57.5	50.4	65.5	0.0
Sport≥4hrs/intensive	16.7	19.1	17.1	17.6	20.4	14.1	0.0	100.0
Metabolic risks								
Overweight, BMI≥25kg/m^2	52.9	50.8	54.6	50.4	50.6	54.2	54.7	41.1
Obesity, BMI≥30kg/m^2	17.9	16.5	18.1	16.9	15.3	19.9	19.2	9.4
High blood pressure	18.3	24.4	21.5	18.8	19.4	20.7	21.6	12.5
High cholesterol	20.3	23.9	25.2	18.0	22.6	19.9	23.1	12.7
NCD prevalence								
Type 2 diabetes	5.2	10.1	7.6	5.7	4.8	8.5	7.6	1.6
Cardiovascular disease	4.8	6.7	6.6	4.2	4.9	5.7	6.0	2.2
Cancer	2.4	2.7	3.1	2.0	2.2	2.8	2.5	2.3
Asthma	5.8	4.5	5.7	5.2	5.3	5.6	5.6	4.7
Chronic bronchitis, COPD, emphysema	4.0	4.7	6.1	2.6	3.4	5.1	4.6	2.4

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease; SSB, sugar-sweetened beverages

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being inactive or lightly active.

Supplementary Table 6 Relative health disparities by engagement in individiual lifestyle risks [a], independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios [b]

	Diet		Smoking		Alcohol		Physical inactivity	
	At least one vs none dietary risks		Current/former vs never		Frequent vs abstainer/occasional		in-/light active vs very active	
	2013	2018	2013	2018	2013	2018	2013	2018
Metabolic risks								
BMI≥25kg/m^2	1.01 (0.93; 1.11)	1.05 (0.98; 1.13)	0.91 (0.85; 0.99)	1.01 (0.94; 1.08)	0.87 (0.80; 0.94)	0.87 (0.81; 0.93)	1.42 (1.25; 1.63)	1.32 (1.18; 1.47)
BMI≥30kg/m^2	1.04 (0.84; 1.30)	1.14 (0.97; 1.35)	1.04 (0.85; 1.27)	1.03 (0.88; 1.20)	0.68 (0.55; 0.84)	0.73 (0.62; 0.85)	2.43 (1.60; 3.68)	1.87 (1.40; 2.48)
High BP	0.82 (0.69; 0.97)	0.88 (0.78; 1.01)	1.01 (0.85; 1.19)	1.07 (0.94; 1.22)	0.97 (0.82; 1.15)	0.87 (0.77; 0.98)	1.20 (0.89; 1.60)	1.41 (1.11; 1.81)
High cholesterol	0.84 (0.72; 0.99)	0.96 (0.84; 1.09)	1.11 (0.95; 1.30)	1.30 (1.14; 1.48)	0.99 (0.84; 1.16)	1.02 (0.90; 1.16)	1.10 (0.84; 1.44)	1.55 (1.25; 1.91)
NCD prevalence								
T2DM	0.54 (0.39; 0.76)	0.59 (0.47; 0.75)	1.02 (0.72; 1.43)	1.27 (0.98; 1.65)	0.49 (0.36; 0.68)	0.50 (0.39; 0.65)	1.62 (0.79; 3.29)	3.81 (2.19; 6.64)
CVD	0.96 (0.62; 1.49)	0.81 (0.61; 1.08)	1.63 (1.10; 2.41)	1.39(1.05; 1.84)	0.59 (0.41; 0.86)	0.73 (0.56; 0.95)	2.62 (1.23; 5.55)	2.12(1.31; 3.42)
Cancer	1.37 (0.74; 2.55)	0.98 (0.59; 1.64)	0.97 (0.54; 1.73)	1.77 (1.10; 2.85)	0.64 (0.36; 1.12)	0.79 (0.51; 1.22)	1.26 (0.58; 2.73)	0.80 (0.44; 1.45)
Asthma	1.14 (0.75; 1.72)	1.39 (1.01; 1.92)	0.91 (0.63; 1.32)	1.11 (0.85; 1.45)	0.68 (0.45; 1.02)	0.99 (0.75; 1.30)	1.05 (0.57; 1.93)	1.11 (0.72; 1.71)
Chronic bronchitis, COPD, emphysema	1.02 (0.66; 1.58)	0.90 (0.62; 1.30)	2.40(1.65; 3.49)	2.4 (1.80; 3.43)	0.79 (0.53; 1.17)	0.57 (0.41; 0.77)	3.12 (1.40; 6.98)	1.43(0.85; 2.41)

Abbreviations: BMI, body mass index; BP, blood pressure; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; T2DM, type 2 diabetes mellitus

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being inactive or lightly active. [b] Adjusted for age, sex and the other lifestyle risks.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-8*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	8-9
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8-9
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	If applicable, see footnote of tables
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	If applicable, see footnote of tables

Outcome data	15*	Report numbers of outcome events or summary measures	Tables
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Age-standardised results for meaningful comparison over the years
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Sup Tab 3 absolute risk difference
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	30

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Quantification of disparities in the distribution of lifestyle and metabolic risk factors, prevalence of non-communicable diseases and related-mortality: The Belgian Health Interview Surveys 1997-2018

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Quantification of disparities in the distribution of lifestyle and metabolic risk factors, prevalence of non-communicable diseases and related-mortality: The Belgian Health Interview Surveys 1997-2018

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ABSTRACT

OBJECTIVES Comprehensively measure the trends in health disparities by socio-demographic strata in terms of exposure to lifestyle and metabolic risks, and prevalence and mortality of non-communicable diseases (NCDs) during the last 20 years in Belgium.

DESIGN Cross-sectional analysis of periodic national-representative health interview surveys and vital statistics.

SETTING Population-based study of adult residents in Belgium between 1997-2018.

PARTICIPANTS Adults aged 25-84 years and resident in Belgium in the years 1997 (7,256 adults), 2001 (8,665), 2004 (9,054), 2008 (7,343), 2013 (7,704), and 2018 (8,358).

MAIN OUTCOME MEASURE Age-standardised prevalence rates of modifiable lifestyle risks (poor diet, smoking, excessive alcohol use and leisure-time physical inactivity), metabolic risks (high body mass index (BMI), blood pressure and cholesterol levels), and major NCDs (type 2 diabetes (T2DM), cardiovascular diseases (CVD), cancer, asthma and chronic obstructive pulmonary disease (COPD)), with their relative health disparities across strata by age, sex, region of residence, nationality, education and income level, and according to high versus low engagement in the four lifestyle risks, calculated from a survey-weighted age-adjusted logistic regression.

RESULTS Greater avoidable disparities were observed between extremes of education and income strata. The most marked disparities were found for exposure to lifestyle risks, except excessive alcohol use, prevalence of high BMI as well as T2DM, asthma and COPD, with disparities of daily smoking and COPD worsening over time. Still, NCD-specific mortality rates were significantly higher among men (except asthma), residents of Wallonia and Brussels (except cerebrovascular disease), and among the native Belgians (except T2DM and asthma). High engagement in lifestyle risks was generally observed for men, residents of the region Wallonia, and among lower education and income strata. This subgroup (20%) had a worse health profile as compared with those who had a low-risk lifestyle (25%), shown by prevalence ratios varying between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD, asthma and COPD.

CONCLUSIONS Improving population health, including promoting greater health equity, requires approaches to be tailored to high-risk groups with actions tackling driving root causes of disparities seen by social factors and unhealthy lifestyle.

KEYWORDS

Lifestyle risks –metabolic risk factors – overweight – type 2 diabetes – cardiovascular disease – socio-demographic factors – disparities

ARTICLE SUMMARY

Strengths and limitations of this study

- The identification of the lower education and lower income groups as vulnerable within the Belgian population and the quantification of their health disparity gaps according to their root causes is essential to support equitable health promotion programmes and preventive strategies aiming at more health gains for all.
- We used data of the Belgian Health Interview Surveys, the best available nationally relevant epidemiological evidence from Belgium over the last 20 years, to study disparities in health from lifestyle and metabolic risks to non-communicable disease outcomes.
- From the socio-demographic sources of health disparities, only ageing, an inevitable part of life, poses an unavoidable risk factor for non-communicable diseases, and therefore equitable health policies for Belgium should account for the general profile of the high-risk groups, as identified by this study i.e. residents with a non-Belgian origin, and the lower education and lower income groups.
- The self-reported lifestyle, metabolic risks and prevalence of common non-communicable diseases were likely to be underestimates; as reporting of them is subjected to more than only their actual presence.
- The cross-sectional survey design cannot rule out the possibility of 'reverse causation' where those with prevalent non-communicable disease did show to have less lifestyle risks.

INTRODUCTION

Chronic non-communicable diseases (NCDs), including type 2 diabetes mellitus (T2DM), cardiovascular diseases (CVD), cancer, and respiratory diseases, are the leading causes of morbidity and mortality in Europe with over 90% of all deaths attributed to NCDs, and 86% in Belgium.[1] The onset of NCDs is primarily driven by four major lifestyle risks: unhealthy diets, tobacco use, alcohol use and physical inactivity, all of which are modifiable.[2] These lifestyle risks are the main cause of the rising prevalence of metabolic risks such as high body mass index (BMI), high blood pressure, hyperglycaemia, and hypercholesterolemia leading to the onset of NCDs and a major population health burden.[2]

Monitoring risks and disease prevalence in the population is essential for public health planning. It is particularly relevant for identifying health disparities and less favoured population subgroups, given the urgent need to address health equity, as acknowledged by the World Health Organisation (WHO),[3,4] the European Union (EU),[4,5] and state members such as Belgium.[6,7] Variables such as age,[8] sex,[9] geographical region,[10] nationality[11,12] and socio-economic status (SES)[10,13] are well-known indicators of health disparities at the population level, as characterised in the EU.[10] In Belgium, health disparities have been consistently monitored over the years for region and educational level, with overall less prevalent NCDs risks and outcomes for residents of Flanders and the higher educated.[14,15]

While these socio-demographic risk factors are non-modifiable (*e.g.* age and sex) or difficult to change (*e.g.* SES), other risk factors, such as lifestyle choices and associated metabolic conditions, offer an additional opportunity for NCD risk stratification. Such a risk stratification assessment is likely to be the most effective in primary care settings either using risk charts, like WHO CVD risk charts,[16] and/or clinical knowledge,[17,18] including an emphasis on the assessment of risk factors susceptible to be improved.[19] In particular, healthier lifestyle choices prior to diagnosis have been shown to be strongly associated with a lower incidence of multi-morbidity of cardiometabolic diseases and cancer,[20] implying that lifestyle-based interventions can, when appropriately accounting for SES, indirectly address disparities in the pursuit of health equity. Lifestyle choices, however, tend to cluster, *i.e.* most individuals engage in multiple lifestyle risks: poor diet, smoking, excess alcohol and physical inactivity,[21] with this accumulation of lifestyle risks having strong implications for living a longer life in good health.[22,23] Defining health disparities in terms of engagement to multiple lifestyle risks offers an additional perspective into identifying high-risk stratum for priority action. The comprehensive understanding of

who is at risk and which lifestyle risks more frequently cluster would certainly support tailored health promotion programmes, aiming at more health gains.

To identify and quantify all relevant health disparities in Belgium, this study aims to provide a clear and comprehensive overview of the health status, from lifestyle risks to NCDs, by relevant population strata of socio-demographic factors as well as by engagement in multiple lifestyle risks, using nationally relevant epidemiological evidence from Belgium over the last 20 years.

METHODS

Data sources

Belgian Health Interview Surveys (BHIS)

The BHIS is a cross-sectional study, conducted by Sciensano, carried out periodically every four to five years since 1997 and including approximately a sample of 10,000 participants per survey wave, representative of Belgian residents. Briefly, participants were selected from the Belgian national population register through a multistage stratified population sampling involving a geographical stratification according to the regions, and subsequently, a selection of municipalities within provinces, households within municipalities, and a maximum of four respondents within households was applied. Data were collected through face-to-face interview at the participant's home covering demographics, specific diseases and conditions, and nutritional status, and a self-administered questionnaire covering more sensitive topics, such as health behaviours and lifestyle. Survey weights were designed and applied to ensure the representativeness of the sample in terms of age, sex and province. Further details on the BHIS are described elsewhere.[24-26] The BHIS was authorised by an independent administrative authority protecting privacy and personal data, and was approved by the ethical committee of Ghent University Hospital. The pseudonymised data from Sciensano was shared with the Institute of Tropical Medicine (ITM) Antwerp through a secure data transfer platform applying data encryption. Ethical clearance for the present analyses was obtained from the Institutional Review Board of ITM after revision of the research protocol num. 1366/20, 23/03/2020.

The present analyses included adults aged between 25 and 84 years. Participants younger than 25 years were excluded from the analysis since a large proportion achieved their highest educational level by the age of 25, and aged 85 years and older since a large proportion of them are institutionalised

and the surveys did not include these people. The final sample included 7,256 adults in the year 1997, 8,665 in 2001, 9,054 in 2004, 7,343 in 2008, 7,704 in 2013 and 8,358 in 2018.

Standardised Procedures for Mortality Analysis (SPMA)

SPMA, operational since the early 1990s, was developed by Sciensano with the aim to facilitate the use of vital statistics data for public health policy and scientific research.[27] From 1998 up to 2017, cause-specific mortality data were coded by the ICD-10 using the initial cause of death only, and grouped by age, sex, region of residence and nationality. Data from 1998 was used as a proxy for the year 1997 so that cause-specific mortality could be coded using ICD-10 for all years included in the analyses, and similarly, data from 2017 as a proxy for the year 2018.

Patient and Public involvement

As a secondary data analysis of the BHIS, this study did not involve patients/participants or the public in the design, conduct or dissemination plans.

Health outcomes measures

Lifestyle risks

Data on dietary habits, smoking status, alcohol consumption, and physical activity were self-reported in the BHIS. Consumption of fruits (excluding juice) and vegetables (including salad, and excluding potatoes or juice) was assessed based on questions related to their daily intake. A non-daily consumer was defined as a participant reporting, at the time of the interview, a frequency of 4-6 times a week or less. Similarly, daily consumption of sweet or salty snacks and sugar-sweetened beverages (SSBs) was assessed based on a consumption frequency of one serving or more a day. Current smoking was defined as smoking at least 100 cigarettes in lifetime and currently a daily smoker. Alcohol consumption was assessed based on questions related to consumption frequency and the average number of drinks across weekdays and during weekends, and excess was defined as drinking more than 15 and 22 servings per week for women and men, respectively, following WHO indicators. For physical inactivity, a dichotomous categorical variable was created to differentiate between having sufficient physical activity and being at risk of physical inactivity during leisure time based on a description of the leisure time activities: hard training and competitive sports more than once week,

jogging and other recreational sports or gardening at least four hours a week; jogging and other recreational sports or gardening at most four hours a week; walking, bicycling or other light activities at least four hours a week; walking, bicycling or other light activities at most four hours a week; or reading, watching TV or other sedentary activities, following WHO indicators.

Clustering of the lifestyle risks was summarised as a composite index (Supplementary Table 1). Each lifestyle risk factor was scored from 1 to 5, with higher points indicating the highest risk, as follows: Dietary risks (non-daily fruit , non-daily vegetables, daily snacks and daily SSBs, four present = 5, three = 4, two = 3, one = 2, none = 1); Smoking (current heavy smoker = 5, current non-heavy/occasional smoker = 4, former smoker quitting < 10 years ago = 3, former smoker quitting ≥ 10 years ago = 2, never smoked = 1); Alcohol consumption (≥ 22 servings a week = 5, 15-21 = 4, 8-14 = 3, 1-7 = 2, occasional drinkers/abstainers = 1); Physical inactivity (sedentary activities = 5, leisure time sport < 4 hour a week or light activities = 3, intensive training or leisure time sport ≥ 4 hours a week = 1). The index ranged from 4 to 20, and was for the analyses further categorised into high engagement (12-20) versus low (4-7). Lifestyle risk index was calculated for the years 2013 and 2018, as dietary data were not available for previous years.

Metabolic risks

BMI was calculated as self-reported body weight divided by self-reported body height squared, using BMI ≥ 25 kg/m^2 for overweight and ≥ 30 kg/m^2 for obesity. Information on prevalent high blood pressure (systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg) and high cholesterol levels (total cholesterol ≥ 190 mg/dl) was self-reported by providing participants with a list of clinical conditions for which they had to specify whether they had each clinical condition in the past 12 months.

Prevalence of NCDs

Similarly, data on the prevalence of NCDs were self-reported collected using a list of chronic diseases for which participants had to specify whether they had each chronic disease in the past 12 months. This study reported on the prevalence of T2DM (ICD-10: E11), myocardial infarction (MI) (ICD-10: I21-I22), coronary artery disease (ICD-10: I20), cerebrovascular disease (ICD-10: I60-I69), other serious heart diseases (ICD-10: I30-I52), cancer (ICD-10: C00-D49), asthma (ICD-10: J45-J46) and chronic bronchitis/chronic obstructive pulmonary disease (COPD) or emphysema (ICD-10: J40-44, J47).

