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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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3 1 **Quantification of disparities in the distribution of lifestyle and metabolic risk factors,**
4
5 2 **prevalence of non-communicable diseases and related-mortality in Belgium 1997-2018**

6
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1
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3 8 **ABSTRACT**

4
5 9 **OBJECTIVES** Comprehensively measure the trends in health disparities by socio-demographic strata
6
7 10 in terms of exposure to lifestyle and metabolic risks, and prevalence of non-communicable diseases
8
9 11 (NCDs) during the last 20 years in Belgium.

10
11 12 **DESIGN** Cross-sectional analysis of periodic national-representative health surveys.

12
13 13 **SETTING** Population-based study of adult residents in Belgium between 1997-2018.

14
15 14 **PARTICIPANTS** Adults aged 25-84 years and resident in Belgium in the years 1997 (7,256 adults),
16
17 15 2001 (8,665), 2004 (9,054), 2008 (7,343), 2013 (7,704), and 2018 (8,358).

18
19 16 **MAIN OUTCOME MEASURE** Age-standardised prevalence rates of modifiable lifestyle risks (poor diet,
20
21 17 smoking, excessive alcohol use and leisure-time physical inactivity), metabolic risks (high body mass
22
23 18 index (BMI), blood pressure and cholesterol levels), and major NCDs (type 2 diabetes (T2DM),
24
25 19 cardiovascular diseases (CVD), cancer, asthma and chronic obstructive pulmonary disease (COPD)),
26
27 20 with their relative health disparities across strata by age, sex, region of residence, nationality, education
28
29 21 and income level, and according to high versus low engagement in the four lifestyle risks

30
31 22 **RESULTS** Greater avoidable disparities were observed between extremes of education and income
32
33 23 strata. The most marked disparities were found for exposure to lifestyle risks, except excessive alcohol
34
35 24 use, prevalence of high BMI as well as T2DM, asthma and COPD, with disparities of daily smoking and
36
37 25 COPD worsening over time. High engagement in lifestyle risks was generally observed for men,
38
39 26 residents of the region Wallonia, and among lower education and income strata. This subgroup (20%)
40
41 27 had a worse health profile as compared with those who had a low-risk lifestyle (25%), shown by
42
43 28 prevalence ratios varying between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD,
44
45 29 asthma and COPD.

46
47 30 **CONCLUSIONS** Improving population health, including promoting greater health equity, requires
48
49 31 approaches to be tailored to high-risk groups with actions tackling driving root causes of disparities seen
50
51 32 by social factors and unhealthy lifestyle.

52
53 34 **KEYWORDS**

54
55 35 Lifestyle risks –metabolic risk factors – overweight – type 2 diabetes – cardiovascular disease – socio-
56
57 36 demographic factors – disparities

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3 37 **ARTICLE SUMMARY**
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5 38

6
7 39 **Strengths and limitations of this study**
8

- 9 40 - The identification of vulnerable groups within populations and the quantification of the health
10 41 disparity gaps according to their root causes is essential to support equitable health promotion
11 42 programmes and preventive strategies aiming at more health gains for all.
12
13 43 - We used data of the Belgian Health Interview Surveys, the best available nationally relevant
14 44 epidemiological evidence from Belgium over the last 20 years, to study disparities in health from
15 45 lifestyle and metabolic risks to non-communicable disease outcomes.
16
17 46 - From the socio-demographic sources of health disparities, only age is unavoidable, others
18 47 should be accounted for when formulating equitable health policies.
19
20 48 - The self-reported lifestyle, metabolic risks and prevalence of common non-communicable
21 49 diseases were likely to be underestimates; as reporting of them is subjected to more than only
22 50 their actual presence.
23
24 51 - The cross-sectional survey design cannot rule out the possibility of reverse causation where
25 52 those with prevalent non-communicable disease did show to have less lifestyle risks.
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53 INTRODUCTION

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

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

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

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

82

83 **METHODS**

84 **Data sources**

85 *Belgian Health Interview Surveys (BHIS)*

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

97 The present analyses included adults aged between 25 and 84 years. Participants younger than
98 25 years were excluded from the analysis since a large proportion achieved their highest educational
99 level by the age of 25, and aged 85 years and older since a large proportion of them are institutionalised
100 and the surveys did not include these people. The final sample included 7,256 adults in the year 1997,
101 8,665 in 2001, 9,054 in 2004, 7,343 in 2008, 7,704 in 2013 and 8,358 in 2018.

102

103 *Standardised Procedures for Mortality Analysis (SPMA)*

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

110

111 *Patient and Public involvement*

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2
3 112 The concept of patient and public involvement of the BHIS was translated to the dissemination phase,
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5 113 *i.e.* in addition to full descriptive reports, main results of the BHIS were disseminated via an interactive
6
7 114 and user-friendly data analysis tool promoting dynamic analysis of the aggregated data without the need
8
9 115 for statistical skill of programming knowledge.

10

11 116

12 117 **Health outcomes measures**

13 118 *Lifestyle risks*

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16 119 Data on dietary habits, smoking status, alcohol consumption, and physical activity were self-
17
18 120 reported in the BHIS. Consumption of fruits (excluding juice) and vegetables (including salad, and
19
20 121 excluding potatoes or juice) was assessed based on questions related to their daily intake. A non-daily
21
22 122 consumer was defined as a participant reporting, at the time of the interview, a frequency of 4-6 times a
23
24 123 week or less. Similarly, daily consumption of sweet or salty snacks and sugar-sweetened beverages
25
26 124 (SSBs) was assessed based on a consumption frequency of one serving or more a day. Current
27
28 125 smoking was defined as smoking at least 100 cigarettes in lifetime and currently a daily smoker. Alcohol
29
30 126 consumption was assessed based on questions related to consumption frequency and the average
31
32 127 number of drinks across weekdays and during weekends, and excess was defined as drinking more
33
34 128 than 15 and 22 servings per week for women and men, respectively. For physical inactivity, a
35
36 129 dichotomous categorical variable was created to differentiate between having sufficient physical activity
37
38 130 and being at risk of physical inactivity during leisure time based on a description of the leisure time
39
40 131 activities: hard training and competitive sports more than once week, jogging and other recreational
41
42 132 sports or gardening at least four hours a week; jogging and other recreational sports or gardening at
43
44 133 most four hours a week; walking, bicycling or other light activities at least four hours a week; walking,
45
46 134 bicycling or other light activities at most four hours a week; or reading, watching TV or other sedentary
47
48 135 activities.

49 136 Clustering of the lifestyle risks was summarised as a composite index (Supplementary Table 1).
50
51 137 Each lifestyle risk factor was scored from 1 to 5, with higher points indicating the highest risk, as follows:
52
53 138 Dietary risks (non-daily fruit, non-daily vegetables, daily snacks and daily SSBs, four present = 5, three
54
55 139 = 4, two = 3, one = 2, none = 1); Smoking (current heavy smoker = 5, current non-heavy/occasional
56
57 140 smoker = 4, former smoker quitting < 10 years ago = 3, former smoker quitting ≥ 10 years ago = 2, never
58
59 141 smoked = 1); Alcohol consumption (≥ 22 servings a week = 5, 15-21 = 4, 8-14 = 3, 1-7 = 2, occasional
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3 142 drinkers/abstainers = 1); Physical inactivity (sedentary activities = 5, leisure time sport < 4 hour a week
4
5 143 or light activities = 3, intensive training or leisure time sport \geq 4 hours a week = 1). The index ranged
6
7 144 from 4 to 20, and was for the analyses further categorised into high engagement (12-20) versus low (4-
8
9 145 7). Lifestyle risk index was calculated for the years 2013 and 2018, as dietary data were not available
10
11 146 for previous years.

12 147

14 148 *Metabolic risks*

16 149 BMI was calculated as self-reported body weight divided by self-reported body height squared,
17
18 150 using BMI \geq 25 kg/m² for overweight and \geq 30 kg/m² for obesity. Information on prevalent high blood
19
20 151 pressure and high cholesterol levels was self-reported by providing participants with a list of clinical
21
22 152 conditions for which they had to specify whether they had each clinical condition in the past 12 months.

23 153

24 154 *Prevalence of NCDs*

26 155 Similarly, data on the prevalence of NCDs, such as T2DM, myocardial infarction (MI), coronary
27
28 156 artery disease, cerebrovascular disease, other serious heart diseases, cancer, asthma and chronic
29
30 157 bronchitis/chronic obstructive pulmonary disease (COPD) or emphysema were self-reported collected
31
32 158 using a list of chronic diseases for which participants had to specify whether they had each chronic
33
34 159 disease in the past 12 months.

35 160

36 161 *NCDs-specific mortality*

37 162 Using the pre-defined procedures accessible from SPMA, age-standardised mortality rates per
38
39 163 100,000 were retrieved using ICD-10 codes for T2DM (E10-E14), coronary artery disease (I20-I25),
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41 164 cerebrovascular disease (I60-I69), cancer (C00-D48), asthma (J45-J46) and chronic lower respiratory
42
43 165 diseases (J40-J44, J47) were obtained with comparisons made by sex, region and nationality.

44 166

45 167 **Population stratification**

46 168 To describe potential health disparities across the Belgian population, the following socio-
47
48 169 demographic determinants of health were selected: 10-year age group, sex, region of residence,
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50 170 nationality, education and income. Educational level was based on the highest level of education
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52 171 attained in the household and was recoded into three categories: low (primary education or less),

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3 172 intermediate (lower and higher secondary education), and high (higher education). Income level was
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5 173 based on the household's total available income and recoded into five quintiles. Additionally, the
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7 174 population was further stratified by lifestyle risk index: high versus low engagement in lifestyle risks, as
8
9 175 an additional layer of potential health disparities.

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11 177 **Data analyses**

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14 178 Annual descriptive statistics were represented as weighted proportions of the characteristics of
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16 179 the survey participants as a whole per survey year. Age-standardised prevalence rates were computed
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18 180 by levels of the population stratification variables using direct standardisation with the Belgian population
19
20 181 of 2018 used as reference. Health disparities were calculated by direct comparison between population
21
22 182 strata: age (oldest vs youngest group), sex (women vs men), region (Walloon vs Flanders, Brussels vs
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24 183 Flanders), nationality (non-Belgian Europeans vs Belgians, non-Europeans vs Belgians), educational
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26 184 level (low vs high), income (low vs high), and engagement in lifestyle risks (high vs low). Health
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28 185 disparities were reported as prevalence ratios, *i.e.* the relative difference between the age-standardised
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30 186 prevalence between two levels of the population stratification variables; with the estimated relative
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32 187 differences and their uncertainty (95% confidence intervals (CI)) calculated using a survey-weighted
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34 188 Cox regression model with time equals one, and adjusting for age. The 20-year trend was tested by
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36 189 including an interaction term between time and the population stratification variable in the models, and
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38 190 *p*-values for this interaction term were reported. We only analysed outcomes for which at least 20 survey
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40 191 participants in any specific strata reported having the outcome of interest. Additionally, we measured
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42 192 health disparities by socio-demographic factors in absolute terms, using prevalence differences between
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44 193 two levels of the population stratification variables. To explore the role of individual lifestyle risks,
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46 194 independently of others, relative health disparities were estimated for having that lifestyle risk versus
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48 195 not (reference).

49 196 Clustering of lifestyle risks was described using Spearman's rank correlation coefficients (*P*)
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51 197 with *p*-values adjusted for multiple testing according to Sidak. Such clustering was quantified using
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53 198 prevalence odds ratios, as estimated from a survey-weighted generalised ordered logistic regression
54
55 199 model using the `gologit2` command in STATA with the `autofit` function that identifies the partial
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57 200 proportional odds model that appropriately fits the data²³, with separate models for each lifestyle risk
58
59 201 related to the other risks. To enhance interpretation of results, we only presented prevalence odds ratios
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3 202 and their 95% CI for the extremes, *i.e.* estimates belonging to the comparisons between a score of 5
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5 203 (high engagement in a lifestyle risk) versus 1 (low; reference), for having a higher score than 1 on the
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7 204 lifestyle risk of interest.

8
9 205 All analyses were conducted using STATA/SE 16, and a *p*-value of 0.05 was considered as
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11 206 statistically significant with no adjustment for multiple comparisons for quantification of health disparities.

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13 207

14 208 **RESULTS**

15
16 209 An overview of the general characteristics of the study population across the six available
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18 210 surveys is presented in TABLE 1, including prevalence estimates for the lifestyle and metabolic risks,
19
20 211 chronic diseases and NCD-specific mortality.

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23 213 *Relative health disparities by socio-demographic population strata*

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25 214 For all population strata, the relative health disparities were generally more pronounced for
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27 215 lifestyle risks and NCDs (FIGURE 1; and Supplementary Table 2).

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31 217 Age: old versus young age groups. Exposure to lifestyle risks, except leisure-time physical inactivity,
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33 218 decreased with age, (prevalence ratios of 0.2 to 0.6; FIGURE1 and Supplementary Table 2.A), while
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35 219 prevalence of metabolic risks was, as expected, higher among the older age group (relative disparities
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37 220 between 1.6 to 14). Over 20 year' s, the disparity gap by age became smaller for asthma only.

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41 222 Sex: women versus men. Lifestyle risks, except for leisure-time physical inactivity, was lower among
42
43 223 women (prevalence ratios of 1.5; Supplementary Table 2.B). Women were significantly on average 1.3
44
45 224 to 3 times less frequently overweight, having high cholesterol and CVD. Relative disparities for high
46
47 225 blood pressure reduced over 20 years' time, reaching more or less equal prevalence in the two most
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49 226 recent surveys (FIGURE 2B). Still, NCD-specific mortality rates were lower among women, most clearly
50
51 227 seen for ischemic heart disease and cancer, with disparities increasing over time.