NCDs-specific mortality

Using the pre-defined procedures accessible from SPMA, age-standardised mortality rates per 100,000 were retrieved using ICD-10 codes for T2DM (E10-E14), coronary artery disease (I20-I25), cerebrovascular disease (I60-I69), cancer (C00-D48), asthma (J45-J46) and chronic lower respiratory diseases (J40-J44, J47) were obtained with comparisons made by sex, region and nationality.

Population stratification

To describe potential health disparities across the Belgian population, the following socio-demographic determinants of health were selected: 10-year age group, sex, region of residence, nationality, education and income. Educational level was based on the highest level of education attained in the household and was recoded into three categories: low (primary education or less), intermediate (lower and higher secondary education), and high (higher education). Income level was based on the household's total available income and recoded into five quintiles. Additionally, the population was further stratified by lifestyle risk index: high versus low engagement in lifestyle risks, as an additional layer of potential health disparities.

Data analyses

Annual descriptive statistics were represented as weighted proportions of the characteristics of the survey participants as a whole per survey year. Age-standardised prevalence rates were computed by levels of the population stratification variables using direct standardisation with the Belgian population of 2018 used as reference. Health disparities were calculated by direct comparison between population strata: age (oldest, *i.e.* aged 75-84 years, vs youngest, *i.e.* aged 25-34 years, group), sex (women vs men), region (Walloon vs Flanders, Brussels vs Flanders), nationality (non-Belgian Europeans vs Belgians, non-Europeans vs Belgians), educational level (low vs high), income (low vs high), and engagement in lifestyle risks (high vs low). The disparities by age for metabolic risk and NCD prevalence were mainly included to assess their time-trends, *i.e.* narrowing disparities over time would suggest their onset occurred at a sooner age than before.

Health disparities were reported as prevalence ratios (PR),widely known as relative risks (RR), between the age-standardised prevalence between two levels of the population stratification variables;

with the estimated PRs and their uncertainty (95% confidence intervals (CI)) calculated using a survey-weighted logistic regression model, and adjusting for age and using the STATA postestimation command adjrr.[28] The 20-year trend was tested by including an interaction term between time and the population stratification variable in the models, and *p*-values for this interaction term were reported. We only analysed outcomes for which at least 20 survey participants in any specific strata reported having the outcome of interest. Additionally, we measured health disparities by socio-demographic factors in absolute terms, using prevalence differences, commonly known as risk differences (RD), between two levels of the population stratification variables. To explore the role of individual lifestyle risks, independently of others, relative health disparities were estimated for having that lifestyle risk versus not (reference).

Clustering of lifestyle risks was described using Spearman's rank correlation coefficients (P) with *p*-values adjusted for multiple testing according to Sidak. Such clustering was quantified using prevalence odds ratios, as estimated from a survey-weighted generalised ordered logistic regression model using the gologit2 command in STATA with the autofit function that identifies the partial proportional odds model that appropriately fits the data[29], with separate models for each lifestyle risk related to the other risks. To enhance interpretation of results, we only presented prevalence odds ratios and their 95% CI for the extremes, *i.e.* estimates belonging to the comparisons between a score of 5 (high engagement in a lifestyle risk) versus 1 (low; reference), for having a higher score than 1 on the lifestyle risk of interest.

All analyses were conducted using STATA/SE 16, and a *p*-value of 0.05 was considered as statistically significant with no adjustment for multiple comparisons for quantification of health disparities.

RESULTS

An overview of the general characteristics of the study population across the six available surveys is presented in TABLE 1, including prevalence estimates for the lifestyle and metabolic risks, chronic diseases and NCD-specific mortality.

Relative health disparities by socio-demographic population strata

For all population strata, the relative health disparities were generally more pronounced for lifestyle risks and NCDs (FIGURE 1; and Supplementary Tables 2).

Exposure to lifestyle risks was observed to be generally higher in young adults and among men (except for daily snacking and leisure-time physical inactivity), residents of Wallonia compared to those of Flanders (except for daily snacking), Belgian nationals (except for non-daily vegetables and leisure-time physical inactivity), the lower education and the lower income group (except for daily snacking and excessive alcohol use). Relative disparities in lifestyle risks were the largest for daily smoking by age (PR: 0.22, 95%CI: 0.13, 0.36), educational level (PR: 2.7 1, 95%CI: 2.22, 3.32) and income level (PR: 2.96, 95%CI: 2.29, 3.81) as well as for non-daily vegetables by educational level (PR: 2.03, 95%CI: 1.76, 2.35) and income level (PR: 2.72, 95%CI: 2.20, 3.36). Over time, the health disadvantages in lifestyle risks were increasing for the lower education and lower income groups for daily smoking (Figure 2A).

Moreover, the prevalence of overweight and obesity was observed to be significantly higher with advanced age groups, among men (only overweight), among residents of Wallonia, non-European residents, and the lower education and lower income groups, with significantly increasing disparities for the non-Europeans reaching a prevalence ratio of 1.18 (95%CI: 1.06, 1.31) for overweight in 2018 (Figure 2B). Disparities were the largest for obesity by educational level (PR: 1.81, 95%CI: 1.52, 2.14), followed by income level (PR: 1.65, 95%CI: 1.27, 2.14) and age (PR: 1.64, 95%CI: 1.19, 2.25) as well as nationality (PR for non-Europeans: 1.36, 95%CI: 1.03, 1.77). A significantly higher prevalence of the metabolic risks of high blood pressure and high cholesterol levels was observed for advanced age, men (only cholesterol levels), and the lower education and lower income groups, presenting for the low income groups an increase in the relative disparities of high blood pressure up to a prevalence ratio of 1.48 (95%CI: 1.19, 1.84) in 2018 (Figure 2B).

The NCD prevalence was significantly higher with advanced age, among men (except for cancer, asthma, chronic bronchitis, COPD or emphysema), among residents of Wallonia and Brussels (except for CVD and cancer), among the low educated (except for CVD and cancer), and the lower income groups (except for CVD), with over 20 years' time reducing disparities in age for asthma and in Brussels for cancer, but worsening disparities by income levels for chronic bronchitis, COPD or emphysema (Figure 2C). Relative disparities in NCD prevalence were the largest for T2DM by nationality (PR for non-Europeans: 2.20, 95%CI: 1.51, 3.22) and by income (PR: 2.11, 95%CI: 1.36, 3.27) as well as for chronic bronchitis, COPD and emphysema.

The NCD-specific mortality rates were significantly higher among men (except for asthma), residents of Wallonia and Brussels as compared to those of Flanders (except for cerebrovascular disease), and among the native Belgians (except for T2DM and asthma).

Absolute health disparities by socio-demographic population strata

Measuring this on an absolute scale did not alter conclusions (Supplementary Tables 3). Similarly, when using absolute differences, health disparities were the most pronounced for age, education and income strata, with the highest disparities seen for lifestyle and metabolic risks, but not for prevalent NCDs related to their low prevalence in the general population. In particular, absolute disparities in lifestyle risks were the largest for dietary risks by age (RD non-daily fruit: -25%, 95%CI: -31, -19; RD daily SSBs: -20%, 95%CI: -25, 16), by income (RD non-daily vegetables: 24%, 95%CI: 19, 29) as well as for leisure-time physical inactivity by age (RD: 22%, 95%CI: 15, 28), by education (22%, 95%CI: 17, 26) and income (22%, 95%CI: 16, 28) and for daily smoking by income (RD: 21%, 95%CI: 16, 28). Moreover, large absolute disparities for overweight were observed for age (RD: 21%, 95%CI: 15, 27), sex (RD: -14%, 95%CI: -17, -11), nationality (RD for non-Europeans: 9.2%, 95%CI: 3, 16), educational level (RD: 17%, 95%CI: 13, 21), and income level (RD: 11%, 95%CI: 6, 17), while lower than 5% for other metabolic risks and NCD prevalence, except for income groups (RD high blood pressure 8.1%, 95%CI: 3.4, 13; RD high cholesterol: 7.0, 95%CI: 2.3, 12; chronic bronchitis, COPD or emphysema: 9.1%, 95%CI: 6.2, 12) and for non-European and diabetes (RD: 7.5%, 95%CI: 2.5, 13).

Clustering of lifestyle risks

One-fifth was engaged in multiple lifestyle risks of poor diet, smoking, excessive alcohol use and physical inactivity, while one-fourth reported an overall healthy lifestyle (Supplementary Table 4). High engagement in multiple lifestyle risks was most frequent among men (65%), residents of Wallonia (37%), the lower education (62%) and the lower income strata (17%) with their multiple risks mainly characterised by non-daily intakes of fruit (76%), daily snacking (43%), current smoking (69%) and physical inactivity (61%), but no distinct pattern of alcohol consumption.

Belgian residents with at least one dietary risk were slightly more likely to be physically inactive, heavy smokers, and heavy drinkers, with former or current smokers also more likely to be heavy drinkers and physically inactive, but heavy drinkers less likely to be physically inactive (Supplementary Table 5).

The odds of having at least one dietary risk was higher for heavy smokers (OR 3.17; 95%CI 2.54, 3.95; TABLE 2), and for the physically inactive (OR 1.45; 95%CI: 1.24, 1.69). Similarly, the odds of being a former or current smoker was higher when having four dietary risks (OR 2.84; 95%CI: 1.87, 4.25), for heavy drinkers (OR 4.75; 95%CI: 3.61, 6.25), and for the physically inactive (OR 1.39; 95%CI: 1.18, 1.64). The odds of being a frequent (at least weekly) drinker was only higher for heavy smokers (OR 2.45, 95%CI: 1.95, 3.08). Lastly, the odds of being at most light physically active was higher for heavy smokers (OR 2.17; 95%CI: 1.73, 2.72), but lower for heavy drinkers (OR 0.60; 95%CI 0.46, 0.78).

The prevalence of metabolic risks and NCDs were higher among individuals with high engagement in multiple lifestyle risks (TABLE 3). In 2018, relative disparities were significantly varying between 1.13 (95%CI: 1.02, 1.25) and 1.56 (95%CI: 1.29, 1.87) for metabolic risks, and between 1.75 (95%CI: 1.12, 2.72) and 3.69 (95%CI: 2.18, 6.28) for CVD, asthma and COPD, with only high cholesterol levels significantly higher in 2018 than in 2013. Focussing on individual lifestyle risks, the prevalence of high BMI, T2DM, and CVD was more frequently reported for abstainers/occasional drinkers and the non-physically active, independently of age, sex and other lifestyle risks, with the prevalence of T2DM also more frequently reported when having none dietary risks, and of CVD and COPD more frequently for former and current smokers (Supplementary Table 6).

DISCUSSION

Using nationally representative data of Belgium, we identified the population strata where health disparities are present, and we traced the evolution of these disparities over 20 years. Older age, lower education, and lower income strata were the most affected by unfavourable health. For the latter two strata, we also observed a greater prevalence of engagement in multiple lifestyle risks, with their disparities worsening over time. Multiple lifestyle risks were also more prevalent in men, and the region of Wallonia. Still, NCD-specific mortality rates were significantly higher among men (except for asthma), residents of Wallonia, and Brussels (except for cerebrovascular disease), and among native Belgians (except for T2DM and asthma).

The socio-economic distribution of health as reported in this study corroborates earlier surveillance findings from western countries, including Belgium,[14,15] as operationalised by highest educational attainment. The inverse education-health gradients are a long-lasting universal phenomenon in Europe with widening disparities for common chronic diseases,[30] self-assessed

health,[31] and mortality[32]. Following earlier observations,[33] results of the present study also confirmed that at present engagement in lifestyle risks remained more frequent for the low educated, and because of the mediating role of health illiteracy, *i.e.* insufficient knowledge, motivation and competence to make appropriate health decisions, likely to persist.[34,35] Using education as a single indicator of socio-economic position at the individual level, however, captures only the knowledge-related assets of the socio-economic stratification, disregarding the full understanding of the existing health disparities by ranks in a society.[36] In our study, health disparities by education resemble well those by income, though slightly more pronounced for income. This suggests that both the social and financial resources provided by education and income, respectively, play a key role in a healthy lifestyle, and thereby delaying the onset of metabolic conditions and NCDs.

We used the most simple absolute and relative measures of disparities in health to illustrate the existing disparities in Belgium, and in this way avoid the value-laden of an arbitrary choice. Our findings might be limited by participants' self-reporting. Reporting risks and diseases is subjected to not only the actual presence of it, but also participant-related characteristics like health knowledge, ability to recall, willingness to report, and in case of health problem, frequency of contact with physician and disadvantages experienced in everyday life. This shortcoming of self-reports has been acknowledged by the first Belgian Health Examination Survey (BELHES), conducted for the first time by Sciensano in 2018.[37] Early findings of the BELHES showed that one-third of the population suffers from high blood pressure, half from high cholesterol levels and one-tenth from T2DM, while according to the self-reports only 15%, 20% and 6%, respectively.[38] This potential bias might differentially affect our population strata, with a misclassification likely to occur to a larger extent in the most disadvantaged group, leading to an underestimation of the true disparity. Besides, our findings provide a general profile of the high-risk groups, and therefore cannot be directly extrapolated to all individuals belonging to certain strata, for example within the low educated prevalence of risks and outcomes might differ not only by age group and sex[30], but also by background psychosocial factors, such as marital status, household composition, social support and job strain, that may operate in the pathway between socio-demographic factors and NCD outcomes.[39] Furthermore, the present study could not address the differential mortality by SES indicators because of the impossibility of individual linkage of census data with the most recent BHIS, as previously done.[40]

In cross-sectional studies, there is a potential bias for reverse causality bias, potentially explaining our contra-intuitive finding of a higher reported T2DM prevalence when having none dietary risks and being abstainers/occasional drinker, since among those with T2DM around 60% of them followed a diet for this condition, as also inquired by the BHIS. While excessive alcohol use (*i.e.* drinking very high amounts of alcohol weekly) is a well-recognised risk factor for NCDs, the light-to-moderate levels of alcohol consumption remain controversial.[41] In fact, zero consumption is nowadays ever more regarded as the consumption amount fitting a healthy lifestyle, since estimated protective effects for some health conditions at low levels are outweighed by increased risks of other health-related harms, including cancer.[42]

Our study implies that over a wide range of risk and health indicators important population strata to target are the elderly, the low educated, the low income strata, and the immigrants, of which only the former is an unfortunately unavoidable disparity difficult to argue to be unjust.[43] Narrowing the disparities by socio-economic position and nationality should be the focus of health policy programmes, likely with interventions based on the principles of proportionate universalism,[44] *i.e.* a universal action with a targeted intervention component tailored to tackle the driving root causes either simultaneously or sequentially, with due consideration to the upstream determinants of health that may lie outside the health sector (e.g. illiteracy, unemployment, the barrier to healthcare consumption).[45]

CONCLUSION

In conclusion, health status is not only a product of individual choice but also related to the population strata where a person belongs to, with this defined particularly by the socio-demographic factors influencing lifestyle. In addition, the tendency of lifestyle risks to cluster strengthens the need for health promotion programmes that tailor multiple targets and aim at reaching the socio-economic disadvantaged for narrowing health disparities.

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TABLES & FIGURES

TABLE 1 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to survey year.