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55 229 Region: Wallonia vs Flanders, and Brussels vs Flanders. Exposure to lifestyle risks was generally
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57 230 slightly higher for Wallonia, most clearly for daily smoking and leisure-time physical inactivity
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59 231 (Supplementary Table 2.C and 2.D) as well as higher prevalence of metabolic risks and NCDs. Over
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3 232 time, the health disadvantages for Brussels were decreasing, as significantly seen for daily smoking,
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5 233 leisure-time physical inactivity (FIGURE 2A), overweight (FIGURE 2B), and cancer (FIGURE 2C).

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9 235 Nationality: non-Belgian Europeans vs Belgians, and non-Europeans vs Belgians. As compared to the
10
11 236 Belgians, exposure to non-daily vegetables and leisure-time physical inactivity was higher among the
12
13 237 non-Belgian Europeans and non-Europeans (Supplementary Table 2.E and 2.F). The prevalence of
14
15 238 high BMI and T2DM was also higher in the non-Europeans (relative disparities of 1.2 to 2.3), with the
16
17 239 disparity of overweight significantly worsening over time (FIGURE 2B). Mortality rates were, however,
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19 240 lower in the foreign populations living in Belgium.

20
21 241
22 242 Educational level: low vs high. Exposure to lifestyle risks, except excessive alcohol use, was higher for
23
24 243 the low educated (relative disparities up to 2.2; FIGURE 1 and Supplementary Table 2.G), with those of
25
26 244 daily smoking and leisure-time physical inactivity worsening over time (FIGURE 2A). The prevalence of
27
28 245 high BMI was and remained higher in the low educated (relative disparities of 1.4 and 1.8) as well as
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30 246 prevalence of T2DM, MI, asthma and COPD (up to 1.7 and 2.8 times higher).

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32 247
33
34 248 Income level: low vs high. Similar to educational level, exposures to lifestyle risks, except excessive
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36 249 alcohol use, was higher for the lowest income quintile (FIGURE 1 and Supplementary Table 2.H), with
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38 250 those of dietary risks and daily smoking worsening over time (FIGURE 2A). The prevalence of metabolic
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40 251 risks as well as NCDs was and also remained higher in the lowest income quintile, with the relative
41
42 252 disparity of high blood pressure (FIGURE 2B) and COPD (FIGURE 2C) worsening over time.

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44 253

45 254 *Absolute health disparities by socio-demographic population strata*

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47 255 Measuring this on an absolute scale did not alter conclusions (Supplementary Table 3).
48
49 256 Similarly, when using absolute differences, health disparities were the most pronounced for age,
50
51 257 education and income strata, with the highest disparities seen for lifestyle and metabolic risks, but not
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53 258 for prevalent NCDs related to their low prevalence in the general population.

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55 259

56 260 *Clustering of lifestyle risks*

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3 261 One-fifth was engaged in multiple lifestyle risks of poor diet, smoking, excessive alcohol use
4
5 262 and physical inactivity, while one-fourth reported an overall healthy lifestyle (Supplementary Table 4).
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7 263 High engagement in multiple lifestyle risks was most frequent among men, residents of Wallonia, the
8
9 264 lower educated and income strata with their multiple risks mainly characterised by non-daily intakes of
10
11 265 fruit, daily snacking, current smoking and physical inactivity, but no distinct pattern of alcohol
12
13 266 consumption.

14 267 Belgian residents with at least one dietary risk were slightly more likely to be physically inactive,
15
16 268 heavy smokers, and heavy drinkers, with former or current smokers also more likely to be heavy drinkers
17
18 269 and physically inactive, but heavy drinkers less likely to be physically inactive (Supplementary Table 5).
19
20 270 The odds of having at least one dietary risk was higher for heavy smokers (OR 3.17; 95%CI 2.54, 3.95;
21
22 271 TABLE 2), and for the physically inactive (1.45; 1.24, 1.69). Similarly, the odds of being a former or
23
24 272 current smoker was higher when having four dietary risks (2.84; 1.87, 4.25), for heavy drinkers (4.75;
25
26 273 3.61, 6.25), and for the physically inactive (1.39; 1.18, 1.64). The odds of being a frequent (at least
27
28 274 weekly) drinker was only higher for heavy smokers (2.45, 1.95, 3.08). Lastly, the odds of being at most
29
30 275 light physically active was higher for heavy smokers (2.17; 1.73, 2.72), but lower for heavy drinkers
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32 276 (0.60; 0.46, 0.78).

33 277 The prevalence of metabolic risks and NCDs were higher among individuals with high
34
35 278 engagement in multiple lifestyle risks (TABLE 3). In 2018, relative disparities were significantly varying
36
37 279 between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD, asthma and COPD, with
38
39 280 only high cholesterol levels significantly higher in 2018 than in 2013. Focussing on individual lifestyle
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41 281 risks, the prevalence of high BMI, T2DM, and CVD was more frequently reported for
42
43 282 abstainers/occasional drinkers and the non-physically active, independently of age, sex and other
44
45 283 lifestyle risks, with the prevalence of T2DM also more frequently reported when having none dietary
46
47 284 risks, and of CVD and COPD more frequently for former and current smokers (Supplementary Table 6).
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49 285

50 286 **DISCUSSION**

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53 287 Using nationally representative data of Belgium, we identified the population strata where health
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55 288 disparities are present, and we traced the evolution of these disparities over 20 years. Older age, lower
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57 289 education, and lower income strata were the most affected by unfavourable health. For the latter two
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59 290 strata, we also observed a greater prevalence of engagement in multiple lifestyle risks, with their
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3 291 disparities worsening over time. Multiple lifestyle risks were also more prevalent in men, and the region
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5 292 of Wallonia. Attention is also warranted for non-Europeans living in Belgium for whom high BMI, high
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7 293 blood pressure and T2DM were more prevalent, although no different lifestyle risks than the native
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9 294 Belgians were observed.

10
11 295 The socio-economic distribution of health as reported in this study corroborates earlier
12
13 296 surveillance findings from western countries, including Belgium,^{14,15} as operationalised by highest
14
15 297 educational attainment. The inverse education-health gradients are a long-lasting universal
16
17 298 phenomenon in Europe with widening disparities for common chronic diseases,²⁴ self-assessed
18
19 299 health,²⁵ and mortality²⁶. Following earlier observations,²⁷ results of the present study also confirmed
20
21 300 that at present engagement in lifestyle risks remained more frequent for the low educated, and because
22
23 301 of the mediating role of health illiteracy, *i.e.* insufficient knowledge, motivation and competence to make
24
25 302 appropriate health decisions, likely to persist.^{28,29} Using education as a single indicator of socio-
26
27 303 economic position at the individual level, however, captures only the knowledge-related assets of the
28
29 304 socio-economic stratification, disregarding the full understanding of the existing health disparities by
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31 305 ranks in a society.³⁰ In our study, health disparities by education resemble well those by income, though
32
33 306 slightly more pronounced for income. This suggests that both the social and financial resources provided
34
35 307 by education and income, respectively, play a key role in a healthy lifestyle, and thereby delaying the
36
37 308 onset of metabolic conditions and NCDs.

38
39 309 We used the most simple absolute and relative measures of disparities in health to illustrate the
40
41 310 existing disparities in Belgium, and in this way avoid the value-laden of an arbitrary choice. Our findings
42
43 311 might be limited by participants' self-reporting. Reporting risks and diseases is subjected to not only the
44
45 312 actual presence of it, but also participant-related characteristics like health knowledge, ability to recall,
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47 313 willingness to report, and in case of health problem, frequency of contact with physician and
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49 314 disadvantages experienced in everyday life. This shortcoming of self-reports has been acknowledged
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51 315 by the first Belgian Health Examination Survey (BELHES), conducted for the first time by Sciensano in
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53 316 2018.³¹ Early findings of the BELHES showed that one-third of the population suffers from high blood
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55 317 pressure, half from high cholesterol levels and one-tenth from T2DM, while according to the self-reports
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57 318 only 15%, 20% and 6%, respectively.³² This potential bias might differentially affect our population strata,
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59 319 with a misclassification likely to occur to a larger extent in the most disadvantaged group, leading to an
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320 underestimation of the true disparity. Besides, our findings provide a general profile of the high-risk

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3 321 groups, and therefore cannot be directly extrapolated to all individuals belonging to certain strata, for
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5 322 example within the low educated prevalence of risks and outcomes might differ by age group and sex.²⁴
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7 323 In cross-sectional studies, there is a potential bias for reverse causality bias, potentially explaining our
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9 324 contra-intuitive finding of a higher reported T2DM prevalence when having none dietary risks and being
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11 325 abstainers/occasional drinker, since among those with T2DM around 60% of them followed a diet for
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13 326 this condition, as also inquired by the BHIS. While excessive alcohol use (*i.e.* drinking very high amounts
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15 327 of alcohol weekly) is a well-recognised risk factor for NCDs, the light-to-moderate levels of alcohol
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17 328 consumption remain controversial.³³ In fact, zero consumption is nowadays ever more regarded as the
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19 329 consumption amount fitting a healthy lifestyle, since estimated protective effects for some health
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21 330 conditions at low levels are outweighed by increased risks of other health-related harms, including
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23 331 cancer.³⁴

24 332 Our study implies that over a wide range of risk and health indicators important population strata
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26 333 to target are the elderly, the low educated, the low income strata, and the immigrants, of which only the
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28 334 former is an unfortunately unavoidable disparity difficult to argue to be unjust.³⁵ Narrowing the disparities
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30 335 by socio-economic position and nationality should be the focus of health policy programmes, likely with
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32 336 interventions based on the principles of proportionate universalism,³⁶ *i.e.* a universal action with a
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34 337 targeted intervention component tailored to tackle the driving root causes either simultaneously or
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36 338 sequentially, with due consideration to the upstream determinants of health that may lie outside the
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38 339 health sector (e.g. illiteracy, unemployment, the barrier to healthcare consumption).³⁷

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42 341 **CONCLUSION**

43 342 In conclusion, health status is not only a product of individual choice but also related to the
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45 343 population strata where a person belongs to, with this defined particularly by the socio-demographic
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47 344 factors influencing lifestyle. In addition, the tendency of lifestyle risks to cluster strengthens the need for
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49 345 health promotion programmes that tailor multiple targets and aim at reaching the socio-economic
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51 346 disadvantaged for narrowing health disparities.

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448 **TABLES & FIGURES**449 **TABLE 1** Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to
450 survey year.

	Year of the survey						p-trend ^a
	1997	2001	2004	2008	2013	2018	
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 \geq 25kg/m ²	45.4	48.8	48.1	50.9	51.7	52.7	<0.001
Obesity, BMI \geq 30kg/m ²	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

451 Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease.
 452 ^a p-trend calculated using the p-value of corrected weighted Pearson chi square statistic for socio-demographic factors, the p-
 453 value of the time term in a survey-weighted logistic regression for lifestyle and metabolic risks and NCD prevalence, and the p-
 454 value of Mann-Kendall trend test for NCD-related mortality rates. ^b Self-reported prevalence of lifestyle and metabolic risks and
 455 NCDs.
 456 .

457 **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 (<i>p</i> -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 (<i>p</i> -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 (<i>p</i> -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 (<i>p</i> -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)

458 ^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
459 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
460 risk of interest.
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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		<i>p</i> -change ^c
	High	Low	High	Low	2013	2018	
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.