	Year of the survey						
	1997	**2001**	**2004**	**2008**	**2013**	**2018**	*p*-trend[a]
Number of individuals	7,256	8,665	9,054	7,343	7,704	8,358	
	(%)	(%)	(%)	(%)	(%)	(%)	
Socio-demographic factors							
Age groups							<0.001
25-34 years	26.1	20.6	19.8	18.8	18.5	19.1	
35-44 years	21.0	19.5	19.1	18.3	17.1	15.7	
45-54 years	20.1	19.4	19.6	20.2	20.4	19.2	
55-64 years	15.7	16.9	17.5	19.0	20.1	21.4	
65-74 years	12.1	14.8	15.9	13.8	14.1	15.4	
75-84 years	4.9	8.8	8.9	9.9	9.9	9.2	
Sex, men	49.7	48.4	48.3	48.2	48.8	48.6	0.236
Region of residence							0.650
Flanders	57.8	58.4	58.3	58.8	57.6	56.7	
Brussels	10.7	9.9	10.0	10.3	10.7	10.1	
Wallonia	31.6	31.7	31.7	30.9	31.7	33.2	
Nationality							<0.001
Belgians	90.8	93.2	92.0	91.4	89.4	88.6	
Non-Belgian Europeans	5.6	4.6	5.0	5.9	6.4	6.6	
Non-Europeans	3.5	2.2	2.9	2.7	4.2	4.8	
Educational level							<0.001
Low	33.7	37.2	33.5	28.8	24.1	29.1	
Intermediate	32.5	30.2	30.8	32.7	33.5	32.0	
High	33.8	32.5	35.7	38.5	42.4	48.4	
Income level							<0.001
Quintile 1	20.4	20.2	19.4	17.9	16.6	11.8	
Quintile 2	19.7	19.0	18.9	17.8	17.0	15.1	
Quintile 3	22.2	19.6	20.0	21.3	21.0	19.9	
Quintile 4	19.6	20.8	19.9	16.8	21.0	25.9	
Quintile 5	18.1	20.4	21.8	26.2	24.2	27.3	
Lifestyle risks [b]							
Dietary risks							
No daily fruits					43.9	44.1	0.810
No daily vegetables					20.4	23.2	0.004
Daily snacking					37.0	34.5	0.027
Daily SSBs					22.6	19.8	0.008
Daily smoking	25.1	23.5	23.4	20.5	19.2	16.1	<0.001
Excessive alcohol use	7.1	9.7	9.0	8.2	6.8	6.2	<0.001
Leisure time physical inactivity	35.1	36.8	28.1	29.4	28.2	29.0	<0.001
Metabolic risks [b]							
Overweight, BMI ≥ 25kg/m²	45.4	48.8	48.1	50.9	51.7	52.7	<0.001
Obesity, BMI ≥ 30kg/m²	12.1	13.6	14.2	15.1	15.2	17.4	<0.001
High blood pressure	12.9	16.7	17.8	18.6	19.2	20.5	<0.001
High cholesterol					19.1	20.2	0.334
NCD prevalence [b]							
Type 2 diabetes mellitus	3.3	4.0	5.0	4.9	6.4	6.9	<0.001

Cardiovascular diseases					4.6	5.3	0.203
Myocardial infarction				0.8	1.1	0.8	0.845
Coronary heart disease				2.4	1.5	1.3	<0.001
Heart disease					2.3	3.5	0.002
Cerebrovascular disease	0.9	0.7	0.8	1.2	1.0	0.9	0.766
Cancer	1.5	1.9	1.4	2.5	2.3	2.8	0.001
Asthma		4.8	4.4	4.3	4.5	5.7	0.071
chronic bronchitis/COPD or emphysema		6.5	6.3	4.3	4.3	4.4	<0.001
NCD-related mortality rates (per 100,000) attributed to							
Diabetes	19.3	16.7	17.1	16.4	12.8	10.6	0.024
Coronary artery disease	159.5	137.4	124.2	92.9	67.5	55.9	0.009
Cerebrovascular disease	90.0	79.2	73.4	60.5	48.1	42.8	0.009
Cancer	378	351	330	324	303	274	0.060
Asthma	4.63	3.96	2.33	1.34	1.25	0.87	0.009
Chronic bronchitis/COPD or emphysema	64.5	54.7	50.2	46.9	43.1	38.0	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease.
[a] *p*-trend calculated using the p-value of corrected weighted Pearson chi square statistic for socio-demographic factors, the p-value of the time term in a survey-weighted logistic regression for lifestyle and metabolic risks and NCD prevalence, and the p-value of Mann-Kendall trend test for NCD-related mortality rates. [b] Self-reported prevalence of lifestyle and metabolic risks and NCDs.
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TABLE 2 Clustering of lifestyle risks in the Belgian population, aged 25-84 years, in 2013 and 2018 [a].

Clustered with		Dietary risks At least one dietary risk	Smoking Former or current smoking	Excessive alcohol use At least weekly drinking	Physical inactivity At most lightly active
Diet	ρ (*p*-value)				
	No dietary risks		Reference	Reference	Reference
	Four dietary risks		2.82 (1.87; 4.25)	0.94 (0.61; 1.45)	1.08 (0.58; 2.00)
Smoking	ρ (*p*-value)	0.160 (<0.001)			
	Never smoked	Reference		Reference	Reference
	Heavy smokers	3.17 (2.54; 3.95)		2.45 (1.95; 3.08)	2.17 (1.73; 2.73)
Alcohol	ρ (*p*-value)	0.003 (0.9980)	0.189 (<0.001)		
	Abstainers/occasional	Reference	Reference		Reference
	Heavy drinkers	1.03 (0.83; 1.28)	4.75 (3.61; 6.25)		0.60 (0.46; 0.78)
Physical inactivity	ρ (*p*-value)	0.122 (<0.001)	0.071 (<0.001)	-0.128 (<0.001)	
	Very active	Reference	Reference	Reference	
	Sedentary	1.45 (1.24; 1.69)	1.39 (1.18; 1.64)	0.36 (0.30; 0.43)	

[a] Clustering described using ρ, Spearman rank correlation coefficient with *p*-value adjusted for multiple testing according to Sidak, and quantified using prevalence odds ratios with 95% confidence intervals for the extremes, *i.e.* estimates belonging to the comparisons between high engagement in a lifestyle risk versus low engagement (reference), for having a higher score than 1 on the lifestyle risk of interest.

TABLE 3 Prevalence (weighted %) of and relative disparities (age-standardised prevalence ratios) in health from metabolic risks to NCDs according to the level of engagement in multiple lifestyle risks for the Belgian population, aged 25-84 years. [a,b]

	2013		2018		Relative difference		
	High	Low	High	Low	2013	2018	*p*-change[c]
Metabolic risks							
Overweight, BMI ≥ 25	52.3	43.8	54.5	46.0	1.10 (0.97; 1.24)	1.13 (1.02; 1.25)	0.649
Obesity, BMI ≥ 30	14.4	10.6	20.2	13.2	1.36 (1.01; 1.83)	1.56 (1.22; 1.98)	0.328
High blood pressure	17.6	15.4	20.1	16.9	1.12 (0.87; 1.42)	1.29 (1.06; 1.57)	0.305
High cholesterol levels	19.3	16.7	23.8	16.3	1.11 (0.88; 1.39)	1.56 (1.29; 1.87)	0.020
NCDs							
T2DM	4.3	3.8	5.9	5.3	1.07 (0.65; 1.75)	1.22 (0.83; 1.79)	0.619
CVD	6.0	2.2	5.1	2.7	2.53 (1.39; 4.60)	1.94 (1.21; 3.12)	0.488
Cancer	1.6	1.5	2.8	1.9	1.31 (0.61; 2.81)	1.83 (0.89; 3.73)	0.468
Asthma	5.2	4.8	6.6	4.1	1.06 (0.59; 1.88)	1.75 (1.12; 2.72)	0.260
COPD	7.9	1.6	7.4	2.1	5.54 (3.03; 10.1)	3.69 (2.18; 6.28)	0.406

[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7). [b] Adjusted for age and sex. [c] The *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model.

LEGEND OF FIGURES

Figure 1 Heatmap of the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle and metabolic risks to non-communicable diseases according to socio-demographic strata in 2018 in Belgium.

Colours depicted the strength of the disparity with the more yellow representing a higher prevalence of poor health in the index group as compared to the reference group, and the more blue a higher prevalence of poor health in the reference group as compared to the index group. Empty boxes represents the non-significant estimates or the non-estimable estimates because too few cases.

Abbreviations: COPD, chronic obstructive pulmonary disease, also including chronic bronchitis, emphysema in the present analyses; CVD, cardiovascular disease; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus

Figure 2 Significant 20-year time trends in the relative health disparities, expressed in age-standardised prevalence ratios between distal groups calculated from periodic national-representative health interview surveys, from lifestyle risks to non-communicable diseases according to socio-demographic strata, from 1997 until 2018 in Belgium.

Legend: 75-84 vs 25-34 years; Women vs men; Wallonia vs Flanders; Brussels vs Flanders; Non-Belgian Europeans vs Belgians; Non-Europeans vs Belgians; Low vs high educated; Low vs high income group. Grey horizontal gridline indicate the null-value, i.e. no disparity between index and reference group.

Note: Omitted from the graphs are the significant 5-year changes in relative health disparities for diet (i.e. a widening gap for non-daily vegetables and daily snacking in the Belgians as compared to the non-Europeans, for non-daily fruits and vegetables in the low income group as compared to high income group), and for high cholesterol and cardiovascular disease (i.e. both reversing the relative disparities between Brussels and Flanders, with in 2018 higher prevalence in Flanders).

2A: Lifestyle risks
2B: Metabolic risks
2C: Non-communicable diseases

LEGEND OF SUPPLEMENTARY MATERIALS

Supplementary Table 1 Components and scoring of the lifestyle risk index [a,b].

Abbreviations: SSB, sugar-sweetened beverages

[a] Each lifestyle risk was scored from 1 to 5, with higher points indicating the highest risk. [b] The sum of the components scores resulted in lifestyle risk index range from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement).

Supplementary Tables 2 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised prevalence ratios between distal groups.

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year.

[a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2A. Age-related relative health disparities: adults aged 75-84 years versus 25-34 years (reference)
2B. Sex- related relative health disparities: women vs men (reference)
2C. Region of residence-related relative health disparities: Wallonia vs Flanders (reference)
2D. Region of residence-related relative health disparities: Brussels vs Flanders (reference)
2E. Nationality-related relative health disparities: non-Belgian Europeans vs Belgians (reference)
2F. Nationality-related relative health disparities: non-Europeans vs Belgians (reference)
2G. Education-related relative health disparities: low vs high (reference)
2H. Income-related relative health disparities: Quintile 1 vs Quintile 5 (reference)

Supplementary Tables 3 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised percentage point differences between distal groups.

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year.

[a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3A. Age-related absolute health disparities: adults aged 75-84 years versus 25-34 years (reference)

3B. Sex-related absolute health disparities: women vs men (reference)

3C. Region of residence-related absolute health disparities: Wallonia vs Flanders (reference)

3D. Region of residence-related absolute health disparities: Brussels vs Flanders (reference)

3E. Nationality-related absolute health disparities: non-Belgian Europeans vs Belgians (reference)

3F. Nationality-related absolute health disparities: non-Europeans vs Belgians (reference)

3G. Education-related absolute health disparities: low vs high (reference)

3H. Income-related absolute health disparities: Quintile 1 vs Quintile 5 (reference)

Supplementary Table 4 General characteristics and lifestyle risks (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus low)

Abbreviations: SSB, sugar-sweetened beverages .[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

Supplementary Table 5 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in the individual lifestyle risks of dietary risks, smoking, alcohol and physical inactivity, in 2018.[a]

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risks for smoking: being a current or former smoker; lifestyle risks for alcohol: being a frequent drinker (at least drinking alcohol weekly; and lifestyle risk for physical inactivity: being physically inactive or lightly active.

Supplementary Table 6 Relative health disparities by engagement in individiual lifestyle risks, independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios.[b]

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being physically inactive or lightly active. [b] Adjusted for age, sex and the other lifestyle risks.

Contributorship statement

JP and EM conceptualised and designed the study. JP and EM identified relevant data sources and retrieved data. EM performed the statistical analyses. EM, JP and DS wrote the manuscript, and all revised, read and approved the submitted version. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Competing interests declaration

Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethics approval

The consecutive Belgian Health Interview Surveys have been approved by the Privacy Commission and the Ethical Committee of Ghent University Hospital, which guarantees that the survey procedures are in line with the privacy legislation, and participants gave informed consent before taking part. The current study obtained ethics approval from the Institutional Review Board of the Institute of Tropical Medicine, Antwerp, Belgium (1366/20).

Transparency statement

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if any relevant, registered) have been explained.

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Dissemination declaration

Not applicable.

Patient and Public Involvement Statement

As a secondary data analysis of the BHIS, this study did not involve patients/participants or the public in the design, conduct or dissemination plans.

Data Sharing Statements

Data of the Health Interview Surveys, conducted by Sciensano, are not publicly available, but access to data is possible through request to the Privacy Commission. More information can be retrieved via https://his.wiv-isp.be/SitePages/Home.aspx. Also, publicly available datasets were utilized in this study: Standardised Procedures for Mortality Analysis – Belgium (SPMA), developed by Sciensano, accessible via https://spma.wiv-isp.be/SitePages/Home.aspx.

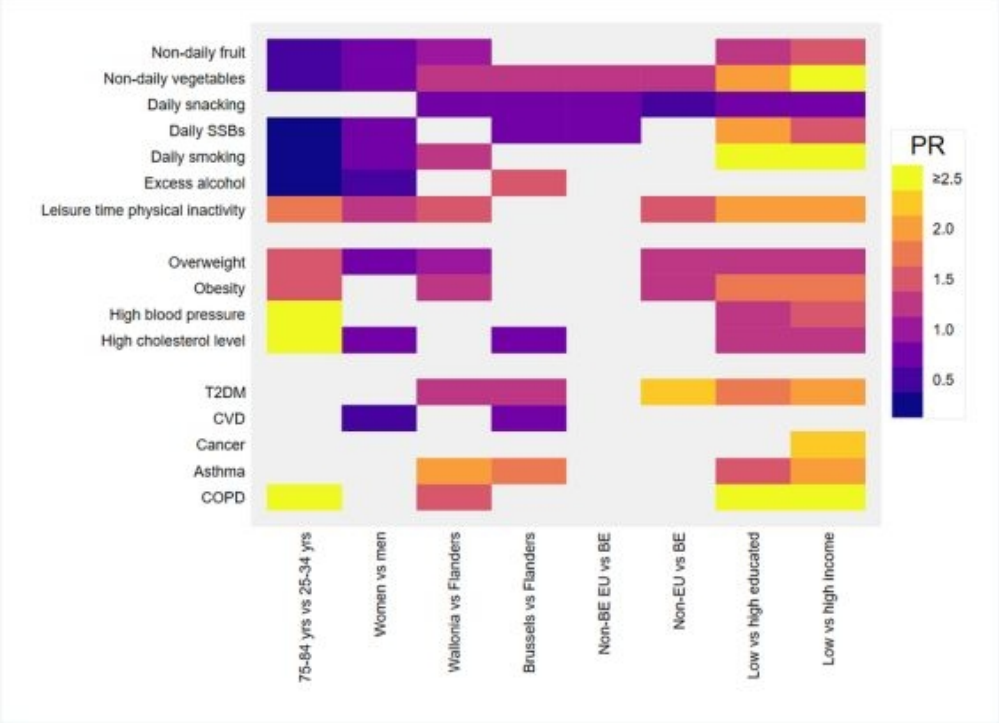

Figure 1 Heatmap of the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle and metabolic risks to non-communicable diseases according to socio-demographic strata in 2018 in Belgium.
Colours depicted the strength of the disparity with the more yellow representing a higher prevalence of poor health in the index group as compared to the reference group, and the more blue a higher prevalence of poor health in the reference group as compared to the index group. Empty boxes represents the non-significant estimates or the non-estimable estimates because too few cases.
Abbreviations: COPD, chronic obstructive pulmonary disease, also including chronic bronchitis, emphysema in the present analyses; CVD, cardiovascular disease; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus

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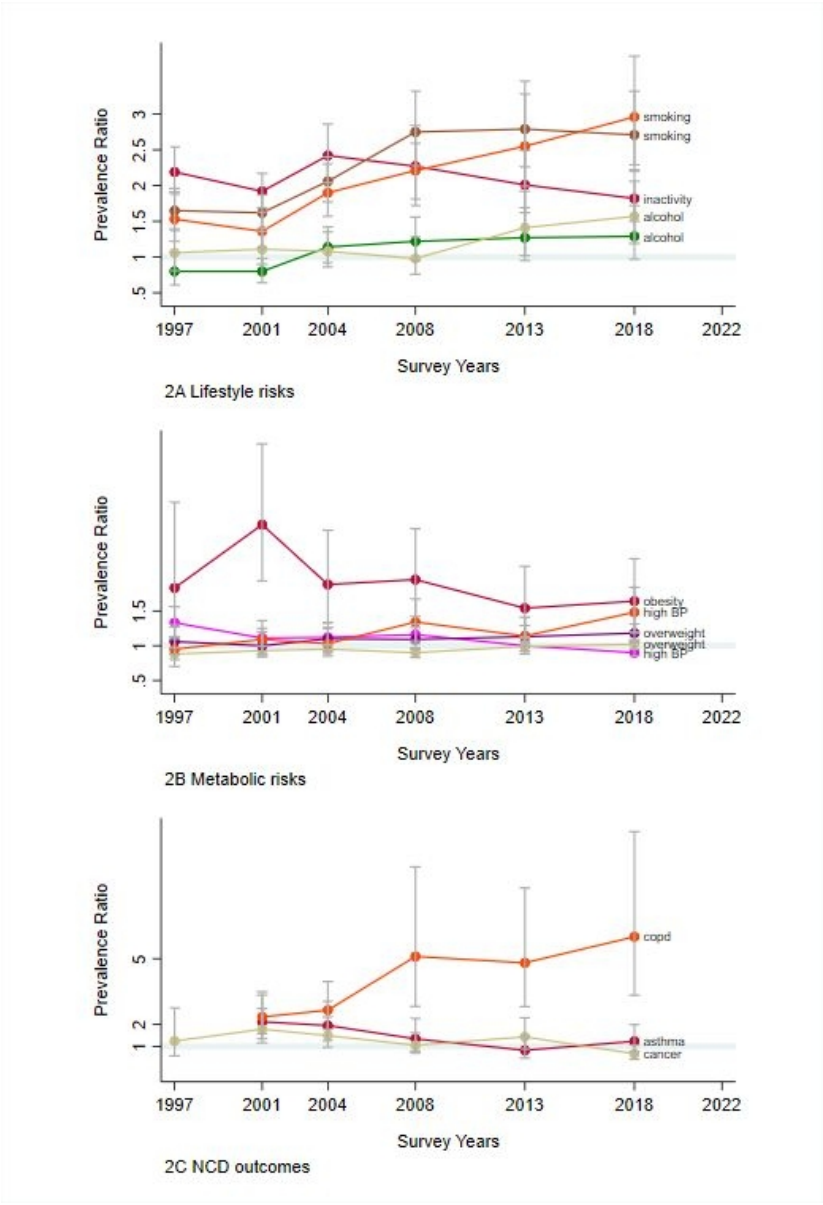

Figure 2 Significant 20-year time trends in the relative health disparities, expressed in age-standardised prevalence ratios between distal groups calculated from periodic national-representative health interview surveys, from lifestyle risks to non-communicable diseases according to socio-demographic strata, from 1997 until 2018 in Belgium.Legend: 75-84 vs 25-34 years; Women vs men; Wallonia vs Flanders; Brussels vs Flanders; Non-Belgian Europeans vs Belgians; Non-Europeans vs Belgians; Low vs high educated; Low vs high income group. Grey horizontal gridline indicate the null-value, i.e. no disparity between index and reference group. Note: Omitted from the graphs are the significant 5-year changes in relative health disparities for diet (i.e. a widening gap for non-daily vegetables and daily snacking in the Belgians as compared to the non-Europeans, for non-daily fruits and vegetables in the low income group as compared to high income group), and for high cholesterol and cardiovascular disease (i.e. both reversing the relative disparities between Brussels and Flanders, with in 2018 higher prevalence in Flanders). 2A: Lifestyle risks2B: Metabolic risks2C: Non-communicable diseases

43x64mm (300 x 300 DPI)

SUPPLEMENTARY TABLES

Supplementary Table 1 Components and scoring of the lifestyle risk index [a,b].