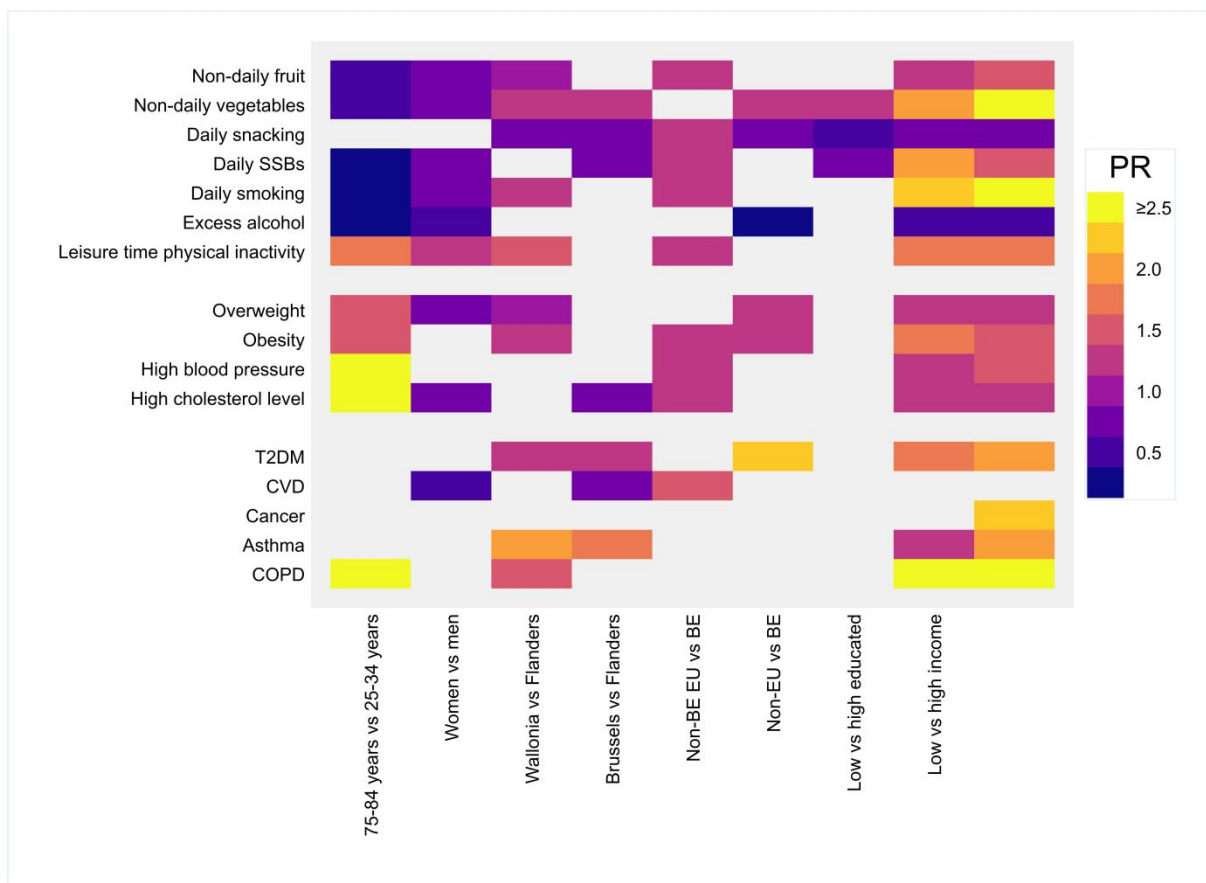
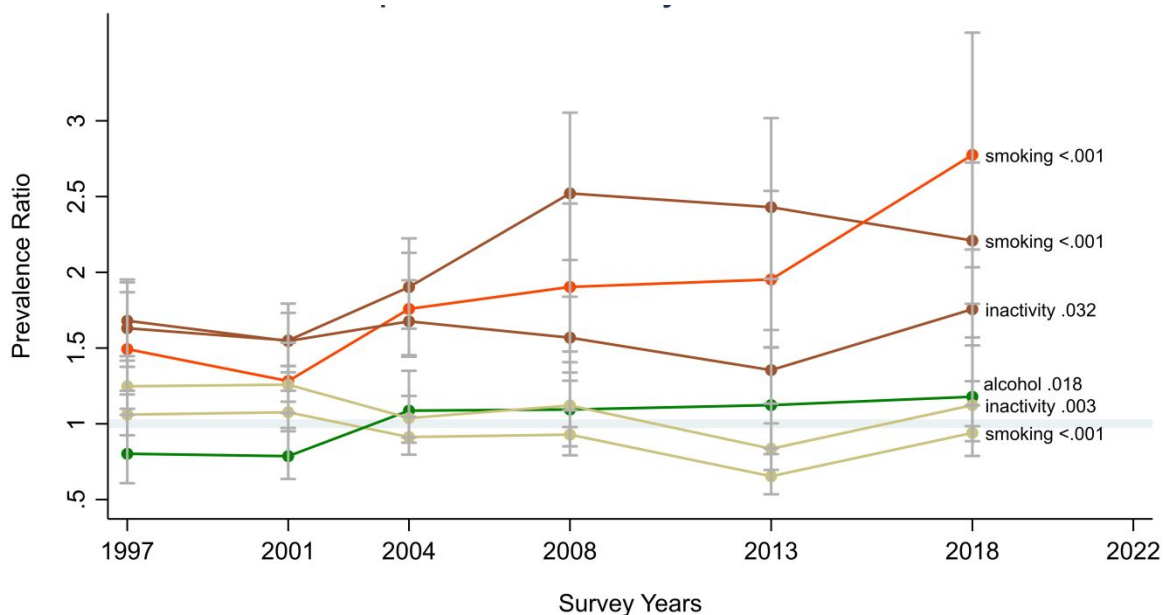


Figure 1 Heatmap of the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle and metabolic risks to non-communicable diseases according to socio-demographic strata in 2018 in Belgium.

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

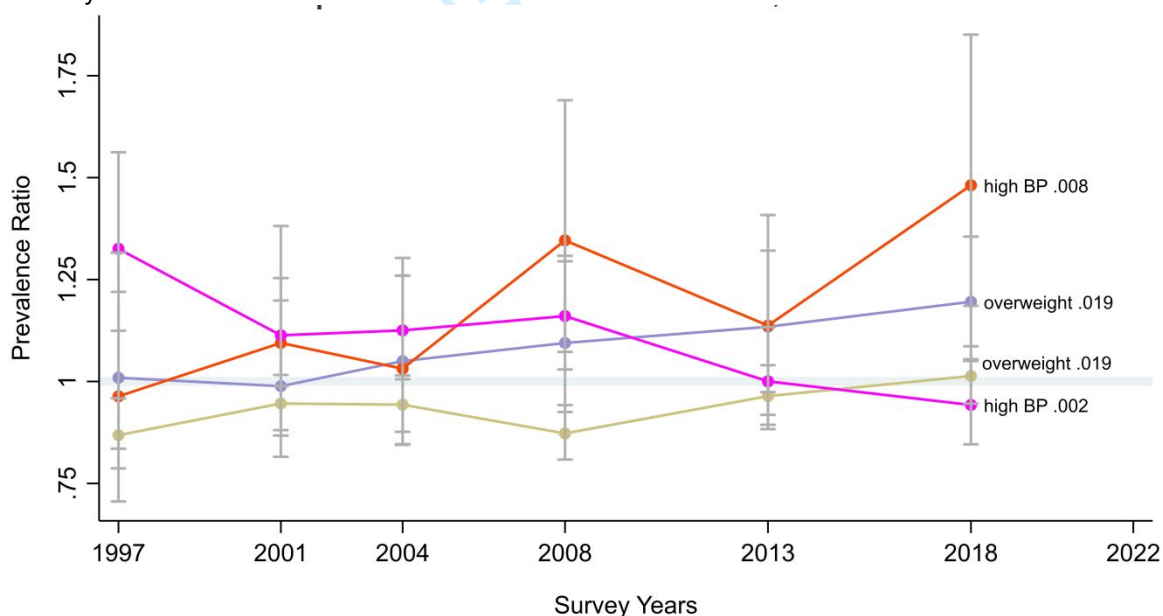
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2A: Lifestyle risks



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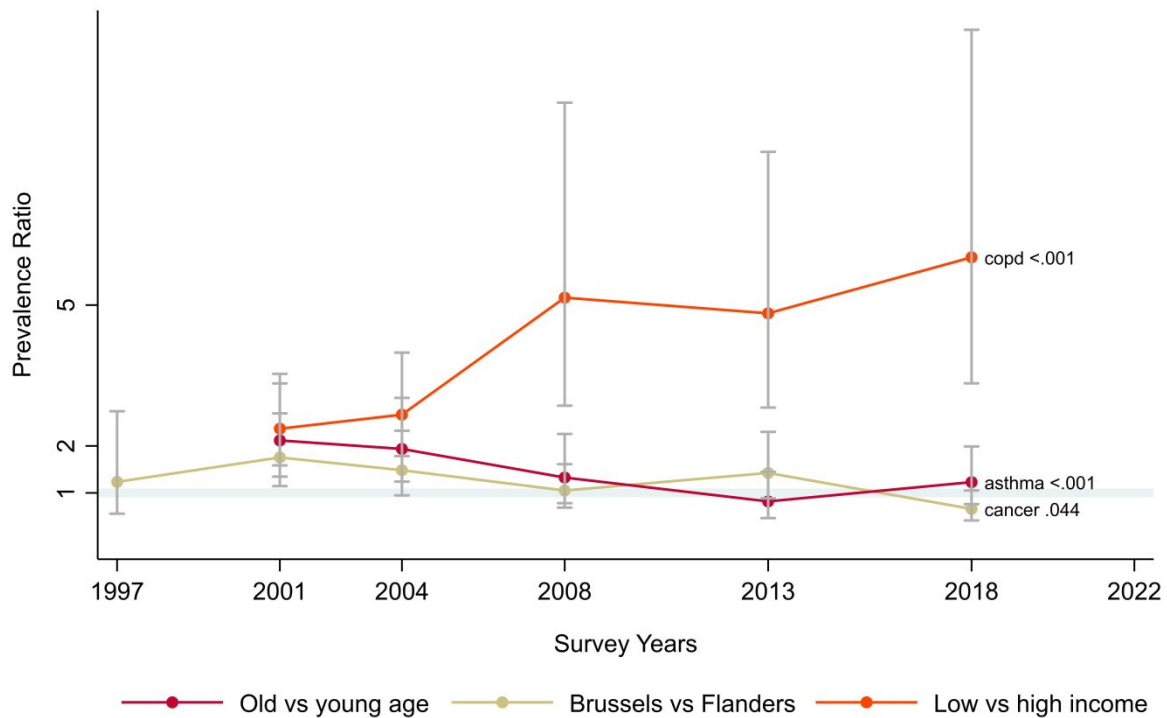
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2B: Metabolic risks



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2C: Non-communicable diseases

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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, from lifestyle risks to non-communicable diseases according to socio-demographic strata, from 1997 until 2018 in Belgium.

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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.

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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).

509 LEGEND OF SUPPLEMENTARY MATERIALS

510

511 **Supplementary Table 1** Components and scoring of the lifestyle risk index ^{a,b}.

512 Abbreviations: SSB, sugar-sweetened beverages

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

515

516 **Supplementary Tables 2** Trends in health disparities related to the prevalence of lifestyle risks, 517 metabolic risks, and major non-communicable diseases according to socio-demographic strata and 518 measured as age-standardised prevalence ratios between distal groups.

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

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

527 2A. Age-related relative health disparities: adults aged 75-84 years versus 25-34 years (reference)

528 2B. Sex- related relative health disparities: women vs men (reference)

529 2C. Region of residence-related relative health disparities: Wallonia vs Flanders (reference)

530 2D. Region of residence-related relative health disparities: Brussels vs Flanders (reference)

531 2E. Nationality-related relative health disparities: non-Belgian Europeans vs Belgians (reference)

532 2F. Nationality-related relative health disparities: non-Europeans vs Belgians (reference)

533 2G. Education-related relative health disparities: low vs high (reference)

534 2H. Income-related relative health disparities: Quintile 1 vs Quintile 5 (reference)

535

536 **Supplementary Tables 3** Trends in health disparities related to the prevalence of lifestyle risks, 537 metabolic risks, and major non-communicable diseases according to socio-demographic strata and 538 measured as age-standardised percentage point differences between distal groups.

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

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

547 3A. Age-related absolute health disparities: adults aged 75-84 years versus 25-34 years (reference)

548 3B. Sex-related absolute health disparities: women vs men (reference)

549 3C. Region of residence-related absolute health disparities: Wallonia vs Flanders (reference)

550 3D. Region of residence-related absolute health disparities: Brussels vs Flanders (reference)

551 3E. Nationality-related absolute health disparities: non-Belgian Europeans vs Belgians (reference)

552 3F. Nationality-related absolute health disparities: non-Europeans vs Belgians (reference)

553 3G. Education-related absolute health disparities: low vs high (reference)

554 3H. Income-related absolute health disparities: Quintile 1 vs Quintile 5 (reference)

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556 **Supplementary Table 4** General characteristics and lifestyle risks (weighted %) of the Belgian 557 population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus 558 low)

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

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3 566 **Supplementary Table 5** Characteristics (weighted %) of the Belgian population, aged 25-84 years,
4 567 according to the level of engagement in the individual lifestyle risks of dietary risks, smoking, alcohol
5 568 and physical inactivity, in 2018.^a
6 569 ^a Lifestyle risks for diet: having at least one dietary risk present, lifestyle risks for smoking: being a current or former smoker;
7 570 lifestyle risks for alcohol: being a frequent drinker (at least drinking alcohol weekly; and lifestyle risk for physical inactivity: being
8 571 physically inactive or lightly active.

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10 572
11 573 **Supplementary Table 6** Relative health disparities by engagement in individual lifestyle risks,
12 574 independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios.^b
13 575 ^a Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle
14 576 risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being physically
15 577 inactive or lightly active. ^b Adjusted for age, sex and the other lifestyle risks.
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579 **Contributorship statement**

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

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595 **Competing interests declaration**