Lifestyle risks	Components' scoring	Points
Dietary risks	Four present	5 points
- Non-daily fruit	Three present	4 points
- Non-daily vegetables	Two present	3 points
- Daily SSBs	One present	2 points
- Daily snacking	No dietary risks	1 points
Smoking	Current heavy smoker	5 points
	Current non-heavy smoker or occasional smoker	4 points
	Former smoker quitting < 10 years ago	3 points
	Former smoker quitting ≥ 10 years ago	2 points
	Never smoked	1 points
Alcohol consumption	≥ 22 servings a week	5 points
	15-21 servings a week	4 points
	8-14 servings a week	3 points
	1-7 servings a week	2 points
	Occasional drinkers and abstainers	1 points
Physical inactivity	Sedentary activities	5 points
	Leisure time sport < 4 hours a week or light activities	3 points
	Intensive training or leisure time ≥ 4 hours a week	1 points

Abbreviations: SSB, sugar-sweetened beverages.
[a] Each lifestyle risk was scored from 1 to 5, with higher points indicating the highest risk. [b] The sum of the components scores resulted in lifestyle risk index range from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement).

Supplementary Table 2 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised prevalence ratios between distal groups

2.A Age-related relative health disparities: adults aged 75-84 years versus adults aged 25-34 years (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.64 (0.54; 0.76)	0.53 (0.45; 0.63)	0.175
Non-daily vegetables					0.69 (0.53; 0.90)	0.59 (0.46; 0.75)	0.383
Daily snacking					0.93 (0.78; 1.11)	1.10 (0.93; 1.30)	0.186
Daily SSBs					0.39 (0.29; 0.52)	0.29 (0.21; 0.40)	0.291
Daily smoking	0.25 (0.15; 0.42)	0.27 (0.19; 0.38)	0.28 (0.20; 0.40)	0.20 (0.13; 0.30)	0.36 (0.20; 0.50)	0.22 (0.13; 0.36)	0.840
Excess alcohol	0.92 (0.42; 2.01)	0.58 (0.35; 0.97)	0.69 (0.37; 1.31)	0.62 (0.36; 1.08)	0.93 (0.50; 1.73)	0.34 (0.18; 0.63)	0.075
Leisure time physical inactivity	2.19 (1.88; 2.54)	1.92 (1.69; 2.17)	2.42 (2.04; 2.86)	2.27 (1.81; 2.59)	2.01 (1.62; 2.49)	1.82 (1.50; 2.20)	0.018
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.64 (1.36; 1.97)	1.56 (1.36; 1.78)	1.83 (1.59; 2.10)	1.56 (1.36; 1.78)	1.51 (1.34; 1.76)	1.58 (1.38; 1.81)	0.894
Obesity, BMI ≥ 30 kg/m²	1.83 (1.10; 3.06)	2.74 (1.93; 3.90)	1.88 (1.33; 2.66)	1.95 (1.42; 2.68)	1.54 (1.11; 2.14)	1.64 (1.19; 2.25)	0.048
High blood pressure	9.83 (6.42; 15.1)	10.0 (7.13; 14.0)	10.8 (7.92; 14.9)	10.7 (7.70; 14.9)	17.2 (10.9; 27.1)	13.9 (8.81; 21.8)	0.072
High cholesterol levels					12.9 (8.25; 20.2)	9.14 (6.31; 13.2)	0.294
NCD prevalence							
Asthma		2.12 (1.35; 3.34)	1.95 (1.25; 3.05)	1.34 (0.79; 2.27)	0.82 (0.46; 1.45)	1.23 (0.76; 1.99)	0.017
Chronic bronchitis, COPD, emphysema		4.21 (2.66; 6.66)	4.07 (2.80; 5.92)	6.16 (3.27; 11.6)		4.99 (2.63; 9.50)	0.567

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.B Sex-related relative health disparities: women versus men (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.78 (0.72; 0.82)	0.75 (0.70; 0.79)	0.504
Non-daily vegetables					0.70 (0.63; 0.78)	0.72 (0.66; 0.79)	0.919
Daily snacking					1.00 (0.93; 1.07)	1.04 (0.96; 1.12)	0.408
Daily SSBs					0.63 (0.57; 0.70)	0.65 (0.58; 0.73)	0.592
Daily smoking	0.60 (0.54; 0.68)	0.69 (0.63; 0.76)	0.72 (0.65; 0.80)	0.76 (0.67; 0.86)	0.74 (0.65; 0.84)	0.65 (0.57; 0.75)	0.075
Excess alcohol	0.44 (0.34; 0.59)	0.54 (0.45; 0.64)	0.46 (0.38; 0.55)	0.63 (0.51; 0.78)	0.57 (0.44; 0.74)	0.56 (0.44; 0.70)	0.067
Leisure time physical inactivity	1.25 (1.15; 1.37)	1.31 (1.22; 1.40)	1.44 (1.30; 1.58)	1.26 (1.14; 1.39)	1.26 (1.12; 1.42)	1.33 (1.21; 1.46)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	0.72 (0.67; 0.78)	0.77 (0.73; 0.82)	0.74 (0.70; 0.78)	0.76 (0.72; 0.81)	0.76 (0.72; 0.81)	0.76 (0.72; 0.80)	0.729
Obesity, BMI ≥ 30 kg/m²	0.98 (0.81; 1.18)	1.07 (0.93; 1.23)	1.10 (0.96; 1.26)	1.10 (0.96; 1.26)	1.02 (0.88; 1.19)	0.90 (0.80; 1.02)	0.180
High blood pressure	1.33 (1.13; 1.56)	1.11 (0.99; 1.25)	1.12 (1.00; 1.26)	1.16 (1.03; 1.31)	1.00 (0.88; 1.13)	0.94 (0.85; 1.05)	0.003
High cholesterol levels					0.99 (0.88; 1.11)	0.85 (0.76; 0.94)	0.067
NCD prevalence							
T2DM	1.04 (0.71; 1.51)	0.89 (0.69; 1.14)	0.90 (0.72; 1.12)	0.92 (0.72; 1.18)	0.91 (0.72; 1.16)	0.89 (0.72; 1.09)	0.479
CVD					0.51 (0.39; 0.67)	0.61 (0.48; 0.78)	0.431
Myocardial infarction				0.46 (0.27; 0.78)	0.40 (0.19; 0.83)	0.48 (0.26; 0.90)	
Coronary artery disease				0.54 (0.36; 0.81)	0.48 (0.29; 0.78)	0.58 (0.33; 1.02)	
Other serious heart disease					0.45 (0.30; 0.68)	0.66 (0.49; 0.90)	
Cerebrovascular disease	1.45 (0.72; 2.94)	0.89 (0.48; 1.65)	0.98 (0.55; 1.73)	1.01 (0.59; 1.73)	0.73 (0.40; 1.31)	0.31 (0.16; 0.59)	
Cancer	1.87 (1.00; 3.47)	1.25 (0.86; 1.81)	1.96 (1.26; 3.05)	0.98 (0.64; 1.50)	1.60 (1.06; 2.41)	1.39 (0.95; 2.02)	0.535
Asthma		0.82 (0.64; 1.05)	1.18 (0.92; 1.51)	1.45 (1.09; 1.94)	1.00 (0.75; 1.32)	1.18 (0.92; 1.52)	0.247
Chronic bronchitis, COPD, emphysema		0.90 (0.74; 1.09)	0.92 (0.76; 1.12)	1.00 (0.76; 1.30)	1.15 (0.86; 1.53)	1.02 (0.78; 1.33)	0.282
NCD-specific mortality rate attributable to							
T2DM	0.96 (0.87; 1.07)	0.96 (0.86; 1.07)	1.07 (0.96; 1.19)	0.87 (0.79; 0.97)	0.79 (0.71; 0.88)	0.67 (0.60; 0.75)	0.085
Ischemic heart disease	0.51 (0.49; 0.53)	0.49 (0.47; 0.51)	0.49 (0.47; 0.52)	0.48 (0.46; 0.50)	0.45 (0.43; 0.47)	0.44 (0.42; 0.46)	0.013
Cerebrovascular disease	0.83 (0.79; 0.87)	0.84 (0.79; 0.90)	0.95 (0.89; 1.01)	0.87 (0.81; 0.93)	0.86 (0.81; 0.92)	0.90 (0.84; 0.96)	0.181
Cancer	0.51 (0.50; 0.53)	0.51 (0.50; 0.52)	0.53 (0.51; 0.54)	0.55 (0.54; 0.56)	0.58 (0.56; 0.59)	0.61 (0.59; 0.62)	0.013
Asthma	0.85 (0.67; 1.07)	1.05 (0.83; 1.34)	1.39 (1.04; 1.88)	1.47 (1.04; 2.10)	1.25 (0.89; 1.76)	1.62 (1.09; 2.39)	0.060
Chronic bronchitis, COPD, emphysema	0.27 (0.25; 0.29)	0.29 (0.27; 0.32)	0.31 (0.29; 0.34)	0.35 (0.32; 0.37)	0.43 (0.40; 0.45)	0.46 (0.43; 0.49)	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.C Region of residence-related relative health disparities: Wallonia versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.04 (0.96; 1.12)	1.14 (1.05; 1.23)	0.104
Non-daily vegetables					1.17 (1.01; 1.36)	1.29 (1.13; 1.48)	0.293
Daily snacking					1.01 (0.92; 1.10)	0.88 (0.79; 0.97)	0.060
Daily SSBs					1.11 (0.98; 1.27)	1.10 (0.95; 1.28)	0.875
Daily smoking	1.17 (1.01; 1.34)	1.15 (1.03; 1.29)	1.22 (1.08; 1.38)	1.30 (1.12; 1.50)	1.24 (1.06; 1.45)	1.38 (1.16; 1.63)	0.155
Excess alcohol	0.80 (0.61; 1.06)	0.80 (0.64; 0.98)	1.14 (0.92; 1.42)	1.22 (0.95; 1.56)	1.21 (0.95; 1.69)	1.29 (0.97; 1.72)	0.002
Leisure time physical inactivity	1.38 (1.24; 1.53)	1.42 (1.30; 1.55)	1.42 (1.28; 1.59)	1.53 (1.36; 1.72)	1.34 (1.17; 1.53)	1.57 (1.40; 1.76)	0.333
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.08 (1.00; 1.18)	1.09 (1.03; 1.16)	1.13 (1.06; 1.21)	1.05 (0.99; 1.13)	1.07 (1.00; 1.14)	1.08 (1.01; 1.15)	0.618
Obesity, BMI ≥ 30 kg/m²	1.37 (1.11; 1.69)	1.28 (1.09; 1.49)	1.34 (1.15; 1.56)	1.08 (0.93; 1.26)	1.31 (1.10; 1.53)	1.22 (1.06; 1.42)	0.287
High blood pressure	1.29 (1.07; 1.56)	1.02 (0.89; 1.18)	1.09 (0.96; 1.23)	1.13 (1.00; 1.29)	0.91 (0.79; 1.03)	1.10 (0.97; 1.23)	0.232
High cholesterol levels					0.96 (0.85; 1.10)	1.01 (0.90; 1.14)	0.658
NCD prevalence							
T2DM	1.68 (1.13; 2.48)	1.77 (1.34; 2.33)	1.47 (1.11; 1.95)	1.25 (0.94; 1.64)	1.24 (0.96; 1.61)	1.37 (1.10; 1.71)	0.126
CVD					1.22 (0.92; 1.65)	1.06 (0.82; 1.36)	0.450
Myocardial infarction				1.57 (0.87; 2.83)		1.96 (1.01; 3.83)	
Coronary artery disease				1.30 (0.85; 1.97)	1.53 (0.87; 2.67)	1.28 (0.75; 2.19)	
Other serious heart disease					0.88 (0.57; 1.24)	0.94 (0.67; 1.30)	
Cerebrovascular disease			1.74 (0.95; 3.21)	2.03 (1.09; 3.77)		1.90 (0.97; 3.75)	
Cancer	0.93 (0.47; 1.83)	1.52 (0.99; 2.35)	0.84 (0.53; 1.33)	0.98 (0.63; 1.50)	0.89 (0.57; 1.38)	0.96 (0.66; 1.39)	0.387
Asthma		1.79 (1.35; 2.38)	1.93 (1.45; 2.57)	2.01 (1.45; 2.78)	1.76 (1.29; 2.41)	1.98 (1.52; 2.58)	0.740
Chronic bronchitis, COPD, emphysema		1.62 (1.29; 2.03)	1.68 (1.35; 2.10)	1.56 (1.18; 2.07)	1.67 (1.24; 2.26)	1.63 (1.22; 2.19)	0.943
NCD-specific mortality rate attributable to							
T2DM	1.05 (0.94; 1.17)	1.44 (1.29; 1.62)	1.66 (1.48; 1.85)	1.30 (1.17; 1.45)	1.12 (1.00; 1.24)	1.37 (1.22; 1.53)	1.000
Ischemic heart disease	0.87 (0.84; 0.91)	0.97 (0.93; 1.00)	1.00 (0.96; 1.04)	1.12 (1.07; 1.17)	1.22 (1.23; 1.35)	1.29 (1.23; 1.36)	0.013
Cerebrovascular disease	0.89 (0.85; 0.93)	0.94 (0.90; 0.99)	0.89 (0.84; 0.93)	0.97 (0.92; 1.02)	0.96 (0.91; 1.01)	1.04 (0.98; 1.09)	0.085
Cancer	1.06 (1.03; 1.09)	1.06 (1.04; 1.09)	1.06 (1.04; 1.09)	1.08 (1.05; 1.11)	1.11 (1.07; 1.13)	1.11 (1.08; 1.14)	0.029
Asthma	1.30 (1.01; 1.67)	1.32 (1.02; 1.72)	2.08 (1.49; 2.91)	1.70 (1.17; 2.49)	2.18 (1.47; 3.23)	2.60 (1.66; 4.05)	0.024
Chronic bronchitis, COPD, emphysema	1.08 (1.02; 1.15)	1.14 (1.07; 1.21)	1.18 (1.10; 1.26)	1.32 (1.24; 1.41)	1.38 (1.24; 1.41)	1.23 (1.16; 1.32)	0.085

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.D Region of residence-related relative health disparities: Brussels versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.84 (0.76; 0.92)	0.93 (0.85; 1.01)	0.069
Non-daily vegetables					1.19 (1.01; 1.39)	1.34 (1.18; 1.53)	0.215
Daily snacking					0.74 (0.67; 0.83)	0.72 (0.65; 0.80)	0.641
Daily SSBs					0.79 (0.69; 0.92)	0.77 (0.66; 0.90)	0.731
Daily smoking	1.11 (0.97; 1.28)	1.13 (1.00; 1.28)	1.11 (0.96; 1.27)	1.15 (0.98; 1.35)	0.96 (0.79; 1.16)	1.14 (0.96; 1.36)	0.365
Excess alcohol	1.06 (0.81; 1.37)	1.11 (0.90; 1.36)	1.08 (0.86; 1.35)	0.98 (0.76; 1.28)	1.41 (1.02; 1.92)	1.57 (1.19; 2.06)	0.027
Leisure time physical inactivity	1.35 (1.19; 1.34)	1.27 (1.16; 1.40)	1.24 (1.10; 1.41)	1.40 (1.23; 1.59)	1.21 (1.03; 1.43)	1.28 (1.13; 1.45)	0.315
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	0.88 (0.80; 0.97)	0.93 (0.87; 1.00)	0.95 (0.89; 1.02)	0.90 (0.83; 0.97)	0.99 (0.92; 1.06)	1.02 (0.95; 1.09)	0.013
Obesity, BMI ≥ 30 kg/m²	0.96 (0.73; 1.25)	1.06 (0.89; 1.26)	1.06 (0.90; 1.24)	0.94 (0.79; 1.12)	1.10 (0.91; 1.32)	1.02 (0.88; 1.19)	0.725
High blood pressure	1.11 (0.90; 1.37)	0.97 (0.83; 1.12)	0.95 (0.84; 1.08)	1.00 (0.87; 1.15)	1.16 (1.00; 1.33)	0.92 (0.81; 1.04)	0.647
High cholesterol levels					1.19 (1.04; 1.38)	0.88 (0.77; 0.99)	0.003
NCD prevalence							
T2DM	1.36 (0.91; 2.05)	1.35 (1.00; 1.83)	1.33 (0.98; 1.79)	1.77 (1.35; 2.33)	1.60 (1.23; 2.08)	1.40 (1.13; 1.74)	0.460
CVD					1.14 (0.81; 1.59)	0.71 (0.53; 0.95)	0.030
Myocardial infarction				2.96 (1.65; 5.31)			
Coronary artery disease				1.57 (1.02; 2.42)	1.15 (0.61; 2.18)	1.42 (0.81; 2.49)	
Other serious heart disease					1.08 (0.68; 1.70)	0.54 (0.36; 0.79)	
Cerebrovascular disease			1.56 (0.84; 2.89)	3.25 (1.77; 5.99)			
Cancer	1.24 (0.56; 2.75)	1.78 (1.16; 2.73)	1.49 (0.95; 2.33)	1.05 (0.69; 1.61)	1.43 (0.88; 2.30)	0.66 (0.41; 1.05)	0.042
Asthma		1.82 (1.37; 2.41)	1.78 (1.31; 2.41)	2.06 (1.47; 2.90)	1.72 (1.18; 2.53)	1.67 (1.28; 2.17)	0.814
Chronic bronchitis, COPD, emphysema		1.59 (1.25; 2.03)	1.44 (1.13; 1.84)	1.57 (1.17; 2.10)	1.30 (0.90; 1.88)	1.26 (0.92; 1.73)	0.181
NCD-specific mortality rate attributable to							
T2DM	0.72 (0.61; 0.86)	0.85 (0.71; 1.02)	0.86 (0.71; 1.04)	1.14 (0.96; 1.36)	1.13 (0.94; 1.36)	1.13 (0.93; 1.38)	0.085
Ischemic heart disease	0.92 (0.87; 0.98)	0.94 (0.89; 1.00)	0.98 (0.92; 1.04)	1.11 (1.03; 1.19)	1.08 (0.99; 1.17)	1.12 (1.02; 1.23)	0.024
Cerebrovascular disease	0.83 (0.78; 0.89)	0.82 (0.76; 0.88)	0.93 (0.86; 1.00)	0.87 (0.80; 0.94)	0.86 (0.79; 0.93)	0.95 (0.86; 1.04)	0.260
Cancer	1.00 (0.96; 1.05)	1.03 (0.98; 1.07)	1.04 (0.99; 1.08)	1.01 (0.97; 1.05)	0.99 (0.95; 1.04)	1.05 (1.00; 1.10)	0.707
Asthma	2.62 (1.78; 3.88)	2.30 (1.52; 3.47)	1.85 (1.06; 3.23)	1.70 (0.92; 3.15)	2.74 (1.38; 5.43)	2.49 (1.09; 5.75)	1.000
Chronic bronchitis, COPD, emphysema	0.99 (0.90; 1.09)	1.08 (0.98; 1.20)	1.01 (0.91; 1.12)	1.07 (0.96; 1.19)	1.25 (1.12; 1.39)	1.18 (1.05; 1.33)	0.133

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.E Nationality-related relative health disparities: non-Belgian Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.94 (0.81; 1.09)	0.88 (0.78; 1.01)	0.708
Non-daily vegetables					1.36 (1.10; 1.68)	1.41 (1.20; 1.66)	0.696
Daily snacking					0.63 (0.52; 0.76)	0.68 (0.56; 0.81)	0.550
Daily SSBs					0.70 (0.55; 0.89)	0.68 (0.53; 0.89)	0.922
Daily smoking	1.03 (0.82; 1.31)	1.05 (0.85; 1.29)	1.06 (0.85; 1.32)	1.00 (0.76; 1.31)	1.29 (0.98; 1.68)	1.05 (0.81; 1.36)	0.683
Excess alcohol	1.31 (0.77; 2.23)	0.66 (0.44; 0.99)	1.04 (0.64; 1.68)	1.11 (0.68; 1.81)	0.80 (0.46; 1.40)	0.82 (0.47; 1.43)	0.552
Leisure time physical inactivity	1.13 (0.95; 1.34)	1.33 (1.16; 1.52)	1.02 (0.82; 1.26)	1.18 (0.96; 1.45)	1.19 (0.93; 1.52)	1.13 (0.94; 1.35)	0.650
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.04 (0.89; 1.21)	1.15 (1.04; 1.27)	1.06 (0.95; 1.18)	0.96 (0.84; 1.10)	0.96 (0.86; 1.07)	1.04 (0.96; 1.14)	0.570
Obesity, BMI ≥ 30 kg/m²	1.32 (0.90; 1.93)	1.10 (0.79; 1.54)	1.33 (1.02; 1.74)	0.94 (0.71; 1.25)	0.94 (0.73; 1.21)	1.00 (0.78; 1.27)	0.213
High blood pressure	0.96 (0.66; 1.39)	0.89 (0.67; 1.18)	1.10 (0.88; 1.38)	0.79 (0.59; 1.06)	0.95 (0.75; 1.21)	1.07 (0.89; 1.30)	0.631
High cholesterol levels					1.04 (0.80; 1.36)	0.99 (0.79; 1.24)	0.895
NCD prevalence							
T2DM	1.45 (0.76; 2.74)	1.43 (0.90; 2.29)	1.25 (0.84; 1.82)	1.49 (0.98; 2.27)	1.07 (0.67; 1.71)	1.04 (0.70; 1.54)	0.250
CVD					0.94 (0.53; 1.65)	1.01 (0.65; 1.59)	0.918
Myocardial infarction							
Coronary artery disease							
Other serious heart disease						0.91 (0.52; 1.57)	
Cerebrovascular disease							
Cancer							
Asthma		1.30 (0.86; 1.98)	1.01 (0.64; 1.58)	0.84 (0.54; 1.31)	0.97 (0.56; 1.69)	0.84 (0.57; 1.25)	0.341
Chronic bronchitis, COPD, emphysema		1.35 (0.97; 1.89)	1.21 (0.82; 1.77)	0.87 (0.53; 1.44)	1.24 (0.74; 2.07)	1.02 (0.60; 1.74)	0.545
NCD-specific mortality attributable to							
T2DM	1.13 (0.61; 2.09)	1.07 (0.55; 2.08)	1.39 (0.74; 2.60)	1.11 (0.57; 2.17)	1.11 (0.52; 2.37)	0.67 (0.26; 1.69)	0.339
Ischemic heart disease	0.74 (0.59; 0.94)	0.99 (0.78; 1.26)	0.93 (0.72; 1.20)	0.86 (0.64; 1.16)	0.96 (0.69; 1.35)	0.54 (0.35; 0.83)	0.707
Cerebrovascular disease	0.74 (0.54; 1.01)	0.95 (0.69; 1.30)	0.74 (0.52; 1.05)	0.88 (0.61; 1.27)	0.91 (0.61; 1.37)	0.54 (0.33; 0.88)	0.848
Cancer	0.80 (0.69; 0.93)	0.87 (0.74; 1.01)	0.87 (0.74; 1.02)	0.83 (0.71; 0.98)	0.83 (0.70; 0.98)	0.47 (0.39; 0.58)	0.436
Asthma	1.50 (0.46; 4.96)	0.98 (0.24; 3.98)	1.01 (0.17; 6.11)	1.65 (0.18; 14.88)	0.91 (0.07; 11.54)	0.97 (0.05; 18.86)	0.452
Chronic bronchitis, COPD, emphysema	1.15 (0.82; 1.60)	1.23 (0.86; 1.76)	1.19 (0.82; 1.74)	1.18 (0.80; 1.75)	0.90 (0.58; 1.38)	0.44 (0.25; 0.77)	0.133

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). NCD mortality rates comparison is between foreigners (all kind) and Belgians. Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.F Nationality-related relative health disparities: non-Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.00 (0.85; 1.19)	0.84 (0.69; 1.02)	0.304
Non-daily vegetables					1.83 (1.46; 2.28)	1.34 (1.09; 1.65)	0.050
Daily snacking					0.75 (0.59; 0.95)	0.49 (0.36; 0.68)	0.040
Daily SSBs					1.06 (0.81; 1.38)	0.81 (0.58; 1.15)	0.184
Daily smoking	0.77 (0.49; 1.21)	0.85 (0.62; 1.15)	0.77 (0.50; 1.18)	0.79 (0.46; 1.37)	0.73 (0.42; 1.25)	0.85 (0.54; 1.34)	0.992
Excess alcohol							
Leisure time physical inactivity	1.74 (1.49; 2.02)	1.50 (1.27; 1.77)	1.12 (0.78; 1.60)	1.55 (1.18; 2.04)	1.07 (0.77; 1.49)	1.48 (1.14; 1.91)	0.249
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.06 (0.88; 1.27)	1.00 (0.84; 1.20)	1.10 (0.92; 1.33)	1.09 (0.95; 1.26)	1.13 (0.99; 1.29)	1.18 (1.06; 1.31)	0.048
Obesity, BMI ≥ 30 kg/m²	0.89 (0.57; 1.38)	1.36 (0.94; 1.97)	1.18 (0.78; 1.78)	1.00 (0.68; 1.46)	1.08 (0.74; 1.56)	1.36 (1.03; 1.77)	0.115
High blood pressure	0.99 (0.63; 1.57)	1.21 (0.81; 1.81)	0.74 (0.53; 1.02)	0.80 (0.54; 1.19)	1.29 (0.93; 1.79)	1.18 (0.91; 1.53)	0.316
High cholesterol levels					0.95 (0.66; 1.37)	1.06 (0.79; 1.42)	0.461
NCD prevalence							
T2DM		3.42 (1.97; 5.93)			2.18 (1.30; 3.65)	2.20 (1.51; 3.22)	0.788
CVD							
Myocardial infarction							
Coronary artery disease							
Other serious heart disease							
Cerebrovascular disease							
Cancer							
Asthma		1.19 (0.69; 2.06)			0.87 (0.47; 1.61)	0.79 (0.47; 1.33)	0.208
Chronic bronchitis, COPD, emphysema		1.01 (0.59; 1.73)	1.10 (0.60; 2.02)				0.260

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.G Education-related relative health disparities: low versus high education level (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.38 (1.26; 1.52)	1.41 (1.29; 1.54)	0.715
Non-daily vegetables					1.66 (1.40; 1.98)	2.03 (1.76; 2.35)	0.099
Daily snacking					0.89 (0.78; 1.00)	0.73 (0.64; 0.84)	0.083
Daily SSBs					1.97 (1.68; 2.31)	2.01 (1.68; 2.40)	0.927
Daily smoking	1.65 (1.39; 1.96)	1.62 (1.40; 1.87)	2.06 (1.77; 2.40)	2.75 (2.28; 3.32)	2.79 (2.26; 3.46)	2.71 (2.22; 3.32)	<0.001
Excess alcohol	1.20 (0.88; 1.66)	0.87 (0.66; 1.15)	0.72 (0.53; 0.97)	0.81 (0.58; 1.12)	1.02 (0.69; 1.51)	0.70 (0.48; 1.04)	0.672
Leisure time physical inactivity	1.70 (1.48; 1.95)	1.59 (1.43; 1.78)	1.87 (1.62; 2.16)	1.81 (1.55; 2.11)	1.75 (1.47; 2.08)	2.06 (1.78; 2.38)	0.754
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.40 (1.26; 1.55)	1.38 (1.27; 1.49)	1.29 (1.19; 1.39)	1.27 (1.17; 1.38)	1.29 (1.20; 1.40)	1.36 (1.27; 1.47)	0.682
Obesity, BMI ≥ 30 kg/m²	1.74 (1.31; 2.30)	2.44 (1.96; 3.03)	2.28 (1.87; 2.79)	2.09 (1.71; 2.56)	2.24 (1.82; 2.75)	1.81 (1.52; 2.14)	0.246
High blood pressure	1.24 (0.98; 1.56)	1.40 (1.16; 1.68)	1.34 (1.16; 1.56)	1.34 (1.14; 1.58)	1.28 (1.08; 1.50)	1.19 (1.03; 1.37)	0.729
High cholesterol levels					1.10 (0.93; 1.28)	1.17 (1.01; 1.35)	0.765
NCD prevalence							
T2DM	2.79 (1.80; 4.31)	1.93 (1.33; 2.82)	2.40 (1.64; 3.51)	2.30 (1.63; 3.23)	1.83 (1.37; 2.45)	1.77 (1.36; 2.29)	0.158
CVD					1.15 (0.77; 1.71)	1.21 (0.90; 1.62)	0.672
Myocardial infarction				1.74 (0.93; 3.27)	2.41 (1.12; 5.19)	2.15 (1.02; 4.53)	
Coronary artery disease				1.30 (0.78; 2.16)	0.66 (0.30; 1.45)	1.37 (0.74; 2.50)	
Other serious heart disease					1.46 (0.90; 2.39)	1.16 (0.79; 1.71)	
Cerebrovascular disease				1.16 (0.60; 2.22)	1.01 (0.43; 2.35)	1.79 (0.93; 3.44)	
Cancer	0.94 (0.44; 1.98)	1.15 (0.67; 1.96)	1.25 (0.74; 2.11)	1.16 (0.69; 1.93)	1.30 (0.75; 2.27)	1.03 (0.66; 1.60)	0.842
Asthma		1.32 (0.95; 1.84)	1.54 (1.11; 2.13)	1.34 (0.94; 1.89)	2.04 (1.47; 2.83)	1.46 (1.07; 1.99)	0.440
Chronic bronchitis, COPD, emphysema		2.24 (1.67; 3.01)	2.64 (1.92; 3.61)	4.32 (2.78; 6.72)	2.78 (1.79; 4.32)	2.75 (1.96; 3.87)	0.623

Analyses were conducted in 1997 in 7,146 individuals (1.5%missing), in 2001 in 8,427 (2.8%missing), in 2004 in 8,796 (2.8%missing), in 2008 in 7,146 (2.7%missing), in 2013 in 7,590 (1.5%missing), and in 2018 in 8,201 (1.9%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

2.H Income-related relative health disparities: Quintile 1 versus Quintile 5 of income (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.08 (0.96; 1.22)	1.48 (1.31; 1.67)	0.003
Non-daily vegetables					1.15 (0.93; 1.41)	2.72 (2.20; 3.36)	<0.001
Daily snacking					0.85 (0.73; 0.99)	0.67 (0.56; 0.80)	0.086
Daily SSBs					1.80 (1.48; 2.20)	1.52 (1.19; 1.93)	0.208
Daily smoking	1.53 (1.22; 1.91)	1.36 (1.13; 1.63)	1.90 (1.57; 2.30)	2.21 (1.72; 2.84)	2.55 (1.99; 3.28)	2.96 (2.29; 3.81)	<0.001
Excess alcohol	1.21 (0.80; 1.82)	0.45 (0.32; 0.65)	0.73 (0.51; 1.04)	0.77 (0.48; 1.23)	1.07 (0.69; 1.65)	0.88 (0.54; 1.43)	0.246
Leisure time physical inactivity	1.49 (1.24; 1.79)	1.58 (1.37; 1.83)	1.67 (1.41; 1.99)	1.88 (1.54; 2.30)	1.77 (1.44; 2.19)	2.12 (1.74; 2.59)	0.208
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.24 (1.09; 1.40)	1.13 (1.02; 1.25)	1.17 (1.05; 1.31)	1.14 (1.01; 1.27)	1.23 (1.11; 1.35)	1.25 (1.12; 1.40)	0.453
Obesity, BMI ≥ 30 kg/m²	1.48 (1.03; 2.13)	1.46 (1.13; 1.88)	1.79 (1.36; 2.35)	1.74 (1.36; 2.23)	2.04 (1.58; 2.62)	1.65 (1.27; 2.14)	0.358
High blood pressure	0.95 (0.70; 1.30)	1.09 (0.87; 1.36)	1.03 (0.85; 1.25)	1.34 (1.07; 1.67)	1.14 (0.92; 1.41)	1.48 (1.19; 1.84)	0.003
High cholesterol levels					1.33 (1.07; 1.66)	1.36 (1.11; 1.66)	0.240
NCD prevalence							
T2DM	1.59 (0.87; 2.90)	1.81 (1.15; 2.84)	1.91 (0.99; 3.71)	2.42 (1.52; 3.85)	2.36 (1.55; 3.61)	2.11 (1.36; 3.27)	0.413
CVD					2.22 (1.36; 3.63)	1.42 (0.88; 2.31)	0.228
Myocardial infarction							
Coronary artery disease				1.49 (0.75; 2.95)			
Other serious heart disease					1.52 (0.76; 3.01)	1.37 (0.72; 2.59)	
Cerebrovascular disease							
Cancer		1.30 (0.66; 2.57)	1.31 (0.66; 2.61)	0.87 (0.43; 1.74)		2.40 (1.21; 4.77)	0.486
Asthma		1.29 (0.86; 1.95)	3.16 (2.02; 4.92)	1.90 (1.22; 2.96)	1.29 (0.83; 2.02)	2.00 (1.32; 3.03)	0.382
Chronic bronchitis, COPD, emphysema		2.34 (1.57; 3.49)	2.65 (1.77; 3.96)	5.10 (2.82; 9.19)	4.81 (2.81; 8.23)	6.00 (3.33; 10.8)	0.005

Analyses were conducted in 1997 in 6,915 individuals (5%missing), in 2001 in 7,495 (14%missing), in 2004 in 7,660 (15%missing), in 2008 in 5,894 (0%missing), in 2013 in 6,666 (13%missing), and in 2018 in 7,053 (16%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a]Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

Supplementary Tables 3 Trends in health disparities related to the prevalence of lifestyle risks, metabolic risks, and major non-communicable diseases according to socio-demographic strata and measured as age-standardised percentage point differences between distal groups.