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

601

602 **Ethics approval**

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

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3 609 **Transparency statement**
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5 610 The lead author affirms that this manuscript is an honest, accurate and transparent account of the study
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7 611 being reported; that no important aspects of the study have been omitted; and that any discrepancies
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9 612 from the study as planned (and, if any relevant, registered) have been explained.
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13 614 **Funding**
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18
19 617 the collection, analysis, or interpretation of data, nor in the writing of the report or in the decision to
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21 618 submit the manuscript for publication.
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28
29 622 Rana Charafeddine for providing access to their data.
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33 624 **Dissemination declaration**
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35 625 Not applicable.
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39 627 **Patient and Public Involvement Statement**
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41 628 The concept of patient and public involvement of the BHIS was translated to the dissemination phase,
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43 629 *i.e.* in addition to full descriptive reports, main results of the BHIS were disseminated via an interactive
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45 630 and user-friendly data analysis tool promoting dynamic analysis of the aggregated data without the need
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47 631 for statistical skill of programming knowledge.
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51 633 **Data Sharing Statements**
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53 634 Data of the Health Interview Surveys, conducted by Sciensano, are not publicly available, but
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55 635 access to data is possible through request to the Privacy Commission. More information can
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57 636 be retrieved via <https://his.wiv-isp.be/SitePages/Home.aspx>. Also, publicly available datasets
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3 637 were utilized in this study: Standardised Procedures for Mortality Analysis – Belgium (SPMA),
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5 638 developed by Sciensano, accessible via <https://spma.wiv-isp.be/SitePages/Home.aspx>.
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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	<i>p</i> -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					0.99 (0.78; 1.10)	1.11 (0.93; 1.31)	0.159
Daily SSBs					0.33 (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)	0.33 (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)	0.99 (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)	1.89 (1.45; 2.32)	1.72 (1.41; 2.12)	0.108
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	1.58 (1.30; 1.91)	1.44 (1.25; 1.66)	1.71 (1.48; 1.97)	1.45 (1.26; 1.66)	1.55 (1.33; 1.75)	1.55 (1.35; 1.78)	0.991
Obesity, BMI ≥ 30 kg/m ²	1.76 (1.05; 2.95)	2.53 (1.78; 3.61)	1.76 (1.24; 2.49)	1.81 (1.31; 2.49)	1.55 (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)	17.24 (10.9; 27.2)	13.85 (8.81; 21.8)	0.111
High cholesterol levels					12.99 (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)	0.89 (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					0.75 (0.72; 0.82)	0.75 (0.71; 0.79)	0.531
Non-daily vegetables					0.72 (0.63; 0.78)	0.72 (0.66; 0.79)	0.763
Daily snacking					1.04 (0.93; 1.07)	1.04 (0.96; 1.12)	0.407
Daily SSBs					0.65 (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)	0.71 (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)	1.22 (1.13; 1.45)	1.33 (1.20; 1.47)	0.836
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	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/m ²	0.96 (0.80; 1.16)	1.05 (0.91; 1.20)	1.07 (0.94; 1.23)	1.07 (0.94; 1.23)	1.05 (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)	1.09 (0.88; 1.13)	0.94 (0.85; 1.05)	0.002
High cholesterol levels					0.91 (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					0.61 (0.39; 0.67)	0.61 (0.48; 0.78)	0.416
Myocardial infarction				0.46 (0.27; 0.78)	0.48 (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					0.41 (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)	0.91 (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)	1.09 (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)	0.70 (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)	0.44 (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)	0.82 (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)	1.05 (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)	0.45 (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	<i>p</i> -trend ^a
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.0 (0.96; 1.12)	1.14 (1.05; 1.23)	0.101
Non-daily vegetables					1.1 (1.01; 1.36)	1.29 (1.13; 1.48)	0.325
Daily snacking					1.0 (0.91; 1.10)	0.88 (0.79; 0.97)	0.050
Daily SSBs					1.1 (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)	1.1 (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)	1.1 (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)	1.1 (1.00; 1.33)	1.45 (1.29; 1.64)	0.741
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	1.10 (1.01; 1.19)	1.09 (1.03; 1.16)	1.12 (1.05; 1.19)	1.05 (0.98; 1.12)	1.0 (1.00; 1.14)	1.08 (1.01; 1.15)	0.338
Obesity, BMI ≥ 30 kg/m ²	1.38 (1.12; 1.71)	1.28 (1.10; 1.50)	1.33 (1.14; 1.55)	1.07 (0.92; 1.25)	1.2 (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)	0.9 (0.79; 1.03)	1.10 (0.97; 1.23)	0.209
High cholesterol levels					0.9 (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)	1.2 (0.96; 1.61)	1.37 (1.10; 1.71)	0.108
CVD					1.2 (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)	1.5 (0.87; 2.67)	1.28 (0.75; 2.20)	
Other serious heart disease					0.8 (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)	0.8 (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)	1.7 (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)	1.6 (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)	1.1 (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)	1.2 (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)	0.9 (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)	1.1 (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)	2.1 (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)	1.3 (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/m ²	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/m ²	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	<i>p</i> -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/m ²	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/m ²	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/m ²	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/m ²	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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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/m ²	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/m ²	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. ^aTrends 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	<i>p</i> -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/m ²	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/m ²	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. ^aTrends 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/m ²	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/m ²	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.

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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%)	6.9% (3.2%; 9.6%)	8.1% (5.4%; 10.9%)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	-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/m ²	-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							
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%)	1.1% (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%)	0.0% (-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)	-121 (-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	<i>p</i> -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/m ²	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/m ²	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. ^aTrends 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% (-9.9%; -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% (1.0%; 9.9%)	6.7% (3.2%; 10.2%)	0.315
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	-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/m ²	-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							
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)	9.9 (-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)	15.5 (-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)	11.8 (-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)	12.0 (-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. ^aTrends 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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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/m ²	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/m ²	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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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/m ²	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/m ²	-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% (0.3%; 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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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/m ²	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/m ²	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%)	4.0% (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					0.6% (-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%)	3.1% (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%)	4.1% (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. ^aTrends 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% (-0.6%; 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% (8.0%; 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% (10.7%; 23.0%)	22.0% (15.8%; 28.1%)	0.208
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	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% (5.1%; 15.9%)	11.4% (5.6%; 17.2%)	0.453
Obesity, BMI ≥ 30 kg/m ²	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% (6.6%; 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% (-0.6%; 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. ^aTrends 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.

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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								

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≥ 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 individual 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 \geq 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 \geq 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

^aLifestyle 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. ^bAdjusted for age, sex and the other lifestyle risks.

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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.

BMJ Open

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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3 1 **Quantification of disparities in the distribution of lifestyle and metabolic risk factors,**
4 **prevalence of non-communicable diseases and related-mortality: The Belgian Health**
5 **Interview Surveys 1997-2018**
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3 9 **ABSTRACT**
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5 10 **OBJECTIVES** Comprehensively measure the trends in health disparities by socio-demographic strata
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7 11 in terms of exposure to lifestyle and metabolic risks, and prevalence and mortality of non-communicable
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9 12 diseases (NCDs) during the last 20 years in Belgium.

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11 13 **DESIGN** Cross-sectional analysis of periodic national-representative health interview surveys and vital
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13 14 statistics.

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15 15 **SETTING** Population-based study of adult residents in Belgium between 1997-2018.

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17 16 **PARTICIPANTS** Adults aged 25-84 years and resident in Belgium in the years 1997 (7,256 adults),
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19 17 2001 (8,665), 2004 (9,054), 2008 (7,343), 2013 (7,704), and 2018 (8,358).

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21 18 **MAIN OUTCOME MEASURE** Age-standardised prevalence rates of modifiable lifestyle risks (poor diet,
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23 19 smoking, excessive alcohol use and leisure-time physical inactivity), metabolic risks (high body mass
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25 20 index (BMI), blood pressure and cholesterol levels), and major NCDs (type 2 diabetes (T2DM),
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27 21 cardiovascular diseases (CVD), cancer, asthma and chronic obstructive pulmonary disease (COPD)),
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29 22 with their relative health disparities across strata by age, sex, region of residence, nationality, education
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31 23 and income level, and according to high versus low engagement in the four lifestyle risks, calculated
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33 24 from a survey-weighted Cox regression with time equals one, and adjusting for age.

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35 25 **RESULTS** Greater avoidable disparities were observed between extremes of education and income
36
37 26 strata. The most marked disparities were found for exposure to lifestyle risks, except excessive alcohol
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39 27 use, prevalence of high BMI as well as T2DM, asthma and COPD, with disparities of daily smoking and
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41 28 COPD worsening over time. Still, NCD-specific mortality rates were significantly higher among men
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43 29 (except asthma), residents of Wallonia and Brussels (except cerebrovascular disease), and among the
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45 30 native Belgians (except T2DM and asthma). High engagement in lifestyle risks was generally observed
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47 31 for men, residents of the region Wallonia, and among lower education and income strata. This subgroup
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49 32 (20%) had a worse health profile as compared with those who had a low-risk lifestyle (25%), shown by
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51 33 prevalence ratios varying between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD,
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53 34 asthma and COPD.

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55 35 **CONCLUSIONS** Improving population health, including promoting greater health equity, requires
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57 36 approaches to be tailored to high-risk groups with actions tackling driving root causes of disparities seen
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59 37 by social factors and unhealthy lifestyle.
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3 39 **KEYWORDS**

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5 40 Lifestyle risks –metabolic risk factors – overweight – type 2 diabetes – cardiovascular disease – socio-
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7 41 demographic factors – disparities
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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.

62 INTRODUCTION

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

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

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

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2
3 92 who is at risk and which lifestyle risks more frequently cluster would certainly support tailored health
4
5 93 promotion programmes, aiming at more health gains.

6
7 94 To identify and quantify all relevant health disparities in Belgium, this study aims to provide a
8
9 95 clear and comprehensive overview of the health status, from lifestyle risks to NCDs, by relevant
10
11 96 population strata of socio-demographic factors as well as by engagement in multiple lifestyle risks, using
12
13 97 nationally relevant epidemiological evidence from Belgium over the last 20 years.

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15 98

16 99 **METHODS**

17 18 100 **Data sources**

19 20 101 *Belgian Health Interview Surveys (BHIS)*

21
22 102 The BHIS is a cross-sectional study, conducted by Sciensano, carried out periodically every
23
24 103 four to five years since 1997 and including approximately a sample of 10,000 participants per survey
25
26 104 wave, representative of Belgian residents. Briefly, participants were selected from the Belgian national
27
28 105 population register through a multistage stratified population sampling involving a geographical
29
30 106 stratification according to the regions, and subsequently, a selection of municipalities within provinces,
31
32 107 households within municipalities, and a maximum of four respondents within households was applied.
33
34 108 Data were collected through face-to-face interview at the participant's home covering demographics,
35
36 109 specific diseases and conditions, and nutritional status, and a self-administered questionnaire covering
37
38 110 more sensitive topics, such as health behaviours and lifestyle. Survey weights were designed and
39
40 111 applied to ensure the representativeness of the sample in terms of age, sex and province. Further details
41
42 112 on the BHIS are described elsewhere.²⁴⁻²⁶ The BHIS was authorised by an independent administrative
43
44 113 authority protecting privacy and personal data, and was approved by the ethical committee of Ghent
45
46 114 University Hospital. The pseudonymised data from Sciensano was shared with the Institute of Tropical
47
48 115 Medicine (ITM) Antwerp through a secure data transfer platform applying data encryption. Ethical
49
50 116 clearance for the present analyses was obtained from the Institutional Review Board of ITM after revision
51
52 117 of the research protocol num. 1366/20, 23/03/2020.

53 118

54
55 119 The present analyses included adults aged between 25 and 84 years. Participants younger than
56
57 120 25 years were excluded from the analysis since a large proportion achieved their highest educational
58
59 121 level by the age of 25, and aged 85 years and older since a large proportion of them are institutionalised

1
2
3 122 and the surveys did not include these people. The final sample included 7,256 adults in the year 1997,
4
5 123 8,665 in 2001, 9,054 in 2004, 7,343 in 2008, 7,704 in 2013 and 8,358 in 2018.

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7 124

8
9 125 *Standardised Procedures for Mortality Analysis (SPMA)*

10 126 SPMA, operational since the early 1990s, was developed by Sciensano with the aim to facilitate
11
12 127 the use of vital statistics data for public health policy and scientific research.²⁷ From 1998 up to 2017,
13
14 128 cause-specific mortality data were coded by the ICD-10 using the initial cause of death only, and
15
16 129 grouped by age, sex, region of residence and nationality. Data from 1998 was used as a proxy for the
17
18 130 year 1997 so that cause-specific mortality could be coded using ICD-10 for all years included in the
19
20 131 analyses, and similarly, data from 2017 as a proxy for the year 2018.

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22 132

23
24 133 *Patient and Public involvement*

25
26 134 As a secondary data analysis of the BHIS, this study did not involve patients/participants or the public
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28 135 in the design, conduct or dissemination plans.

29
30 136

31
32 137 **Health outcomes measures**

33
34 138 *Lifestyle risks*

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36 139 Data on dietary habits, smoking status, alcohol consumption, and physical activity were self-
37
38 140 reported in the BHIS. Consumption of fruits (excluding juice) and vegetables (including salad, and
39
40 141 excluding potatoes or juice) was assessed based on questions related to their daily intake. A non-daily
41
42 142 consumer was defined as a participant reporting, at the time of the interview, a frequency of 4-6 times a
43
44 143 week or less. Similarly, daily consumption of sweet or salty snacks and sugar-sweetened beverages
45
46 144 (SSBs) was assessed based on a consumption frequency of one serving or more a day. Current
47
48 145 smoking was defined as smoking at least 100 cigarettes in lifetime and currently a daily smoker. Alcohol
49
50 146 consumption was assessed based on questions related to consumption frequency and the average
51
52 147 number of drinks across weekdays and during weekends, and excess was defined as drinking more
53
54 148 than 15 and 22 servings per week for women and men, respectively, following WHO indicators. For
55
56 149 physical inactivity, a dichotomous categorical variable was created to differentiate between having
57
58 150 sufficient physical activity and being at risk of physical inactivity during leisure time based on a
59
60 151 description of the leisure time activities: hard training and competitive sports more than once week,

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2
3 152 jogging and other recreational sports or gardening at least four hours a week; jogging and other
4
5 153 recreational sports or gardening at most four hours a week; walking, bicycling or other light activities at
6
7 154 least four hours a week; walking, bicycling or other light activities at most four hours a week; or reading,
8
9 155 watching TV or other sedentary activities, following WHO indicators.

10
11 156 Clustering of the lifestyle risks was summarised as a composite index (Supplementary Table 1).
12
13 157 Each lifestyle risk factor was scored from 1 to 5, with higher points indicating the highest risk, as follows:
14
15 158 Dietary risks (non-daily fruit, non-daily vegetables, daily snacks and daily SSBs, four present = 5, three
16
17 159 = 4, two = 3, one = 2, none = 1); Smoking (current heavy smoker = 5, current non-heavy/occasional
18
19 160 smoker = 4, former smoker quitting < 10 years ago = 3, former smoker quitting ≥ 10 years ago = 2, never
20
21 161 smoked = 1); Alcohol consumption (≥ 22 servings a week = 5, 15-21 = 4, 8-14 = 3, 1-7 = 2, occasional
22
23 162 drinkers/abstainers = 1); Physical inactivity (sedentary activities = 5, leisure time sport < 4 hour a week
24
25 163 or light activities = 3, intensive training or leisure time sport ≥ 4 hours a week = 1). The index ranged
26
27 164 from 4 to 20, and was for the analyses further categorised into high engagement (12-20) versus low (4-
28
29 165 7). Lifestyle risk index was calculated for the years 2013 and 2018, as dietary data were not available
30
31 166 for previous years.

32 167

33 168 *Metabolic risks*

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35 169 BMI was calculated as self-reported body weight divided by self-reported body height squared,
36
37 170 using BMI ≥ 25 kg/m² for overweight and ≥ 30 kg/m² for obesity. Information on prevalent high blood
38
39 171 pressure (systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg) and high cholesterol levels (total
40
41 172 cholesterol ≥ 190 mg/dl) was self-reported by providing participants with a list of clinical conditions for
42
43 173 which they had to specify whether they had each clinical condition in the past 12 months.

44 174

45 175 *Prevalence of NCDs*

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47 176 Similarly, data on the prevalence of NCDs were self-reported collected using a list of chronic
48
49 177 diseases for which participants had to specify whether they had each chronic disease in the past 12
50
51 178 months. This study reported on the prevalence of T2DM (ICD-10: E11), myocardial infarction (MI) (ICD-
52
53 179 10: I21-I22), coronary artery disease (ICD-10: I20), cerebrovascular disease (ICD-10: I60-I69), other
54
55 180 serious heart diseases (ICD-10: I30-I52), cancer (ICD-10: C00-D49), asthma (ICD-10: J45-J46) and
56
57 181 chronic bronchitis/chronic obstructive pulmonary disease (COPD) or emphysema (ICD-10: J40-44, J47).

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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.

188

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.

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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;

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2
3 212 with the estimated PRs and their uncertainty (95% confidence intervals (CI)) calculated using a survey-
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5 213 weighted Cox regression model with time equals one, and adjusting for age. The 20-year trend was
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7 214 tested by including an interaction term between time and the population stratification variable in the
8
9 215 models, and p -values for this interaction term were reported. We only analysed outcomes for which at
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11 216 least 20 survey participants in any specific strata reported having the outcome of interest. Additionally,
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13 217 we measured health disparities by socio-demographic factors in absolute terms, using prevalence
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15 218 differences, commonly known as risk differences (RD), between two levels of the population stratification
16
17 219 variables, calculated from a survey-weighted logistic regression and using the STATA postestimation
18
19 220 command `adjr`.²⁸ To explore the role of individual lifestyle risks, independently of others, relative health
20
21 221 disparities were estimated for having that lifestyle risk versus not (reference).

22
23 222 Clustering of lifestyle risks was described using Spearman's rank correlation coefficients (P)
24
25 223 with p -values adjusted for multiple testing according to Sidak. Such clustering was quantified using
26
27 224 prevalence odds ratios, as estimated from a survey-weighted generalised ordered logistic regression
28
29 225 model using the `gologit2` command in STATA with the `autofit` function that identifies the partial
30
31 226 proportional odds model that appropriately fits the data²⁹, with separate models for each lifestyle risk
32
33 227 related to the other risks. To enhance interpretation of results, we only presented prevalence odds ratios
34
35 228 and their 95% CI for the extremes, *i.e.* estimates belonging to the comparisons between a score of 5
36
37 229 (high engagement in a lifestyle risk) versus 1 (low; reference), for having a higher score than 1 on the
38
39 230 lifestyle risk of interest.

40
41 231 All analyses were conducted using STATA/SE 16, and a p -value of 0.05 was considered as
42
43 232 statistically significant with no adjustment for multiple comparisons for quantification of health disparities.

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44 233

45 234 **RESULTS**

46
47 235 An overview of the general characteristics of the study population across the six available
48
49 236 surveys is presented in TABLE 1, including prevalence estimates for the lifestyle and metabolic risks,
50
51 237 chronic diseases and NCD-specific mortality.

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53 238

55 239 *Relative health disparities by socio-demographic population strata*

56
57 240 For all population strata, the relative health disparities were generally more pronounced for
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59 241 lifestyle risks and NCDs (FIGURE 1; and Supplementary Tables 2).

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2
3 242 Exposure to lifestyle risks was observed to be generally higher in young adults and among men
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5 243 (except for daily snacking and leisure-time physical inactivity), residents of Wallonia compared to those
6
7 244 of Flanders (except for daily snacking), Belgian nationals (except for non-daily vegetables and leisure-
8
9 245 time physical inactivity), the lower education and the lower income group (except for daily snacking and
10
11 246 excessive alcohol use). Relative disparities in lifestyle risks were the largest for daily smoking by age
12
13 247 (PR: 0.22, 95%CI: 0.14, 0.37), educational level (PR: 2.21, 95%CI: 1.79, 2.72) and income level (PR:
14
15 248 2.78, 95%CI: 1.77, 2.37) as well as for non-daily vegetables by educational level (PR: 2.05, 95%CI:
16
17 249 1.77, 2.37) and income level (PR: 2.72, 95%CI: 2.20, 3.35). Over time, the health disadvantages in
18
19 250 lifestyle risks were decreasing for Brussels, as significantly seen for daily smoking and leisure-time
20
21 251 physical inactivity, while increasing for the lower education and lower income groups for daily smoking
22
23 252 (Figure 2A).

24 253 Moreover, the prevalence of overweight and obesity was observed to be significantly higher with
25
26 254 advanced age groups, among men (only overweight), among residents of Wallonia, non-European
27
28 255 residents, and the lower education and lower income groups, with significantly increasing disparities for
29
30 256 the non-Europeans reaching a prevalence ratio of 1.20 (95%CI: 1.05, 1.36) for overweight in 2018
31
32 257 (Figure 2B). Disparities were the largest for obesity by educational level (PR: 1.80, 95%CI: 1.52, 2.13),
33
34 258 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
35
36 259 as nationality (PR for non-Europeans: 1.36, 95%CI: 1.03, 1.80). A significantly higher prevalence of the
37
38 260 metabolic risks of high blood pressure and high cholesterol levels was observed for advanced age, men
39
40 261 (only cholesterol levels), and the lower education and lower income groups, presenting for the low
41
42 262 income groups an increase in the relative disparities up to a prevalence ratio of 1.48 (95%CI: 1.19, 1.85)
43
44 263 in 2018 (Figure 2B).

45 264 The NCD prevalence was significantly higher with advanced age, among men (except for
46
47 265 asthma), among residents of Wallonia and Brussels (except for cerebrovascular disease), among the
48
49 266 low educated (except for CVD and cancer), and the lower income groups (except for CVD), with over
50
51 267 20 years' time reducing disparities in age for asthma and in Brussels for cancer, but worsening
52
53 268 disparities by income levels for chronic bronchitis, COPD or emphysema (Figure 2C). Relative
54
55 269 disparities in NCD prevalence were the largest for T2DM by nationality (PR for non-Europeans: 2.34,
56
57 270 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
58
59 271 and emphysema.

1
2
3 272 The NCD-specific mortality rates were significantly higher among men (except for asthma),
4
5 273 residents of Wallonia and Brussels as compared to those of Flanders (except for cerebrovascular
6
7 274 disease), and among the native Belgians (except for T2DM and asthma).
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9 275

10 276 *Absolute health disparities by socio-demographic population strata*

11 277 Measuring this on an absolute scale did not alter conclusions (Supplementary Tables 3).
12
13 278 Similarly, when using absolute differences, health disparities were the most pronounced for age,
14
15 279 education and income strata, with the highest disparities seen for lifestyle and metabolic risks, but not
16
17 280 for prevalent NCDs related to their low prevalence in the general population. In particular, absolute
18
19 281 disparities in lifestyle risks were the largest for dietary risks by age (RD non-daily fruit: -25%, 95%CI: -
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21 282 31, -19; RD daily SSBs: -20%, 95%CI: -25, 16), by income (RD non-daily vegetables: 24%, 95%CI: 19,
22
23 283 29) as well as for leisure-time physical inactivity by age (RD: 22%, 95%CI: 15, 28), by education (22%,
24
25 284 95%CI: 17, 26) and income (22%, 95%CI: 16, 28) and for daily smoking by income (RD: 21%, 95%CI:
26
27 285 16, 28). Moreover, large absolute disparities for overweight were observed for age (RD: 21%, 95%CI:
28
29 286 15, 27), sex (RD: -14%, 95%CI: -17, -11), nationality (RD for non-Europeans: 9.2%, 95%CI: 3, 16),
30
31 287 educational level (RD: 17%, 95%CI: 13, 21), and income level (RD: 11%, 95%CI: 6, 17), while lower
32
33 288 than 5% for other metabolic risks and NCD prevalence, except for income groups (RD high blood
34
35 289 pressure 8.1%, 95%CI: 3.4, 13; RD high cholesterol: 7.0, 95%CI: 2.3, 12; chronic bronchitis, COPD or
36
37 290 emphysema: 9.1%, 95%CI: 6.2, 12) and for non-European and diabetes (RD: 7.5%, 95%CI: 2.5, 13).
38
39 291

40 292 *Clustering of lifestyle risks*

41 293 One-fifth was engaged in multiple lifestyle risks of poor diet, smoking, excessive alcohol use
42
43 294 and physical inactivity, while one-fourth reported an overall healthy lifestyle (Supplementary Table 4).
44
45 295 High engagement in multiple lifestyle risks was most frequent among men (65%), residents of Wallonia
46
47 296 (37%), the lower education (62%) and the lower income strata (17%) with their multiple risks mainly
48
49 297 characterised by non-daily intakes of fruit (76%), daily snacking (43%), current smoking (69%) and
50
51 298 physical inactivity (61%), but no distinct pattern of alcohol consumption.
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53 299

54 300 Belgian residents with at least one dietary risk were slightly more likely to be physically inactive,
55
56 301 heavy smokers, and heavy drinkers, with former or current smokers also more likely to be heavy drinkers
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3 302 The odds of having at least one dietary risk was higher for heavy smokers (OR 3.17; 95%CI 2.54, 3.95;
4
5 303 TABLE 2), and for the physically inactive (OR 1.45; 95%CI: 1.24, 1.69). Similarly, the odds of being a
6
7 304 former or current smoker was higher when having four dietary risks (OR 2.84; 95%CI: 1.87, 4.25), for
8
9 305 heavy drinkers (OR 4.75; 95%CI: 3.61, 6.25), and for the physically inactive (OR 1.39; 95%CI: 1.18,
10
11 306 1.64). The odds of being a frequent (at least weekly) drinker was only higher for heavy smokers (OR
12
13 307 2.45, 95%CI: 1.95, 3.08). Lastly, the odds of being at most light physically active was higher for heavy
14
15 308 smokers (OR 2.17; 95%CI: 1.73, 2.72), but lower for heavy drinkers (OR 0.60; 95%CI 0.46, 0.78).

16
17 309 The prevalence of metabolic risks and NCDs were higher among individuals with high
18
19 310 engagement in multiple lifestyle risks (TABLE 3). In 2018, relative disparities were significantly varying
20
21 311 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
22
23 312 (95%CI: 1.12, 2.72) and 3.73 (95%CI: 2.19, 6.35) for CVD, asthma and COPD, with only high cholesterol
24
25 313 levels significantly higher in 2018 than in 2013. Focussing on individual lifestyle risks, the prevalence of
26
27 314 high BMI, T2DM, and CVD was more frequently reported for abstainers/occasional drinkers and the
28
29 315 non-physically active, independently of age, sex and other lifestyle risks, with the prevalence of T2DM
30
31 316 also more frequently reported when having none dietary risks, and of CVD and COPD more frequently
32
33 317 for former and current smokers (Supplementary Table 6).

34 318

35 319 **DISCUSSION**

37 320 Using nationally representative data of Belgium, we identified the population strata where health
38
39 321 disparities are present, and we traced the evolution of these disparities over 20 years. Older age, lower
40
41 322 education, and lower income strata were the most affected by unfavourable health. For the latter two
42
43 323 strata, we also observed a greater prevalence of engagement in multiple lifestyle risks, with their
44
45 324 disparities worsening over time. Multiple lifestyle risks were also more prevalent in men, and the region
46
47 325 of Wallonia. Still, NCD-specific mortality rates were significantly higher among men (except for asthma),
48
49 326 residents of Wallonia, and Brussels (except for cerebrovascular disease), and among native Belgians
50
51 327 (except for T2DM and asthma).

53 328 The socio-economic distribution of health as reported in this study corroborates earlier
54
55 329 surveillance findings from western countries, including Belgium,^{14,15} as operationalised by highest
56
57 330 educational attainment. The inverse education-health gradients are a long-lasting universal
58
59 331 phenomenon in Europe with widening disparities for common chronic diseases,³⁰ self-assessed

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3 332 health,³¹ and mortality³². Following earlier observations,³³ results of the present study also confirmed
4
5 333 that at present engagement in lifestyle risks remained more frequent for the low educated, and because
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7 334 of the mediating role of health illiteracy, *i.e.* insufficient knowledge, motivation and competence to make
8
9 335 appropriate health decisions, likely to persist.^{34,35} Using education as a single indicator of socio-
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11 336 economic position at the individual level, however, captures only the knowledge-related assets of the
12
13 337 socio-economic stratification, disregarding the full understanding of the existing health disparities by
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15 338 ranks in a society.³⁶ In our study, health disparities by education resemble well those by income, though
16
17 339 slightly more pronounced for income. This suggests that both the social and financial resources provided
18
19 340 by education and income, respectively, play a key role in a healthy lifestyle, and thereby delaying the
20
21 341 onset of metabolic conditions and NCDs.