3.A Age-related absolute health disparities: adults aged 75-84 years versus adults aged 25-34 years (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-19.2% (-25.7%; -12.7%)	-25.0% (-30.8%; -19.1%)	0.175
Non-daily vegetables					-8.4% (-14.1%; -2.7%)	-11.3% (-16.1%; -6.5%)	0.383
Daily snacking					-2.7% (-9.3%; 4.9%)	3.5% (-2.9%; 9.9%)	0.186
Diet high in SSBs					-20.9% (-25.9%; -15.8%)	-20.3% (-24.9%; -15.8%)	0.291
Daily smoking	-19.9% (-24.3%; -15.4%)	-21.1% (-25.2%; -17.1%)	-19.6% (-23.9%; -15.3%)	-18.8% (-22.9%; -14.8%)	-13.0% (-17.3%; -8.7%)	-14.3% (-18.1%; -10.5%)	0.840
Excess alcohol	-0.4% (-4.0%; 3.2%)	-3.4% (-6.3%; -0.5%)	-2.4% (-6.1%; 1.3%)	-2.4% (-5.1%; 0.3%)	-0.2% (-2.2%; 1.7%)	-3.2% (-5.1%; -1.3%)	0.075
Leisure time physical inactivity	35.6% (28.1%; 43.1%)	30.6% (24.5%; 36.8%)	31.6% (25.4%; 37.7%)	30.2% (23.5%; 37.0%)	26.1% (18.1%; 34.1%)	21.5% (14.7%; 28.3%)	0.018
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	19.1% (10.7%; 27.4%)	19.3% (12.9%; 25.8%)	24.0% (18.5%; 29.5%)	20.1% (14.1%; 26.1%)	19.9% (13.7%; 26.2%)	20.8% (14.6%; 26.9%)	0.894
Obesity, BMI ≥ 30 kg/m²	4.2% (-0.1%; 8.6%)	11.2% (6.4%; 16.0%)	6.1% (2.5%; 9.7%)	7.7% (3.8%; 11.7%)	5.5% (1.2%; 9.9%)	6.3% (2.1%; 10.6%)	0.048
High blood pressure	26.7% (19.4%; 34.1%)	33.2% (27.5%; 39.0%)	33.0% (28.7%; 37.2%)	32.3% (28.0%; 36.5%)	32.8% (27.9%; 37.7%)	38.7% (33.8%; 43.6%)	0.072
High cholesterol levels					35.4% (30.3%; 40.6%)	35.0% (29.9%; 40.0%)	0.294
NCD prevalence							
Asthma		4.3% (1.2%; 7.4%)	3.3% (1.0%; 5.7%)	1.5% (-1.4%; 4.5%)	-1.0% (-3.6%; 1.7%)		0.017
Chronic bronchitis, COPD, emphysema		10.2% (6.6%; 13.8%)	10.5% (7.3%; 13.7%)	8.1% (5.6%; 10.7%)		6.8% (3.8%; 9.8%)	0.567

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.B sex-related absolute health disparities: women versus men (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-11.8% (-14.6%; -9.0%)	-12.8% (-15.4%; -10.2%)	0.504
Non-daily vegetables					-7.2% (-9.3%; -5.1%)	-7.6% (-9.8%; -5.5%)	0.919
Daily snacking					-0.1% (-2.7%; 2.6%)	1.4% (-1.2%; 4.0%)	0.408
Daily SSBs					-10.3% (-12.6%; -8.0%)	-8.5% (-10.7%; -6.4%)	0.597
Daily smoking	-11.7% (-14.6%; -8.9%)	-8.6% (-10.7%; -6.5%)	-7.6% (-10.0%; -5.3%)	-5.6% (-8.1%; -3.2%)	-6.0% (-8.4%; -3.5%)	-6.9% (-9.2%; -4.7%)	0.075
Excess alcohol	-5.3% (-7.1%; -3.6%)	-5.9% (-7.6%; -4.2%)	-6.8% (-8.4%; -5.2%)	-3.7% (-5.4%; -2.0%)	-3.6% (-5.2%; -2.0%)	-3.4% (-4.8%; -2.1%)	0.067
Leisure time physical inactivity	8.3% (5.1%; 11.5%)	9.6% (7.2%; 12.1%)	10.0% (7.4%; 12.6%)	6.6% (3.8%; 9.5%)	6.4% (3.2%; 9.6%)	8.1% (5.4%; 10.9%)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	-15.4% (-18.6%; -12.1%)	-12.6% (-15.3%; -10.0%)	-14.4% (-17.0%; -11.8%)	-13.9% (-16.8%; -10.9%)	-14.1% (-17.0%; -11.1%)	-14.2% (-17.0%; -11.4%)	0.729
Obesity, BMI ≥ 30 kg/m²	-0.3% (-2.7%; 2.2%)	1.0% (-0.9%; 2.9%)	1.4% (-0.5%; 3.3%)	1.4% (-0.7%; 3.4%)	0.4% (-1.9%; 2.6%)	-1.7% (-3.9%; 0.4%)	0.180
High blood pressure	4.1% (1.7%; 6.5%)	1.8% (-0.2%; 3.8%)	2.1% (0.1%; 4.0%)	2.8% (0.6%; 4.9%)	0.0% (-2.3%; 2.3%)	-1.2% (-3.3%; 1.0%)	0.003
High cholesterol levels					-0.2% (-2.5%; 2.0%)	-3.4% (-5.5%; -1.2%)	0.067
NCD prevalence							
T2DM	0.1% (-1.3%; 1.6%)	-0.5% (-1.5%; 0.6%)	-0.5% (-1.6%; 0.6%)	-0.4% (-1.6%; 0.8%)	-0.6% (-2.0%; 0.9%)	-0.8% (-2.1%; 0.6%)	0.479
CVD					-3.1% (-4.3%; -1.9%)	-2.6% (-3.8%; -1.3%)	0.431
Myocardial infarction				-0.7% (-1.1%; -0.2%)	-1.2% (-2.1%; -0.3%)	-0.7% (-1.4%; -0.1%)	
Coronary artery disease				-1.5% (-2.5%; -0.5%)	-1.1% (-1.8%; -0.4%)	-0.9% (-1.7%; 0.0%)	
Other serious heart disease					-1.8% (-2.7%; -0.9%)	-1.4% (-2.5%; -0.4%)	
Cerebrovascular disease	0.5% (-0.5%; 1.4%)	-0.1% (-0.6%; 0.4%)	0.0% (-0.5%; 0.5%)	0.0% (-0.6%; 0.7%)	-0.4% (-1.1%; 0.3%)	-1.1% (-1.8%; -0.4%)	
Cancer	1.0% (-0.1%; 2.1%)	0.4% (-0.3%; 1.1%)	0.9% (0.3%; 1.5%)	0.0% (-1.1%; 1.0%)	1.0% (0.1%; 1.9%)	0.9% (-0.1%; 1.8%)	0.535
Asthma		-1.0% (-2.2%; 0.2%)	0.7% (-0.4%; 1.8%)	1.6% (0.4%; 2.8%)	0.0% (-1.3%; 1.3%)	1.0% (-0.4%; 2.3%)	0.247
Chronic bronchitis, COPD, emphysema		-0.7% (-2.0%; 0.6%)	-0.5% (-1.8%; 0.7%)	0.0% (-1.2%; 1.1%)	0.6% (-0.6%; 1.8%)	0.1% (-1.1%; 1.2%)	0.282
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	-0.8 (-3.0; 1.5)	-0.8 (-2.8; 1.2)	1.2 (-0.8; 3.2)	-2.52 (-4.4; -0.6)	-3.6 (-5.2; -2.0)	-5.4 (-6.8; -3.9)	0.085
Ischemic heart disease	-114 (-1120; -106)	-110 (-116; -103)	-99 (-105; -93)	-80 (-85.24; -75)	-64 (-67; -59.8)	-53 (-56; -50)	0.009
Cerebrovascular disease	-22 (-27; -16)	-19 (-26; -12)	-5.5 (-12; 0.9)	-11.66 (-17.18; -6.2)	-9.7 (-14; -5.4)	-6.2 (-10; -2.5)	0.133
Cancer	-226 (-235; -217)	-213 (-222; -205)	-191 (-199; -182)	-175 (-183; -167)	-141 (-157; -143.9)	-126 (-132; -119)	0.009
Asthma	-0.6 (-1.6; 0.3)	0.2 (-0.6; 1.0)	0.7 (0.1; 1.3)	0.6 (0.1; 1.1)	0.3 (-0.2; 0.7)	0.4 (0.1; 0.8)	0.452
Chronic bronchitis, COPD, emphysema	-91 (-96; -86)	-74 (-79; -70)	-66 (-71; -62)	-57 (-60; -53)	-40 (-43; -37)	-32 (-34; -29)	0.009

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.C Region of residence-related absolute health disparities: Wallonia versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.7% (-1.8%; 5.2%)	5.8% (2.2%; 9.4%)	0.104
Non-daily vegetables					3.3% (0.3%; 6.3%)	6.0% (2.8%; 9.2%)	0.293
Daily snacking					0.2% (-3.4%; 3.8%)	-4.4% (-7.9%; -1.0%)	0.060
Daily SSBs					2.6% (-0.4%; 5.6%)	2.1% (-1.1%; 5.2%)	0.875
Daily smoking	3.7% (0.4%; 7.1%)	3.4% (0.7%; 6.1%)	4.8% (1.8%; 7.8%)	5.5% (2.3%; 8.7%)	4.4% (1.1%; 7.6%)	5.4% (2.5%; 8.4%)	0.155
Excess alcohol	-1.5% (-3.3%; 0.4%)	-2.1% (-4.0%; -0.2%)	1.2% (-0.8%; 3.2%)	1.7% (-0.5%; 3.8%)	1.6% (-0.4%; 3.5%)	1.5% (-0.2%; 3.3%)	0.002
Leisure time physical inactivity	12.0% (8.0%; 16.0%)	13.1% (9.9%; 16.3%)	10.3% (7.1%; 13.5%)	13.0% (9.5%; 16.5%)	8.4% (4.6%; 12.3%)	13.6% (10.0%; 17.2%)	0.333
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	4.1% (0.2%; 8.0%)	4.3% (1.2%; 7.4%)	6.2% (3.1%; 9.3%)	2.7% (-0.7%; 6.1%)	3.5% (0.1%; 6.9%)	4.0% (0.7%; 7.4%)	0.618
Obesity, BMI ≥ 30 kg/m²	4.2% (1.5%; 7.0%)	3.5% (1.3%; 5.7%)	4.3% (2.0%; 6.6%)	1.2% (-1.2%; 3.5%)	4.0% (1.5%; 6.6%)	3.6% (0.9%; 6.2%)	0.287
High blood pressure	3.9% (1.0%; 6.9%)	0.4% (-2.0%; 2.8%)	1.5% (-0.7%; 3.8%)	2.3% (-0.1%; 4.8%)	-1.8% (-4.3%; 0.6%)	1.8% (-0.6%; 4.2%)	0.232
High cholesterol levels					-0.7% (-3.2%; 1.8%)	0.2% (-2.3%; 2.7%)	0.658
NCD prevalence							
T2DM	2.1% (0.5%; 3.7%)	2.4% (1.2%; 3.6%)	2.0% (0.6%; 3.4%)	1.0% (-0.2%; 2.3%)	1.3% (-0.3%; 2.9%)	2.1% (0.6%; 3.6%)	0.126
CVD					1.0% (-0.4%; 2.4%)	0.3% (-1.1%; 1.7%)	0.450
Myocardial infarction				0.4% (-0.1%; 0.8%)	)	0.7% (0.0%; 1.5%)	
Coronary artery disease				0.6% (-0.4%; 1.6%)	0.7% (-0.2%; 1.5%)	0.4% (-0.5%; 1.3%)	
Other serious heart disease					-0.4% (-1.3%; 0.5%)	-0.2% (-1.4%; 0.9%)	
Cerebrovascular disease			0.5% (-0.1%; 1.0%)	0.8% (0.1%; 1.5%)		0.7% (0.0%; 1.4%)	
Cancer	-0.1% (-1.3%; 1.0%)	0.8% (-0.1%; 1.7%)	-0.2% (-0.8%; 0.4%)	-0.1% (-1.1%; 1.0%)	-0.3% (-1.2%; 0.7%)	-0.1% (-1.1%; 0.9%)	0.387
Asthma		2.9% (1.5%; 4.3%)	3.0% (1.7%; 4.2%)	3.1% (1.7%; 4.4%)	2.6% (1.2%; 4.0%)	3.9% (2.3%; 5.6%)	0.740
Chronic bronchitis, COPD, emphysema		3.3% (1.8%; 4.8%)	3.5% (2.0%; 4.9%)	2.0% (0.7%; 3.2%)	2.3% (1.0%; 3.7%)	2.2% (0.9%; 3.5%)	0.943
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	1.1 (-1.3; 3.4)	7.3 (5.1; 10)	11 (8.3; 13)	5.1 (3.1; 7.2)	1.7 (-0.01; 3.3)	4.3 (2.8; 5.9)	1.000
Ischemic heart disease	-22 (-28; -16)	-5.2 (-11; 0.6)	0.1 (-5.5; 5.6)	12 (7.3; 17)	20 (17; 24)	17 (13; 20)	0.024
Cerebrovascular disease	-13 (-18.5; -7.8)	-6.4 (-11; -1.3)	-11 (-16; -6.6)	-2.3 (-6.5; 1.9)	-3.1 (-6.6; 0.3)	2.1 (-1.0; 5)	0.060
Cancer	18 (9.7; 27)	19 (11; 27)	18 (10; 26)	23 (15; 30)	26 (19; 33)	26 (19; 32)	0.051
Asthma	0.9 (0.0; 1.8)	0.9 (0.1; 1.8)	1.7 (0.9; 2.5)	0.9 (0.3; 1.5)	1.0 (0.5; 1.6)	1.0 (0.5; 1.4)	0.411
Chronic bronchitis, COPD, emphysema	5.2 (1.2; 9.2)	7.5 (3.9; 11)	9.0 (5.4; 13)	15 (11; 18)	13 (9.9; 16)	8.4 (5.8; 11)	0.260