22 342 We used the most simple absolute and relative measures of disparities in health to illustrate the
23
24 343 existing disparities in Belgium, and in this way avoid the value-laden of an arbitrary choice. Our findings
25
26 344 might be limited by participants' self-reporting. Reporting risks and diseases is subjected to not only the
27
28 345 actual presence of it, but also participant-related characteristics like health knowledge, ability to recall,
29
30 346 willingness to report, and in case of health problem, frequency of contact with physician and
31
32 347 disadvantages experienced in everyday life. This shortcoming of self-reports has been acknowledged
33
34 348 by the first Belgian Health Examination Survey (BELHES), conducted for the first time by Sciensano in
35
36 349 2018.³⁷ Early findings of the BELHES showed that one-third of the population suffers from high blood
37
38 350 pressure, half from high cholesterol levels and one-tenth from T2DM, while according to the self-reports
39
40 351 only 15%, 20% and 6%, respectively.³⁸ This potential bias might differentially affect our population strata,
41
42 352 with a misclassification likely to occur to a larger extent in the most disadvantaged group, leading to an
43
44 353 underestimation of the true disparity. Besides, our findings provide a general profile of the high-risk
45
46 354 groups, and therefore cannot be directly extrapolated to all individuals belonging to certain strata, for
47
48 355 example within the low educated prevalence of risks and outcomes might differ not only by age group
49
50 356 and sex³⁰, but also by background psychosocial factors, such as marital status, household composition,
51
52 357 social support and job strain, that may operate in the pathway between socio-demographic factors and
53
54 358 NCD outcomes.³⁹ Furthermore, the present study could not address the differential mortality by SES
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56 359 indicators because of the impossibility of individual linkage of census data with the most recent BHIS,
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58 360 as previously done.⁴⁰
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3 361 In cross-sectional studies, there is a potential bias for reverse causality bias, potentially
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5 362 explaining our contra-intuitive finding of a higher reported T2DM prevalence when having none dietary
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7 363 risks and being abstainers/occasional drinker, since among those with T2DM around 60% of them
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9 364 followed a diet for this condition, as also inquired by the BHIS. While excessive alcohol use (*i.e.* drinking
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11 365 very high amounts of alcohol weekly) is a well-recognised risk factor for NCDs, the light-to-moderate
12
13 366 levels of alcohol consumption remain controversial.⁴¹ In fact, zero consumption is nowadays ever more
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15 367 regarded as the consumption amount fitting a healthy lifestyle, since estimated protective effects for
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17 368 some health conditions at low levels are outweighed by increased risks of other health-related harms,
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19 369 including cancer.⁴²

20 370 Our study implies that over a wide range of risk and health indicators important population strata
21
22 371 to target are the elderly, the low educated, the low income strata, and the immigrants, of which only the
23
24 372 former is an unfortunately unavoidable disparity difficult to argue to be unjust.⁴³ Narrowing the disparities
25
26 373 by socio-economic position and nationality should be the focus of health policy programmes, likely with
27
28 374 interventions based on the principles of proportionate universalism,⁴⁴ *i.e.* a universal action with a
29
30 375 targeted intervention component tailored to tackle the driving root causes either simultaneously or
31
32 376 sequentially, with due consideration to the upstream determinants of health that may lie outside the
33
34 377 health sector (e.g. illiteracy, unemployment, the barrier to healthcare consumption).⁴⁵

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36 378

37 379 **CONCLUSION**

38
39 380 In conclusion, health status is not only a product of individual choice but also related to the
40
41 381 population strata where a person belongs to, with this defined particularly by the socio-demographic
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43 382 factors influencing lifestyle. In addition, the tendency of lifestyle risks to cluster strengthens the need for
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45 383 health promotion programmes that tailor multiple targets and aim at reaching the socio-economic
46
47 384 disadvantaged for narrowing health disparities.

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508 **TABLES & FIGURES**509 **TABLE 1** Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to
510 survey year.

	Year of the survey						<i>p</i> -trend ^a
	1997	2001	2004	2008	2013	2018	
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 \geq 25kg/m ²	45.4	48.8	48.1	50.9	51.7	52.7	<0.001
Obesity, BMI \geq 30kg/m ²	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.

517 **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		<i>p</i> -change ^c
	High	Low	High	Low	2013	2018	
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.

533 LEGEND OF FIGURES

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

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

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

544
 545 **Figure 2** Significant 20-year time trends in the relative health disparities, expressed in age-standardised
 546 prevalence ratios between distal groups, from lifestyle risks to non-communicable diseases according
 547 to socio-demographic strata, from 1997 until 2018 in Belgium.

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

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

556 2A: Lifestyle risks

557 2B: Metabolic risks

558 2C: Non-communicable diseases

559

560 LEGEND OF SUPPLEMENTARY MATERIALS

561

562 **Supplementary Table 1** Components and scoring of the lifestyle risk index ^{a,b}.

563 Abbreviations: SSB, sugar-sweetened beverages

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

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

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

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

578 2A. Age-related relative health disparities: adults aged 75-84 years versus 25-34 years (reference)

579 2B. Sex- related relative health disparities: women vs men (reference)

580 2C. Region of residence-related relative health disparities: Wallonia vs Flanders (reference)

581 2D. Region of residence-related relative health disparities: Brussels vs Flanders (reference)

582 2E. Nationality-related relative health disparities: non-Belgian Europeans vs Belgians (reference)

583 2F. Nationality-related relative health disparities: non-Europeans vs Belgians (reference)

584 2G. Education-related relative health disparities: low vs high (reference)

585 2H. Income-related relative health disparities: Quintile 1 vs Quintile 5 (reference)

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3 587 **Supplementary Tables 3** Trends in health disparities related to the prevalence of lifestyle risks,
4 588 metabolic risks, and major non-communicable diseases according to socio-demographic strata and
5 589 measured as age-standardised percentage point differences between distal groups.

6 590 Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs,
7 591 non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence
8 592 of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and
9 593 chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants
10 594 in any specific strata reported having the outcome of interest in the particular survey year.

11 595 ^a Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted Cox regression model for
12 596 lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related mortality
13 597 rates, and interpreted as a *p*-value for change when only two time points available.

14 598 3A. Age-related absolute health disparities: adults aged 75-84 years versus 25-34 years (reference)

15 599 3B. Sex-related absolute health disparities: women vs men (reference)

16 600 3C. Region of residence-related absolute health disparities: Wallonia vs Flanders (reference)

17 601 3D. Region of residence-related absolute health disparities: Brussels vs Flanders (reference)

18 602 3E. Nationality-related absolute health disparities: non-Belgian Europeans vs Belgians (reference)

19 603 3F. Nationality-related absolute health disparities: non-Europeans vs Belgians (reference)

20 604 3G. Education-related absolute health disparities: low vs high (reference)

21 605 3H. Income-related absolute health disparities: Quintile 1 vs Quintile 5 (reference)

22 606
23 607 **Supplementary Table 4** General characteristics and lifestyle risks (weighted %) of the Belgian
24 608 population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus
25 609 low)

26 610 Abbreviations: SSB, sugar-sweetened beverages. ^a Engagement in multiple lifestyle risks was summarised in a composite index
27 611 of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored
28 612 from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and
29 613 sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.*
30 614 sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement),
31 615 and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

32 616
33 617 **Supplementary Table 5** Characteristics (weighted %) of the Belgian population, aged 25-84 years,
34 618 according to the level of engagement in the individual lifestyle risks of dietary risks, smoking, alcohol
35 619 and physical inactivity, in 2018.^a

36 620 ^a Lifestyle risks for diet: having at least one dietary risk present, lifestyle risks for smoking: being a current or former smoker;
37 621 lifestyle risks for alcohol: being a frequent drinker (at least drinking alcohol weekly); and lifestyle risk for physical inactivity: being
38 622 physically inactive or lightly active.

39 623
40 624 **Supplementary Table 6** Relative health disparities by engagement in individual lifestyle risks,
41 625 independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios.^b

42 626 ^a Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle
43 627 risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being physically
44 628 inactive or lightly active. ^b Adjusted for age, sex and the other lifestyle risks.

45 629

630 **Contributorship statement**

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

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644 it may be located; and, vi) licence any third party to do any or all of the above.

646 **Competing interests declaration**

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

653 **Ethics approval**

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

659

660 **Transparency statement**

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

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673 Rana Charafeddine for providing access to their data.

675 **Dissemination declaration**

676 Not applicable.

678 **Patient and Public Involvement Statement**

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

682 **Data Sharing Statements**

683 Data of the Health Interview Surveys, conducted by Sciensano, are not publicly available, but
684 access to data is possible through request to the Privacy Commission. More information can
685 be retrieved via <https://his.wiv-isp.be/SitePages/Home.aspx>. Also, publicly available datasets
686 were utilized in this study: Standardised Procedures for Mortality Analysis – Belgium (SPMA),
687 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)

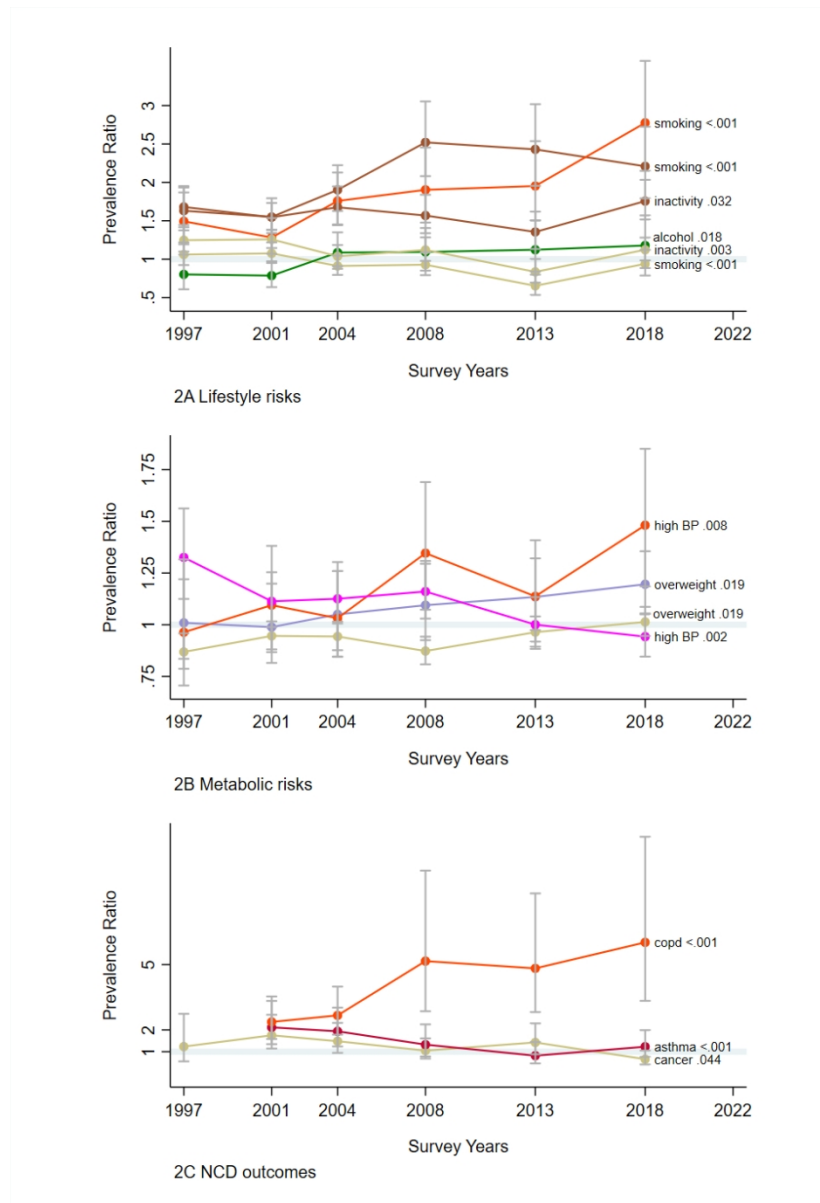


Figure 2 Significant 20-year time trends in the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle risks to non-communicable diseases according to socio-demographic strata, from 1997 until 2018 in Belgium.

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)

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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	<i>p</i> -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					0.64 (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					0.33 (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)	0.33 (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)	0.99 (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)	1.88 (1.45; 2.32)	1.72 (1.41; 2.12)	0.108
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	1.58 (1.30; 1.91)	1.44 (1.25; 1.66)	1.71 (1.48; 1.97)	1.45 (1.26; 1.66)	1.52 (1.33; 1.75)	1.55 (1.35; 1.78)	0.991
Obesity, BMI ≥ 30 kg/m ²	1.76 (1.05; 2.95)	2.53 (1.78; 3.61)	1.76 (1.24; 2.49)	1.81 (1.31; 2.49)	1.52 (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)	17.22 (10.9; 27.2)	13.85 (8.81; 21.8)	0.111
High cholesterol levels					12.99 (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)	0.87 (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. ^aTrends 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.