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.D Region of residence-related absolute health disparities: Brussels versus Flanders (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-7.2% (-10.9%; -3.4%)	-3.2% (-6.6%; 0.2%)	0.069
Non-daily vegetables					3.5% (0.2%; 6.8%)	7.1% (4.0%; 10.2%)	0.225
Daily snacking					-9.8% (-13.3%; -6.3%)	-10.5% (-13.7%; -7.3%)	0.641
Daily SSBs					-4.6% (-7.4%; -1.7%)	-4.5% (-7.2%; -1.9%)	0.731
Daily smoking	2.5% (-0.7%; 5.8%)	2.9% (0.02%; 5.8%)	2.3% (-0.8%; 5.4%)	2.9% (-0.3%; 6.0%)	-0.8% (-4.3%; 2.6%)	2.1% (-0.6%; 4.8%)	0.365
Excess alcohol	0.4% (-1.6%; 2.4%)	1.1% (-1.1%; 3.4%)	0.7% (-1.4%; 2.7%)	-0.1% (-2.1%; 1.8%)	2.4% (0.1%; 4.7%)	3.0% (1.1%; 4.8%)	0.027
Leisure time physical inactivity	11.2% (6.6%; 15.7%)	8.6% (5.3%; 11.9%)	6.0% (2.5%; 9.4%)	9.8% (6.0%; 13.5%)	5.3% (0.7%; 9.9%)	6.7% (3.2%; 10.2%)	0.315
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	-5.6% (-9.7%; -1.4%)	-3.2% (-6.4%; 0.0%)	-2.2% (-5.4%; 1.0%)	-5.2% (-8.6%; -1.7%)	-0.7% (-4.3%; 3.0%)	1.0% (-2.4%; 4.4%)	0.013
Obesity, BMI ≥ 30 kg/m²	-0.5% (-3.5%; 2.5%)	0.7% (-1.5%; 3.0%)	0.7% (-1.4%; 2.9%)	-0.9% (-3.3%; 1.6%)	1.3% (-1.3%; 4.0%)	0.4% (-2.1%; 2.8%)	0.725
High blood pressure	1.5% (-1.5%; 4.4%)	-0.5% (-2.9%; 2.0%)	-0.8% (-2.9%; 1.3%)	0.1% (-2.4%; 2.5%)	2.9% (0.0%; 5.9%)	-1.5% (-3.8%; 0.8%)	0.647
High cholesterol levels					3.7% (0.7%; 6.8%)	-2.5% (-4.8%; -0.1%)	0.003
NCD prevalence							
T2DM	1.1% (-0.4%; 2.6%)	1.1% (0.0%; 2.2%)	1.4% (-0.1%; 2.8%)	3.2% (1.6%; 4.8%)	3.3% (1.4%; 5.1%)	2.3% (0.7%; 3.8%)	0.460
CVD					0.6% (-1.0%; 2.2%)	-1.5% (-2.8%; -0.3%)	0.030
Myocardial infarction				1.2% (0.5%; 2.0%)			
Coronary artery disease				1.2% (0.0%; 2.4%)	0.7% (-0.2%; 1.5%)	0.6% (-0.4%; 1.6%)	
Other serious heart disease					0.2% (-1.0%; 1.4%)	-1.7% (-2.7%; -0.7%)	
Cerebrovascular disease			0.4% (-0.1%; 0.9%)	1.8% (0.9%; 2.7%)			
Cancer	0.4% (-1.2%; 2.0%)	1.2% (0.3%; 2.1%)	0.7% (-0.1%; 1.5%)	0.1% (-0.9%; 1.2%)	-1.2% (-2.5%; 0.0%)	-0.9% (-1.9%; 0.1%)	0.042
Asthma		3.0% (1.6%; 4.4%)	2.5% (1.1%; 3.8%)	3.2% (1.7%; 4.7%)	2.5% (0.6%; 4.3%)	2.7% (1.3%; 4.2%)	0.814
Chronic bronchitis, COPD, emphysema		3.1% (1.5%; 4.8%)	2.2% (0.7%; 3.7%)	2.0% (0.7%; 3.3%)	1.1% (0.4%; 2.5%)	0.9% (-0.3%; 2.1%)	0.181
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	-5.8 (-8.9; -2.8)	-2.5 (-5.3; 0.3)	-2.3 (-5.1; 0.6)	2.4 (-0.8; 5.6)	4.9 (-1.0; 4.7)	1.6 (-1.0; 4.1)	0.133
Ischemic heart disease	-13 (-23; -3.9)	-8.8 (-17.62; 0.1)	-2.9 (-11; 5.8)	11 (3.5; 19)	5.5 (-0.6; 12)	7.0 (1.5; 13)	0.060
Cerebrovascular disease	-20 (-28; -13)	-20 (-27; -13)	-6.9 (-14; 0.4)	-11 (-17; -4.8)	-9.8 (-15; -4.4)	-3.1 (-8.1; 2.0)	0.085
Cancer	1.2 (-12; 14)	8.1 (-4.8; 21)	11 (-1.9; 23)	2.4 (-9.6; 14)	2.0 (-13; 9.3)	11.5 (0.5; 22)	0.707
Asthma	5.0 (3.0; 7.0)	3.7 (1.9; 5.5)	1.3 (0.1; 2.5)	0.9 (-0.1; 1.9)	1.5 (0.5; 2.6)	0.9 (0.1; 1.7)	0.085
Chronic bronchitis, COPD, emphysema	-0.6 (-6.5; 5.3)	4.4 (-1.3; 10)	0.3 (-4.9; 5.6)	3.0 (-2.0; 8.1)	9.8 (4.9; 15)	6.6 (2.0; 11)	0.133

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.E Nationality-related absolute health disparities: non-Belgian Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					-2.6% (-9.0%; 3.3%)	-5.2% (-10.4%; 0.0%)	0.708
Non-daily vegetables					6.9% (1.6%; 12.2%)	9.1% (4.2%; 14.0%)	0.696
Daily snacking					-14.2% (-19.0%;-9.4%)	-11.7% (-16.2%;-7.2%)	0.550
Daily SSBs					-6.9% (-10.8%; -2.9%)	-6.5% (-10.3%; -2.7%)	0.922
Daily smoking	0.8% (-5.0%; 6.6%)	1.1% (-4.1%; 6.2%)	1.3% (-4.1%; 6.7%)	-0.1% (-5.7%; 5.5%)	5.5% (-1.0%; 12.0%)	0.8% (-3.6%; 5.2%)	0.683
Excess alcohol	2.2% (-2.6%; 6.9%)	-3.4% (-6.2%; -0.6%)	0.4% (-4.2%; 4.9%)	0.9% (-3.5%; 5.3%)	-1.3% (-4.4%; 1.7%)	-1.1% (-4.0%; 1.7%)	0.552
Leisure time physical inactivity	4.5% (-2.5%; 11.6%)	11.6% (5.4%; 17.9%)	0.5% (-5.5%; 6.5%)	5.1% (-1.9%; 12.0%)	5.3% (-2.7%; 13.2%)	3.5% (-2.3%; 9.3%)	0.650
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	1.8% (-5.5%; 9.1%)	7.2% (1.6%; 12.7%)	2.9% (-2.6%; 8.4%)	-1.9% (-8.5%; 4.7%)	-2.0% (-7.4%; 3.4%)	2.2% (-2.5%; 7.0%)	0.570
Obesity, BMI ≥ 30 kg/m²	4.0% (-2.2%; 10.2%)	1.4% (-3.5%; 6.3%)	4.6% (-0.2%; 9.5%)	-0.9% (-4.9%; 3.1%)	-0.9% (-4.4%; 2.7%)	0.0% (-4.1%; 4.1%)	0.213
High blood pressure	-0.6% (-5.9%; 4.6%)	-1.9% (-6.1%; 2.4%)	1.8% (-2.5%; 6.1%)	-3.9% (-8.2%; 0.4%)	-0.9% (-5.2%; 3.3%)	1.4% (-2.5%; 5.3%)	0.631
High cholesterol levels					0.8% (-4.5%; 6.1%)	-0.2% (-4.7%; 4.4%)	0.895
NCD prevalence							
T2DM	1.6% (-1.7%; 5.0%)	1.7% (-0.9%; 4.2%)	1.1% (-1.1%; 3.4%)	2.3% (-0.5%; 5.1%)	0.4% (-2.5%; 3.4%)	0.2% (-2.4%; 2.8%)	0.250
CVD					-0.3% (-2.7%; 2.1%)	0.1% (-2.3%; 2.4%)	0.918
Myocardial infarction							
Coronary artery disease							
Other serious heart disease						-0.3% (-2.0%; 1.4%)	
Cerebrovascular disease							
Cancer							
Asthma		1.4% (-1.1%; 4.0%)	0.0% (-1.9%; 2.0%)	-0.7% (-2.4%; 1.0%)	-0.1% (-2.6%; 2.3%)	-0.9% (-2.9%; 1.0%)	0.341
Chronic bronchitis, COPD, emphysema		2.3% (-0.6%; 5.2%)	1.3% (-1.6%; 4.2%)	-0.5% (-2.4%; 1.4%)	1.0% (-1.6%; 3.7%)	0.1% (-2.2%; 2.4%)	0.545
NCD-specific mortality rate, per 100,000, attributable to							
T2DM	2.6 (-0.5; 5.6)	1.2 (-1.6; 3.9)	6.5 (3.5; 9.6)	1.8 (-0.9; 4.6)	1.4 (-1.0; 3.9)	-3.7 (-5.7; -1.7)	0.260
Ischemic heart disease	-42 (-50; -34)	-1.0 (-8.9; 6.9)	-9.0 (-16; -1.6)	-13 (-19; -6.3)	-2.5 (-8.1; 3.1)	-28 (-32; -23)	1.000
Cerebrovascular disease	-24 (-29; -18)	-4.4 (-10; 1.4)	-20 (-25; -14)	-7.5 (-13; -2.5)	-4.2 (-8.6; 0.3)	-21 (-25; -17)	0.707
Cancer	-76 (-89; -63)	-47 (-60; -35)	-43 (-55; -30)	-55 (-68; -43)	-53 (-65; -41)	-156 (-166; -146)	0.707
Asthma	2.3 (0.5; 4.0)	-0.1 (-1.5; 1.4)	0.0 (-1.1; 1.1)	0.8 (-0.1; 1.8)	-0.1 (-0.9; 0.7)	-0.0 (-0.7; 0.6)	0.697
Chronic bronchitis, COPD, emphysema	9.4 (3.9; 15)	12 (7.3; 18)	9.6 (4.8; 14)	8.5 (3.7; 13)	-4.6 (-8.9; -0.3)	-23 (-27; -19)	0.060

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). NCD-specific mortality rates, per 100,000 are comparing all foreigners living in Belgium with Belgians. Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence, and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.F Nationality-related absolute health disparities: non-Europeans versus Belgians (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					0.2% (-7.5%; 7.9%)	-7.1% (-14.6%; 0.3%)	0.304
Non-daily vegetables					15.9% (8.5%; 23.3%)	7.6% (1.5%; 13.6%)	0.050
Daily snacking					-9.7% (-16.4%; -2.9%)	-18.4% (-24.4%;-12.4%)	0.040
Daily SSBs					1.4% (-5.5%; 8.4%)	-4.0% (-9.9%; 1.9%)	0.184
Daily smoking	-5.5% (-13.8%; 2.9%)	-3.6% (-9.7%; 2.6%)	-5.4% (-13.1%; 2.4%)	-4.3% (-13.4%; 4.8%)	-5.3% (-13.0%; 2.4%)	-2.5% (-8.9%; 4.0%)	0.992
Excess alcohol							
Leisure time physical inactivity	26.5% (17.3%; 35.6%)	17.7% (9.0%; 26.3%)	3.3% (-8.0%; 14.5%)	15.8% (4.0%; 27.5%)	2.0% (-7.7%; 11.8%)	13.4% (2.9%; 24.0%)	0.249
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	2.7% (-6.3%; 11.7%)	0.2% (-8.5%; 8.8%)	5.0% (-4.8%; 14.7%)	4.6% (-3.2%; 12.4%)	6.7% (-0.8%; 14.2%)	9.2% (2.7%; 15.7%)	0.048
Obesity, BMI ≥ 30 kg/m²	-1.5% (-6.4%; 3.5%)	4.9% (-1.8%; 11.7%)	2.4% (-4.3%; 9.1%)	-0.1% (-5.8%; 5.7%)	1.2% (-4.8%; 7.2%)	6.0% (0.0%; 12.0%)	0.115
High blood pressure	-0.1% (-6.9%; 6.7%)	3.6% (-4.7%; 11.8%)	-4.6% (-8.9%; -0.4%)	-3.8% (-9.7%; 2.2%)	5.3% (-2.3%; 13.0%)	3.5% (-2.4%; 9.3%)	0.316
High cholesterol levels					-0.9% (-7.7%; 5.8%)	1.1% (-5.1%; 7.4%)	0.461
NCD prevalence							
T2DM		9.2% (2.2%; 16.2%)			7.0% (0.5%; 13.5%)	7.5% (2.5%; 12.6%)	0.788
CVD							
Myocardial infarction							
Coronary artery disease							
Other serious heart disease							
Cerebrovascular disease							
Cancer							
Asthma		0.9% (-2.2%; 4.0%)			-0.6% (-3.0%; 1.9%)	-1.2% (-3.6%; 1.2%)	0.208
Chronic bronchitis, COPD, emphysema		0.1% (-3.5%; 3.6%)	0.6% (-3.6%; 4.8%)				0.260

Analyses were conducted in 1997 in 7,254 individuals (0.03%missing), in 2001 in 8,647 (0.21%missing), in 2004 in 9,030 (0.27%missing), in 2008 in 7,327 (0.22%missing), in 2013 in 7,698 (0.08%missing), and in 2018 in 8,354 (0.05%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.G Education-related absolute health disparities: low versus high (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					14.5% (10.1%; 18.8%)	15.5% (11.2%; 19.9%)	0.715
Non-daily vegetables					11.1% (7.2%; 15.1%)	17.6% (13.7%; 21.6%)	0.099
Daily snacking					-4.2% (-8.4%; 0.0%)	-9.9% (-13.8%; -6.0%)	0.083
Daily SSBs					14.9% (11.1%; 18.6%)	13.9% (9.9%; 17.9%)	0.926
Daily smoking	11.6% (7.7%; 15.5%)	10.9% (7.7%; 14.1%)	16.4% (12.9%; 19.8%)	20.6% (16.4%; 24.8%)	19.7% (15.3%; 24.1%)	17.3% (13.2%; 21.3%)	<0.001
Excess alcohol	1.3% (-1.0%; 3.6%)	-1.3% (-3.8%; 1.2%)	-2.8% (-5.2%; -0.3%)	-1.6% (-4.1%; 0.8%)	0.2% (-2.4%; 2.7%)	-2.0% (-4.0%; 0.0%)	0.672
Leisure time physical inactivity	19.1% (14.4%; 23.9%)	16.5% (12.7%; 20.3%)	17.4% (13.6%; 21.3%)	17.2% (12.8%; 21.7%)	16.8% (11.3%; 22.3%)	21.5% (16.6%; 26.4%)	0.754
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	15.4% (10.8%; 20.1%)	15.2% (11.5%; 18.9%)	11.7% (8.1%; 15.4%)	12.2% (8.0%; 16.4%)	13.5% (9.3%; 17.6%)	16.5% (12.5%; 20.5%)	0.682
Obesity, BMI ≥ 30 kg/m²	6.4% (3.4%; 9.5%)	10.9% (8.5%; 13.3%)	11.0% (8.5%; 13.6%)	10.8% (7.8%; 13.9%)	12.3% (9.1%; 15.6%)	10.7% (7.3%; 14.0%)	0.246
High blood pressure	3.3% (-0.1%; 6.7%)	5.4% (2.6%; 8.3%)	5.1% (2.6%; 7.6%)	5.2% (2.3%; 8.1%)	4.6% (1.5%; 7.7%)	3.3% (0.6%; 6.1%)	0.729
High cholesterol levels					1.7% (-1.3%; 4.8%)	3.2% (0.2%; 6.2%)	0.765
NCD prevalence							
T2DM	3.6% (2.1%; 5.0%)	2.3% (1.1%; 3.4%)	3.7% (2.3%; 5.1%)	3.7% (2.3%; 5.1%)	3.7% (1.9%; 5.5%)	3.6% (1.9%; 5.3%)	0.158
CVD					0.6% (-1.2%; 2.4%)	1.0% (-0.6%; 2.7%)	0.672
Myocardial infarction				0.5% (0.0%; 1.0%)	1.3% (0.0%; 2.5%)	0.8% (-0.1%; 1.6%)	
Coronary artery disease				0.7% (-0.6%; 1.9%)	-0.7% (-2.1%; 0.7%)	0.5% (-0.4%; 1.3%)	
Other serious heart disease					0.9% (-0.3%; 2.1%)	0.6% (-0.9%; 2.0%)	
Cerebrovascular disease				0.2% (-0.6%; 1.0%)	0.0% (-0.7%; 0.8%)	0.7% (-0.1%; 1.5%)	
Cancer	-0.1% (-1.4%; 1.2%)	0.3% (-0.7%; 1.2%)	0.3% (-0.5%; 1.1%)	0.3% (-0.8%; 1.4%)	0.6% (-0.7%; 1.9%)	0.1% (-1.1%; 1.2%)	0.842
Asthma		1.3% (-0.2%; 2.8%)	1.9% (0.5%; 3.3%)	1.2% (-0.3%; 2.7%)	3.6% (1.8%; 5.4%)	2.2% (0.3%; 4.2%)	0.440
Chronic bronchitis, COPD, emphysema		5.1% (3.4%; 6.9%)	5.8% (4.1%; 7.6%)	5.1% (3.6%; 6.7%)	4.2% (2.4%; 6.0%)	4.5% (2.8%; 6.2%)	0.623

Analyses were conducted in 1997 in 7,146 individuals (1.5%missing), in 2001 in 8,427 (2.8%missing), in 2004 in 8,796 (2.8%missing), in 2008 in 7,146 (2.7%missing), in 2013 in 7,590(1.5%missing), and in 2018 in 8,201 (1.9%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

3.H Income-related absolute health disparities: Quintile 1 versus Quintile 5 (reference)