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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					0.74 (0.72; 0.82)	0.75 (0.71; 0.79)	0.531
Non-daily vegetables					0.72 (0.63; 0.78)	0.72 (0.66; 0.79)	0.763
Daily snacking					1.04 (0.93; 1.07)	1.04 (0.96; 1.12)	0.407
Daily SSBs					0.68 (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)	0.72 (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)	0.71 (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)	1.21 (1.13; 1.45)	1.33 (1.20; 1.47)	0.836
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	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/m ²	0.96 (0.80; 1.16)	1.05 (0.91; 1.20)	1.07 (0.94; 1.23)	1.07 (0.94; 1.23)	1.05 (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)	1.09 (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							
Myocardial infarction				0.46 (0.27; 0.78)	0.50 (0.19; 0.83)	0.48 (0.26; 0.90)	
Coronary artery disease				0.53 (0.35; 0.80)	0.43 (0.29; 0.78)	0.58 (0.33; 1.02)	
Other serious heart disease					0.41 (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)	0.72 (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)	1.55 (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)	1.01 (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)	1.01 (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)	0.72 (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)	0.47 (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)	0.82 (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)	0.54 (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)	1.01 (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. ^aTrends 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	<i>p</i> -trend ^a
Lifestyle risks							
Dietary risks							
Non-daily fruit					1.0 (0.96; 1.12)	1.14 (1.05; 1.23)	0.101
Non-daily vegetables					1.1 (1.01; 1.36)	1.29 (1.13; 1.48)	0.325
Daily snacking					1.0 (0.91; 1.10)	0.88 (0.79; 0.97)	0.050
Daily SSBs					1.1 (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)	1.1 (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)	1.1 (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)	1.1 (1.00; 1.33)	1.45 (1.29; 1.64)	0.741
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	1.10 (1.01; 1.19)	1.09 (1.03; 1.16)	1.12 (1.05; 1.19)	1.05 (0.98; 1.12)	1.0 (1.00; 1.14)	1.08 (1.01; 1.15)	0.338
Obesity, BMI ≥ 30 kg/m ²	1.38 (1.12; 1.71)	1.28 (1.10; 1.50)	1.33 (1.14; 1.55)	1.07 (0.92; 1.25)	1.1 (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)	0.9 (0.79; 1.03)	1.10 (0.97; 1.23)	0.209
High cholesterol levels					0.9 (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)	1.2 (0.96; 1.61)	1.37 (1.10; 1.71)	0.108
CVD							
Myocardial infarction				1.57 (0.87; 2.83)		1.96 (1.01; 3.83)	
Coronary artery disease				1.30 (0.85; 1.98)	1.5 (0.87; 2.67)	1.28 (0.75; 2.20)	
Other serious heart disease					0.8 (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)	0.8 (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)	1.7 (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)	1.6 (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)	1.1 (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)	1.2 (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)	0.9 (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)	1.1 (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)	2.1 (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)	1.3 (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. ^aTrends 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/m ²	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/m ²	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							
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. ^aTrends 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/m ²	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/m ²	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							
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	<i>p</i> -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/m ²	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/m ²	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. ^aTrends 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	<i>p</i> -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/m ²	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/m ²	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							
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/m ²	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/m ²	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							
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.

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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/m ²	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/m ²	4.2% (-0.1%; 8.6%)	11.2% (6.4%; 16.0%)	6.1% (2.5%; 9.7%)	7.7% (3.8%; 11.7%)	5.3% (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. ^aTrends 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.

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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%)	6.9% (3.2%; 9.6%)	8.1% (5.4%; 10.9%)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	-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/m ²	-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							
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%)	1.1% (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. ^aTrends 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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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/m ²	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/m ²	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							
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. ^aTrends 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% (1.0%; 9.9%)	6.7% (3.2%; 10.2%)	0.315
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	-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/m ²	-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							
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)	15.5 (-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)	11.8 (-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)	10.0 (-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. ^aTrends 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	<i>p</i> -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/m ²	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/m ²	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%)	0.8% (-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. ^aTrends 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.

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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% (6.5%; 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% (-4.7%; 11.8%)	13.4% (2.9%; 24.0%)	0.249
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	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/m ²	-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% (0.3%; 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. ^aTrends 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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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/m ²	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/m ²	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%)	4.9% (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%)	3.3% (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%)	4.3% (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. ^aTrends 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.

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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% (-1.0%; 8.7%)	17.4% (11.7%; 23.0%)	0.003
Non-daily vegetables					3.1% (-0.6%; 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% (8.0%; 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/m ²	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% (5.0%; 15.9%)	11.4% (5.6%; 17.2%)	0.453
Obesity, BMI ≥ 30 kg/m ²	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% (6.0%; 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% (-0.6%; 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. ^aTrends 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.

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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 \geq 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						
\geq 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 \geq 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								

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≥ 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 individual 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.

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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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3 1 **Quantification of disparities in the distribution of lifestyle and metabolic risk factors,**
4 **prevalence of non-communicable diseases and related-mortality: The Belgian Health**
5 **Interview Surveys 1997-2018**
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3 9 **ABSTRACT**

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5 10 **OBJECTIVES** Comprehensively measure the trends in health disparities by socio-demographic strata
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7 11 in terms of exposure to lifestyle and metabolic risks, and prevalence and mortality of non-communicable
8
9 12 diseases (NCDs) during the last 20 years in Belgium.

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11 13 **DESIGN** Cross-sectional analysis of periodic national-representative health interview surveys and vital
12
13 14 statistics.

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15 15 **SETTING** Population-based study of adult residents in Belgium between 1997-2018.

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17 16 **PARTICIPANTS** Adults aged 25-84 years and resident in Belgium in the years 1997 (7,256 adults),
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19 17 2001 (8,665), 2004 (9,054), 2008 (7,343), 2013 (7,704), and 2018 (8,358).

20
21 18 **MAIN OUTCOME MEASURE** Age-standardised prevalence rates of modifiable lifestyle risks (poor diet,
22
23 19 smoking, excessive alcohol use and leisure-time physical inactivity), metabolic risks (high body mass
24
25 20 index (BMI), blood pressure and cholesterol levels), and major NCDs (type 2 diabetes (T2DM),
26
27 21 cardiovascular diseases (CVD), cancer, asthma and chronic obstructive pulmonary disease (COPD)),
28
29 22 with their relative health disparities across strata by age, sex, region of residence, nationality, education
30
31 23 and income level, and according to high versus low engagement in the four lifestyle risks, calculated
32
33 24 from a survey-weighted age-adjusted logistic regression.

34
35 25 **RESULTS** Greater avoidable disparities were observed between extremes of education and income
36
37 26 strata. The most marked disparities were found for exposure to lifestyle risks, except excessive alcohol
38
39 27 use, prevalence of high BMI as well as T2DM, asthma and COPD, with disparities of daily smoking and
40
41 28 COPD worsening over time. Still, NCD-specific mortality rates were significantly higher among men
42
43 29 (except asthma), residents of Wallonia and Brussels (except cerebrovascular disease), and among the
44
45 30 native Belgians (except T2DM and asthma). High engagement in lifestyle risks was generally observed
46
47 31 for men, residents of the region Wallonia, and among lower education and income strata. This subgroup
48
49 32 (20%) had a worse health profile as compared with those who had a low-risk lifestyle (25%), shown by
50
51 33 prevalence ratios varying between 1.1 and 1.6 for metabolic risks, and between 1.8 and 3.7 for CVD,
52
53 34 asthma and COPD.

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55 35 **CONCLUSIONS** Improving population health, including promoting greater health equity, requires
56
57 36 approaches to be tailored to high-risk groups with actions tackling driving root causes of disparities seen
58
59 37 by social factors and unhealthy lifestyle.
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3 39 **KEYWORDS**
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5 40 Lifestyle risks –metabolic risk factors – overweight – type 2 diabetes – cardiovascular disease – socio-
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7 41 demographic factors – disparities
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For peer review only

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.

62 INTRODUCTION

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

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

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

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3 92 who is at risk and which lifestyle risks more frequently cluster would certainly support tailored health
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5 93 promotion programmes, aiming at more health gains.

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7 94 To identify and quantify all relevant health disparities in Belgium, this study aims to provide a
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9 95 clear and comprehensive overview of the health status, from lifestyle risks to NCDs, by relevant
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11 96 population strata of socio-demographic factors as well as by engagement in multiple lifestyle risks, using
12
13 97 nationally relevant epidemiological evidence from Belgium over the last 20 years.

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16 99 **METHODS**

17 100 **Data sources**

18 101 *Belgian Health Interview Surveys (BHIS)*

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20 102 The BHIS is a cross-sectional study, conducted by Sciensano, carried out periodically every
21
22 103 four to five years since 1997 and including approximately a sample of 10,000 participants per survey
23
24 104 wave, representative of Belgian residents. Briefly, participants were selected from the Belgian national
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26 105 population register through a multistage stratified population sampling involving a geographical
27
28 106 stratification according to the regions, and subsequently, a selection of municipalities within provinces,
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30 107 households within municipalities, and a maximum of four respondents within households was applied.
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32 108 Data were collected through face-to-face interview at the participant's home covering demographics,
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34 109 specific diseases and conditions, and nutritional status, and a self-administered questionnaire covering
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36 110 more sensitive topics, such as health behaviours and lifestyle. Survey weights were designed and
37
38 111 applied to ensure the representativeness of the sample in terms of age, sex and province. Further details
39
40 112 on the BHIS are described elsewhere.²⁴⁻²⁶ The BHIS was authorised by an independent administrative
41
42 113 authority protecting privacy and personal data, and was approved by the ethical committee of Ghent
43
44 114 University Hospital. The pseudonymised data from Sciensano was shared with the Institute of Tropical
45
46 115 Medicine (ITM) Antwerp through a secure data transfer platform applying data encryption. Ethical
47
48 116 clearance for the present analyses was obtained from the Institutional Review Board of ITM after revision
49
50 117 of the research protocol num. 1366/20, 23/03/2020.

51
52 118 The present analyses included adults aged between 25 and 84 years. Participants younger than
53
54 119 25 years were excluded from the analysis since a large proportion achieved their highest educational
55
56 120 level by the age of 25, and aged 85 years and older since a large proportion of them are institutionalised
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3 121 and the surveys did not include these people. The final sample included 7,256 adults in the year 1997,
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5 122 8,665 in 2001, 9,054 in 2004, 7,343 in 2008, 7,704 in 2013 and 8,358 in 2018.

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7 123

8 124 *Standardised Procedures for Mortality Analysis (SPMA)*

9
10 125 SPMA, operational since the early 1990s, was developed by Sciensano with the aim to facilitate
11
12 126 the use of vital statistics data for public health policy and scientific research.²⁷ From 1998 up to 2017,
13
14 127 cause-specific mortality data were coded by the ICD-10 using the initial cause of death only, and
15
16 128 grouped by age, sex, region of residence and nationality. Data from 1998 was used as a proxy for the
17
18 129 year 1997 so that cause-specific mortality could be coded using ICD-10 for all years included in the
19
20 130 analyses, and similarly, data from 2017 as a proxy for the year 2018.

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23 132 *Patient and Public involvement*

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25 133 As a secondary data analysis of the BHIS, this study did not involve patients/participants or the public
26
27 134 in the design, conduct or dissemination plans.

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30 136 **Health outcomes measures**

31 137 *Lifestyle risks*

32
33 138 Data on dietary habits, smoking status, alcohol consumption, and physical activity were self-
34
35 139 reported in the BHIS. Consumption of fruits (excluding juice) and vegetables (including salad, and
36
37 140 excluding potatoes or juice) was assessed based on questions related to their daily intake. A non-daily
38
39 141 consumer was defined as a participant reporting, at the time of the interview, a frequency of 4-6 times a
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41 142 week or less. Similarly, daily consumption of sweet or salty snacks and sugar-sweetened beverages
42
43 143 (SSBs) was assessed based on a consumption frequency of one serving or more a day. Current
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45 144 smoking was defined as smoking at least 100 cigarettes in lifetime and currently a daily smoker. Alcohol
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47 145 consumption was assessed based on questions related to consumption frequency and the average
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49 146 number of drinks across weekdays and during weekends, and excess was defined as drinking more
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51 147 than 15 and 22 servings per week for women and men, respectively, following WHO indicators. For
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53 148 physical inactivity, a dichotomous categorical variable was created to differentiate between having
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55 149 sufficient physical activity and being at risk of physical inactivity during leisure time based on a
56
57 150 description of the leisure time activities: hard training and competitive sports more than once week,
58
59
60

1
2
3 151 jogging and other recreational sports or gardening at least four hours a week; jogging and other
4
5 152 recreational sports or gardening at most four hours a week; walking, bicycling or other light activities at
6
7 153 least four hours a week; walking, bicycling or other light activities at most four hours a week; or reading,
8
9 154 watching TV or other sedentary activities, following WHO indicators.

10
11 155 Clustering of the lifestyle risks was summarised as a composite index (Supplementary Table 1).
12
13 156 Each lifestyle risk factor was scored from 1 to 5, with higher points indicating the highest risk, as follows:
14
15 157 Dietary risks (non-daily fruit, non-daily vegetables, daily snacks and daily SSBs, four present = 5, three
16
17 158 = 4, two = 3, one = 2, none = 1); Smoking (current heavy smoker = 5, current non-heavy/occasional
18
19 159 smoker = 4, former smoker quitting < 10 years ago = 3, former smoker quitting ≥ 10 years ago = 2, never
20
21 160 smoked = 1); Alcohol consumption (≥ 22 servings a week = 5, 15-21 = 4, 8-14 = 3, 1-7 = 2, occasional
22
23 161 drinkers/abstainers = 1); Physical inactivity (sedentary activities = 5, leisure time sport < 4 hour a week
24
25 162 or light activities = 3, intensive training or leisure time sport ≥ 4 hours a week = 1). The index ranged
26
27 163 from 4 to 20, and was for the analyses further categorised into high engagement (12-20) versus low (4-
28
29 164 7). Lifestyle risk index was calculated for the years 2013 and 2018, as dietary data were not available
30
31 165 for previous years.

32 166

33 167 *Metabolic risks*

34
35 168 BMI was calculated as self-reported body weight divided by self-reported body height squared,
36
37 169 using BMI ≥ 25 kg/m² for overweight and ≥ 30 kg/m² for obesity. Information on prevalent high blood
38
39 170 pressure (systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg) and high cholesterol levels (total
40
41 171 cholesterol ≥ 190 mg/dl) was self-reported by providing participants with a list of clinical conditions for
42
43 172 which they had to specify whether they had each clinical condition in the past 12 months.

44 173

45 174 *Prevalence of NCDs*

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47 175 Similarly, data on the prevalence of NCDs were self-reported collected using a list of chronic
48
49 176 diseases for which participants had to specify whether they had each chronic disease in the past 12
50
51 177 months. This study reported on the prevalence of T2DM (ICD-10: E11), myocardial infarction (MI) (ICD-
52
53 178 10: I21-I22), coronary artery disease (ICD-10: I20), cerebrovascular disease (ICD-10: I60-I69), other
54
55 179 serious heart diseases (ICD-10: I30-I52), cancer (ICD-10: C00-D49), asthma (ICD-10: J45-J46) and
56
57 180 chronic bronchitis/chronic obstructive pulmonary disease (COPD) or emphysema (ICD-10: J40-44, J47).