	1997	2001	2004	2008	2013	2018	*p*-trend[a]
Lifestyle risks							
Dietary risks							
Non-daily fruit					3.3% (-2.0%; 8.7%)	17.4% (11.7%; 23.0%)	0.003
Non-daily vegetables					3.1% (-2.6%; 7.7%)	24.0% (18.8%; 29.3%)	<0.001
Daily snacking					-5.9% (-11.3%; -0.5%)	-12.4% (-17.7%; -7.2%)	0.086
Daily SSBs					12.8% (8.4%; 17.1%)	8.2% (3.3%; 13.1%)	0.208
Daily smoking	9.1% (4.5%; 13.7%)	7.3% (3.1%; 11.5%)	15.1% (10.6%; 19.7%)	15.9% (10.4%; 21.3%)	18.2% (13.1%; 23.2%)	21.2% (15.8%; 26.6%)	<0.001
Excess alcohol	1.3% (-1.6%; 4.3%)	-7.5% (-10.7%; -4.3%)	-2.8% (-5.8%; 0.2%)	-2.0% (-5.3%; 1.4%)	0.5% (-2.7%; 3.6%)	-0.7% (-3.3%; 1.9%)	0.246
Leisure time physical inactivity	13.7% (7.6%; 19.7%)	16.6% (11.6%; 21.7%)	15.2% (10.1%; 20.2%)	18.3% (12.5%; 24.1%)	16.7% (10.4%; 23.0%)	22.0% (15.8%; 28.1%)	0.208
Metabolic risks							
Overweight, BMI ≥ 25 kg/m²	9.5% (4.1%; 14.8%)	5.8% (1.0%; 10.6%)	7.5% (2.4%; 12.5%)	6.1% (0.6%; 11.7%)	10.6% (5.4%; 15.9%)	11.4% (5.6%; 17.2%)	0.453
Obesity, BMI ≥ 30 kg/m²	4.7% (0.6%; 8.9%)	4.8% (1.6%; 8.1%)	7.5% (4.1%; 10.9%)	8.6% (4.7%; 12.4%)	10.7% (6.9%; 14.5%)	8.2% (3.7%; 12.7%)	0.358
High blood pressure	-0.6% (-4.9%; 3.6%)	1.4% (-2.3%; 5.0%)	0.5% (-3.0%; 4.1%)	5.6% (1.2%; 10.0%)	2.4% (-1.6%; 6.5%)	8.1% (3.4%; 12.7%)	0.003
High cholesterol levels					5.5% (1.3%; 9.6%)	7.0% (2.3%; 11.7%)	0.240
NCD prevalence							
T2DM	1.5% (-0.4%; 3.5%)	2.4% (0.7%; 4.1%)	2.6% (-0.2%; 5.5%)	3.8% (1.9%; 5.7%)	5.5% (2.9%; 8.2%)	4.8% (2.1%; 7.5%)	0.413
CVD					3.3% (1.1%; 5.5%)	2.3% (-0.7%; 5.3%)	0.228
Myocardial infarction							
Coronary artery disease				1.0% (-0.6%; 2.5%)			
Other serious heart disease					0.9% (-0.7%; 2.4%)	1.3% (-1.3%; 3.8%)	
Cerebrovascular disease							
Cancer		0.5% (-0.7%; 1.7%)	0.4% (-0.6%; 1.3%)	-0.3% (-1.9%; 1.3%)		2.1% (0.3%; 3.9%)	0.486
Asthma		1.3% (-0.7%; 3.2%)	4.7% (2.9%; 6.6%)	2.7% (0.8%; 4.6%)	1.3% (-0.9%; 3.6%)	4.8% (1.7%; 7.9%)	0.382
Chronic bronchitis, COPD, emphysema		5.0% (2.9%; 7.2%)	5.7% (3.4%; 8.0%)	6.8% (4.5%; 9.0%)	5.8% (3.8%; 7.9%)	9.1% (6.2%; 12.0%)	0.005

Analyses were conducted in 1997 in 6,915 individuals (5%missing), in 2001 in 7,495 (14%missing), in 2004 in 7,660 (15%missing), in 2008 in 5,894 (20%missing), in 2013 in 6,666(13%missing), and in 2018 in 7,053 (16%missing). Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs, non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants in any specific strata reported having the outcome of interest in the particular survey year. [a] Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality rates, and interpreted as a *p*-value for change when only two time points available.

Supplementary Table 4 General characteristics and lifestyle risks (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus low) [a].

	Year of the survey					
	2013			2018		
	Engaged in multiple lifestyle risks			Engaged in multiple lifestyle risks		
	Total	High	Low	Total	High	Low
Number of individuals	4,386	975 (21.2%)	1,061 (24.1%)	6,216	1,240 (19.5%)	1,634 (26.5%)
		(%)	(%)		(%)	(%)
Age groups						
25-34 years	18.5	20.2	22.3	19.1	20.8	20.0
35-44 years	17.1	18.7	19.5	15.7	18.8	16.8
45-54 years	20.4	21.5	21.3	19.2	21.0	19.7
55-64 years	20.1	23.2	18.7	21.4	25.3	22.0
65-74 years	14.1	11.7	11.9	15.4	9.9	14.2
75-84 years	9.9	4.7	6.4	9.2	4.1	7.2
Sex, men	48.8	63.7	39.6	48.6	64.6	43.2
Region of residence						
Flanders	57.6	57.2	64.5	56.7	52.8	63.7
Brussels	10.7	7.7	8.6	10.1	10.3	9.5
Wallonia	31.7	35.1	26.9	33.2	36.9	26.8
Nationality						
Belgians	89.4	92.9	92.1	88.6	90.1	88.9
Non-Belgian Europeans	6.4	5.8	5.2	6.6	6.5	5.9
Non-Europeans	4.2	1.3	2.8	4.8	3.4	5.2
Education level						
Low	24.1	23.8	15.1	29.1	20.3	13.0
Intermediate	33.5	40.0	28.8	32.0	41.6	27.0
High	42.4	36.2	56.0	48.4	38.1	60.0
Income level						
Quintile 1	16.6	14.4	8.5	11.8	16.7	8.6
Quintile 2	17.0	16.2	15.3	15.1	15.7	13.3
Quintile 3	21.0	22.7	19.3	19.9	17.9	18.7
Quintile 4	21.0	22.4	24.6	25.9	28.7	24.6
Quintile 5	24.2	24.3	32.3	27.3	21.0	34.8
Lifestyle risks						
Diet						
No daily fruit	43.9	74.6	17.1	44.1	76.1	16.2
No daily vegetables	20.4	35.5	5.6	23.2	40.5	7.9
Daily snacking	37.0	43.0	26.8	34.5	43.2	23.5
Daily SSBs	22.6	37.1	6.6	19.8	40.8	6.2
Four dietary risks present	1.4	5.1	0.0	1.6	6.7	0.0
3 out of 4	9.4	23.8	0.5	9.3	24.7	1.2
2 out of 4	26.1	35.7	5.4	24.4	37.7	5.1
1 out of 4	37.8	27.2	43.8	36.7	24.2	40.1
No dietary risks	25.2	8.2	50.3	28.0	6.6	53.7
Smoking						
Heavy	6.6	28.3	0.0	5.5	24.2	0.0
Occasional/light	15.0	41.1	0.9	15.1	44.8	0.6
Quit < 10years ago	9.7	12.8	1.9	9.0	12.0	2.5

Quit ≥ 10years ago	14.1	9.2	8.9	16.6	9.6	11.5
Never smoked	54.6	8.5	88.3	53.9	9.3	85.4
Alcohol consumption						
≥ 22 servings/week	4.6	16.8	0.0	4.8	19.3	0.0
15-21 servings/week	6.6	15.3	0.0	5.2	13.8	1.0
8-14 servings/week	14.4	21.5	7.0	12.1	17.7	3.3
1-7 servings/week	28.0	21.5	24.2	29.9	20.1	28.2
Abstainer/occasional	46.4	24.8	68.7	48.1	29.1	67.5
Physical inactivity						
Sedentary	27.2	54.6	0.0	28.6	61.3	0.0
Sport < 4hours/light	57.2	41.3	65.2	53.9	35.1	58.8
Sport ≥ 4hours/intensive	15.5	4.1	34.8	17.6	3.6	41.2

Abbreviations: SSB, sugar-sweetened beverages

[a] Engagement in multiple lifestyle risks was summarised in a composite index of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.* sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement), and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

Supplementary Table 5 Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to the level of engagement in the individual lifestyle risks of diet, smoking, excess alcohol and physical activity, in 2018. [a]

	Dietary risks		Smoking		Excess alcohol		Physical inactivity	
	Yes	No	Yes	No	Yes	No	Yes	No
Number of individuals	5,074 (72%)	2,040 (27%)	3,076 (46%)	4,038 (54%)	3,573 (52%)	3,541 (48%)	5,828 (82%)	1,286 (18%)
Age groups								
25-34 years	20.9	13.2	16.6	20.5	16.5	21.1	16.7	28.4
35-44 years	17.4	14.0	15.5	17.3	15.3	17.7	16.1	18.3
45-54 years	20.8	16.8	18.2	20.9	20.6	18.6	19.9	18.6
55-64 years	20.1	27.2	26.4	18.5	24.0	20.1	22.6	20.0
65-74 years	13.4	18.9	16.7	13.4	16.3	13.4	15.7	11.2
75-84 years	7.4	9.9	6.6	9.5	7.2	9.2	9.1	3.5
Sex, men	51.8	41.9	59.2	40.1	58.8	38.2	45.3	66.4
Region of residence								
Flanders	59.2	58.0	59.2	58.6	61.1	56.4	58.1	62.6
Brussels	8.7	10.3	8.7	9.6	8.7	9.7	9.5	7.5
Wallonia	32.0	31.7	32.1	31.8	30.2	33.9	32.4	29.9
Nationality								
Belgians	90.9	89.0	92.0	88.9	92.8	87.6	90.4	90.0
Non-Belgian Europeans	5.6	7.3	6.1	6.1	5.3	6.9	6.0	6.2
Non-Europeans	3.6	3.7	2.0	5.0	1.9	5.5	3.6	3.7
Education level								
Low	16.9	16.8	18.6	15.3	11.7	22.5	18.6	8.2
Intermediate	33.9	26.4	36.1	28.0	28.3	35.7	32.2	30.0
High	49.2	56.9	45.2	56.7	60.0	41.9	49.2	61.7
Income level								
Quintile 1	11.4	9.9	12.7	9.5	8.5	13.6	12.0	6.2
Quintile 2	15.0	14.7	14.5	15.3	12.3	17.7	15.6	11.5
Quintile 3	18.6	19.7	18.8	19.1	17.6	20.3	19.8	14.8
Quintile 4	27.0	24.7	27.7	25.2	27.1	25.7	26.6	25.3
Quintile 5	27.9	31.1	26.3	30.9	34.5	22.7	26.0	42.1
Behavioral risks								
Dietary risks								
No daily fruits	60.3	0.0	48.4	38.7	44.4	42.0	44.5	37.3
No daily vegetables	31.0	0.0	22.9	21.6	19.8	24.8	23.0	18.5
Daily snacking	48.4	0.0	36.5	33.1	35.5	33.8	34.2	37.1
Daily SSBs	26.2	0.0	22.8	15.3	15.9	21.9	19.2	16.7
4 dietary risks present	2.2	0.0	2.3	0.9	1.4	1.8	1.6	1.4
3 out of 4	12.8	0.0	11.7	7.0	8.2	10.3	9.4	8.2
2 out of 4	33.8	0.0	25.5	23.0	23.2	25.3	25.0	20.2
1 out of 4	51.2	0.0	35.5	37.8	39.0	34.2	36.2	39.2
No dietary risks	0.0	100.0	25.0	31.2	28.2	28.5	27.8	31.1
Smoking								
Heavy	6.8	2.3	12.0	0.0	6.4	4.7	5.9	4.0
Occasional/light	16.8	10.4	32.2	0.0	16.9	12.8	15.4	13.1
Quit < 10yrs ago	8.9	8.9	19.2	0.0	9.2	8.6	8.6	10.6
Quit ≥ 10yrs ago	16.1	19.5	36.7	0.0	21.4	12.2	16.8	18.1
Never smoked	51.4	58.9	0.0	100.0	46.1	61.7	53.4	54.2
Alcohol consumption								

≥ 22 servings/week	5.6	3.3	8.2	2.2	9.5	0.0	4.9	5.3
15-21 servings/week	5.3	4.8	7.1	3.5	9.9	0.0	4.9	6.7
8-14 servings/week	12.3	12.0	15.7	9.2	23.4	0.0	11.4	16.3
1-7 servings/week	29.1	31.8	29.6	30.1	57.1	0.0	29.2	32.9
Abstainer/occasional	47.6	48.1	39.3	55.1	0.0	100.0	49.6	38.8
Physical inactivity								
Sedentary	31.2	21.8	31.1	26.3	22.1	35.5	34.5	0.0
Sport<4hrs/light	52.1	59.1	51.8	56.1	57.5	50.4	65.5	0.0
Sport≥4hrs/intensive	16.7	19.1	17.1	17.6	20.4	14.1	0.0	100.0
Metabolic risks								
Overweight, BMI≥25kg/m^2	52.9	50.8	54.6	50.4	50.6	54.2	54.7	41.1
Obesity, BMI≥30kg/m^2	17.9	16.5	18.1	16.9	15.3	19.9	19.2	9.4
High blood pressure	18.3	24.4	21.5	18.8	19.4	20.7	21.6	12.5
High cholesterol	20.3	23.9	25.2	18.0	22.6	19.9	23.1	12.7
NCD prevalence								
Type 2 diabetes	5.2	10.1	7.6	5.7	4.8	8.5	7.6	1.6
Cardiovascular disease	4.8	6.7	6.6	4.2	4.9	5.7	6.0	2.2
Cancer	2.4	2.7	3.1	2.0	2.2	2.8	2.5	2.3
Asthma	5.8	4.5	5.7	5.2	5.3	5.6	5.6	4.7
Chronic bronchitis, COPD, emphysema	4.0	4.7	6.1	2.6	3.4	5.1	4.6	2.4

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease; SSB, sugar-sweetened beverages

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being inactive or lightly active.

Supplementary Table 6 Relative health disparities by engagement in individiual lifestyle risks [a], independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios [b]

	Diet		Smoking		Alcohol		Physical inactivity	
	At least one vs none dietary risks		Current/former vs never		Frequent vs abstainer/occasional		in-/light active vs very active	
	2013	2018	2013	2018	2013	2018	2013	2018
Metabolic risks								
BMI≥25kg/m^2	1.01 (0.92; 1.10)	1.05 (0.98; 1.12)	0.92 (0.85; 1.00)	1.02 (0.95; 1.09)	0.87 (0.80; 0.94)	0.86 (0.81; 0.92)	1.44 (1.26; 1.65)	1.33 (1.19; 1.48)
BMI≥30kg/m^2	1.04 (0.83; 1.30)	1.14 (0.96; 1.34)	1.05 (0.85; 1.28)	1.04 (0.89; 1.21)	0.68 (0.55; 0.84)	0.73 (0.62; 0.85)	2.41 (1.59; 3.66)	1.87 (1.41; 2.47)
High BP	0.82 (0.69; 0.97)	0.88 (0.77; 1.01)	1.01 (0.85; 1.19)	1.07 (0.94; 1.22)	0.97 (0.82; 1.15)	0.87 (0.77; 0.98)	1.19 (0.90; 1.57)	1.40 (1.10; 1.78)
High cholesterol	0.84 (0.71; 0.99)	0.96 (0.84; 1.09)	1.11 (0.95; 1.30)	1.30 (1.14; 1.48)	0.99 (0.85; 1.16)	1.02 (0.90; 1.16)	1.10 (0.85; 1.42)	1.53 (1.24; 1.88)
NCD prevalence								
T2DM	0.54 (0.39; 0.76)	0.59 (0.47; 0.76)	1.02 (0.72; 1.43)	1.27 (0.98; 1.65)	0.49 (0.36; 0.68)	0.50 (0.39; 0.65)	1.61 (0.79; 3.25)	3.77 (2.17; 6.56)
CVD	0.96 (0.62; 1.49)	0.81 (0.61; 1.08)	1.63 (1.11; 2.41)	1.39 (1.05; 1.84)	0.59 (0.41; 0.86)	0.73 (0.56; 0.95)	2.58 (1.22; 5.42)	2.11 (1.31; 3.39)
Cancer	1.37 (0.74; 2.56)	0.98 (0.59; 1.64)	0.96 (0.54; 1.73)	1.76 (1.10; 2.83)	0.64 (0.36; 1.12)	0.79 (0.51; 1.22)	1.26 (0.58; 2.70)	0.80 (0.44; 1.45)
Asthma	1.14 (0.75; 1.72)	1.39 (1.01; 1.92)	0.91 (0.63; 1.32)	1.11 (0.85; 1.45)	0.68 (0.45; 1.02)	0.99 (0.75; 1.30)	1.05 (0.57; 1.93)	1.11 (0.72; 1.71)
Chronic bronchitis, COPD, emphysema	1.02 (0.66; 1.58)	0.90 (0.62; 1.30)	2.38 (1.64; 3.47)	2.48 (1.80; 3.42)	0.79 (0.53; 1.17)	0.57 (0.41; 0.77)	3.08 (1.38; 6.87)	1.43 (0.85; 2.39)

Abbreviations: BMI, body mass index; BP, blood pressure; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; T2DM, type 2 diabetes mellitus

[a] Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being inactive or lightly active. [b] Adjusted for age, sex and the other lifestyle risks.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-8*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	8-9
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8-9
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	If applicable, see footnote of tables
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	If applicable, see footnote of tables

Outcome data	15*	Report numbers of outcome events or summary measures	Tables
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Age-standardised results for meaningful comparison over the years
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Sup Tab 3 absolute risk difference
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	30

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.