181

NCDs-specific mortality

182 Using the pre-defined procedures accessible from SPMA, age-standardised mortality rates per
183 100,000 were retrieved using ICD-10 codes for T2DM (E10-E14), coronary artery disease (I20-I25),
184 cerebrovascular disease (I60-I69), cancer (C00-D48), asthma (J45-J46) and chronic lower respiratory
185 diseases (J40-J44, J47) were obtained with comparisons made by sex, region and nationality.
186

187

Population stratification

188 To describe potential health disparities across the Belgian population, the following socio-
189 demographic determinants of health were selected: 10-year age group, sex, region of residence,
190 nationality, education and income. Educational level was based on the highest level of education
191 attained in the household and was recoded into three categories: low (primary education or less),
192 intermediate (lower and higher secondary education), and high (higher education). Income level was
193 based on the household's total available income and recoded into five quintiles. Additionally, the
194 population was further stratified by lifestyle risk index: high versus low engagement in lifestyle risks, as
195 an additional layer of potential health disparities.
196

197

Data analyses

198 Annual descriptive statistics were represented as weighted proportions of the characteristics of
199 the survey participants as a whole per survey year. Age-standardised prevalence rates were computed
200 by levels of the population stratification variables using direct standardisation with the Belgian population
201 of 2018 used as reference. Health disparities were calculated by direct comparison between population
202 strata: age (oldest, *i.e.* aged 75-84 years, vs youngest, *i.e.* aged 25-34 years, group), sex (women vs
203 men), region (Walloon vs Flanders, Brussels vs Flanders), nationality (non-Belgian Europeans vs
204 Belgians, non-Europeans vs Belgians), educational level (low vs high), income (low vs high), and
205 engagement in lifestyle risks (high vs low). The disparities by age for metabolic risk and NCD prevalence
206 were mainly included to assess their time-trends, *i.e.* narrowing disparities over time would suggest their
207 onset occurred at a sooner age than before.
208

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

1
2
3 211 with the estimated PRs and their uncertainty (95% confidence intervals (CI)) calculated using a survey-
4
5 212 weighted logistic regression model, and adjusting for age and using the STATA postestimation
6
7 213 command `adjrr`.²⁸ The 20-year trend was tested by including an interaction term between time and the
8
9 214 population stratification variable in the models, and *p*-values for this interaction term were reported. We
10
11 215 only analysed outcomes for which at least 20 survey participants in any specific strata reported having
12
13 216 the outcome of interest. Additionally, we measured health disparities by socio-demographic factors in
14
15 217 absolute terms, using prevalence differences, commonly known as risk differences (RD), between two
16
17 218 levels of the population stratification variables. To explore the role of individual lifestyle risks,
18
19 219 independently of others, relative health disparities were estimated for having that lifestyle risk versus
20
21 220 not (reference).

22 221 Clustering of lifestyle risks was described using Spearman's rank correlation coefficients (*P*)
23
24 222 with *p*-values adjusted for multiple testing according to Sidak. Such clustering was quantified using
25
26 223 prevalence odds ratios, as estimated from a survey-weighted generalised ordered logistic regression
27
28 224 model using the `gologit2` command in STATA with the `autofit` function that identifies the partial
29
30 225 proportional odds model that appropriately fits the data²⁹, with separate models for each lifestyle risk
31
32 226 related to the other risks. To enhance interpretation of results, we only presented prevalence odds ratios
33
34 227 and their 95% CI for the extremes, *i.e.* estimates belonging to the comparisons between a score of 5
35
36 228 (high engagement in a lifestyle risk) versus 1 (low; reference), for having a higher score than 1 on the
37
38 229 lifestyle risk of interest.

39 230 All analyses were conducted using STATA/SE 16, and a *p*-value of 0.05 was considered as
40
41 231 statistically significant with no adjustment for multiple comparisons for quantification of health disparities.

42
43 232

44 233 **RESULTS**

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47 234 An overview of the general characteristics of the study population across the six available
48
49 235 surveys is presented in TABLE 1, including prevalence estimates for the lifestyle and metabolic risks,
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51 236 chronic diseases and NCD-specific mortality.

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53 237

54 238 *Relative health disparities by socio-demographic population strata*

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56
57 239 For all population strata, the relative health disparities were generally more pronounced for
58
59 240 lifestyle risks and NCDs (FIGURE 1; and Supplementary Tables 2).

1
2
3 241 Exposure to lifestyle risks was observed to be generally higher in young adults and among men
4
5 242 (except for daily snacking and leisure-time physical inactivity), residents of Wallonia compared to those
6
7 243 of Flanders (except for daily snacking), Belgian nationals (except for non-daily vegetables and leisure-
8
9 244 time physical inactivity), the lower education and the lower income group (except for daily snacking and
10
11 245 excessive alcohol use). Relative disparities in lifestyle risks were the largest for daily smoking by age
12
13 246 (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:
14
15 247 2.96, 95%CI: 2.29, 3.81) as well as for non-daily vegetables by educational level (PR: 2.03, 95%CI:
16
17 248 1.76, 2.35) and income level (PR: 2.72, 95%CI: 2.20, 3.36). Over time, the health disadvantages in
18
19 249 lifestyle risks were increasing for the lower education and lower income groups for daily smoking (Figure
20
21 250 2A).

22 251 Moreover, the prevalence of overweight and obesity was observed to be significantly higher with
23
24 252 advanced age groups, among men (only overweight), among residents of Wallonia, non-European
25
26 253 residents, and the lower education and lower income groups, with significantly increasing disparities for
27
28 254 the non-Europeans reaching a prevalence ratio of 1.18 (95%CI: 1.06, 1.31) for overweight in 2018
29
30 255 (Figure 2B). Disparities were the largest for obesity by educational level (PR: 1.81, 95%CI: 1.52, 2.14),
31
32 256 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
33
34 257 as nationality (PR for non-Europeans: 1.36, 95%CI: 1.03, 1.77). A significantly higher prevalence of the
35
36 258 metabolic risks of high blood pressure and high cholesterol levels was observed for advanced age, men
37
38 259 (only cholesterol levels), and the lower education and lower income groups, presenting for the low
39
40 260 income groups an increase in the relative disparities of high blood pressure up to a prevalence ratio of
41
42 261 1.48 (95%CI: 1.19, 1.84) in 2018 (Figure 2B).

43 262 The NCD prevalence was significantly higher with advanced age, among men (except for
44
45 263 cancer, asthma, chronic bronchitis, COPD or emphysema), among residents of Wallonia and Brussels
46
47 264 (except for CVD and cancer), among the low educated (except for CVD and cancer), and the lower
48
49 265 income groups (except for CVD), with over 20 years' time reducing disparities in age for asthma and in
50
51 266 Brussels for cancer, but worsening disparities by income levels for chronic bronchitis, COPD or
52
53 267 emphysema (Figure 2C). Relative disparities in NCD prevalence were the largest for T2DM by
54
55 268 nationality (PR for non-Europeans: 2.20, 95%CI: 1.51, 3.22) and by income (PR: 2.11, 95%CI: 1.36,
56
57 269 3.27) as well as for chronic bronchitis, COPD and emphysema.

1
2
3 270 The NCD-specific mortality rates were significantly higher among men (except for asthma),
4
5 271 residents of Wallonia and Brussels as compared to those of Flanders (except for cerebrovascular
6
7 272 disease), and among the native Belgians (except for T2DM and asthma).
8
9 273

10 274 *Absolute health disparities by socio-demographic population strata*

11 275 Measuring this on an absolute scale did not alter conclusions (Supplementary Tables 3).
12
13 276 Similarly, when using absolute differences, health disparities were the most pronounced for age,
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15 277 education and income strata, with the highest disparities seen for lifestyle and metabolic risks, but not
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17 278 for prevalent NCDs related to their low prevalence in the general population. In particular, absolute
18
19 279 disparities in lifestyle risks were the largest for dietary risks by age (RD non-daily fruit: -25%, 95%CI: -
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21 280 31, -19; RD daily SSBs: -20%, 95%CI: -25, 16), by income (RD non-daily vegetables: 24%, 95%CI: 19,
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23 281 29) as well as for leisure-time physical inactivity by age (RD: 22%, 95%CI: 15, 28), by education (22%,
24
25 282 95%CI: 17, 26) and income (22%, 95%CI: 16, 28) and for daily smoking by income (RD: 21%, 95%CI:
26
27 283 16, 28). Moreover, large absolute disparities for overweight were observed for age (RD: 21%, 95%CI:
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29 284 15, 27), sex (RD: -14%, 95%CI: -17, -11), nationality (RD for non-Europeans: 9.2%, 95%CI: 3, 16),
30
31 285 educational level (RD: 17%, 95%CI: 13, 21), and income level (RD: 11%, 95%CI: 6, 17), while lower
32
33 286 than 5% for other metabolic risks and NCD prevalence, except for income groups (RD high blood
34
35 287 pressure 8.1%, 95%CI: 3.4, 13; RD high cholesterol: 7.0, 95%CI: 2.3, 12; chronic bronchitis, COPD or
36
37 288 emphysema: 9.1%, 95%CI: 6.2, 12) and for non-European and diabetes (RD: 7.5%, 95%CI: 2.5, 13).
38
39 289

40 290 *Clustering of lifestyle risks*

41 291 One-fifth was engaged in multiple lifestyle risks of poor diet, smoking, excessive alcohol use
42
43 292 and physical inactivity, while one-fourth reported an overall healthy lifestyle (Supplementary Table 4).
44
45 293 High engagement in multiple lifestyle risks was most frequent among men (65%), residents of Wallonia
46
47 294 (37%), the lower education (62%) and the lower income strata (17%) with their multiple risks mainly
48
49 295 characterised by non-daily intakes of fruit (76%), daily snacking (43%), current smoking (69%) and
50
51 296 physical inactivity (61%), but no distinct pattern of alcohol consumption.
52
53 297

54 298 Belgian residents with at least one dietary risk were slightly more likely to be physically inactive,
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56 299 heavy smokers, and heavy drinkers, with former or current smokers also more likely to be heavy drinkers
57
58 and physically inactive, but heavy drinkers less likely to be physically inactive (Supplementary Table 5).
59
60

1
2
3 300 The odds of having at least one dietary risk was higher for heavy smokers (OR 3.17; 95%CI 2.54, 3.95;
4
5 301 TABLE 2), and for the physically inactive (OR 1.45; 95%CI: 1.24, 1.69). Similarly, the odds of being a
6
7 302 former or current smoker was higher when having four dietary risks (OR 2.84; 95%CI: 1.87, 4.25), for
8
9 303 heavy drinkers (OR 4.75; 95%CI: 3.61, 6.25), and for the physically inactive (OR 1.39; 95%CI: 1.18,
10
11 304 1.64). The odds of being a frequent (at least weekly) drinker was only higher for heavy smokers (OR
12
13 305 2.45, 95%CI: 1.95, 3.08). Lastly, the odds of being at most light physically active was higher for heavy
14
15 306 smokers (OR 2.17; 95%CI: 1.73, 2.72), but lower for heavy drinkers (OR 0.60; 95%CI 0.46, 0.78).

16
17 307 The prevalence of metabolic risks and NCDs were higher among individuals with high
18
19 308 engagement in multiple lifestyle risks (TABLE 3). In 2018, relative disparities were significantly varying
20
21 309 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
22
23 310 (95%CI: 1.12, 2.72) and 3.69 (95%CI: 2.18, 6.28) for CVD, asthma and COPD, with only high cholesterol
24
25 311 levels significantly higher in 2018 than in 2013. Focussing on individual lifestyle risks, the prevalence of
26
27 312 high BMI, T2DM, and CVD was more frequently reported for abstainers/occasional drinkers and the
28
29 313 non-physically active, independently of age, sex and other lifestyle risks, with the prevalence of T2DM
30
31 314 also more frequently reported when having none dietary risks, and of CVD and COPD more frequently
32
33 315 for former and current smokers (Supplementary Table 6).

34 316

35 317 **DISCUSSION**

37 318 Using nationally representative data of Belgium, we identified the population strata where health
38
39 319 disparities are present, and we traced the evolution of these disparities over 20 years. Older age, lower
40
41 320 education, and lower income strata were the most affected by unfavourable health. For the latter two
42
43 321 strata, we also observed a greater prevalence of engagement in multiple lifestyle risks, with their
44
45 322 disparities worsening over time. Multiple lifestyle risks were also more prevalent in men, and the region
46
47 323 of Wallonia. Still, NCD-specific mortality rates were significantly higher among men (except for asthma),
48
49 324 residents of Wallonia, and Brussels (except for cerebrovascular disease), and among native Belgians
50
51 325 (except for T2DM and asthma).

53 326 The socio-economic distribution of health as reported in this study corroborates earlier
54
55 327 surveillance findings from western countries, including Belgium,^{14,15} as operationalised by highest
56
57 328 educational attainment. The inverse education-health gradients are a long-lasting universal
58
59 329 phenomenon in Europe with widening disparities for common chronic diseases,³⁰ self-assessed

1
2
3 330 health,³¹ and mortality³². Following earlier observations,³³ results of the present study also confirmed
4
5 331 that at present engagement in lifestyle risks remained more frequent for the low educated, and because
6
7 332 of the mediating role of health illiteracy, *i.e.* insufficient knowledge, motivation and competence to make
8
9 333 appropriate health decisions, likely to persist.^{34,35} Using education as a single indicator of socio-
10
11 334 economic position at the individual level, however, captures only the knowledge-related assets of the
12
13 335 socio-economic stratification, disregarding the full understanding of the existing health disparities by
14
15 336 ranks in a society.³⁶ In our study, health disparities by education resemble well those by income, though
16
17 337 slightly more pronounced for income. This suggests that both the social and financial resources provided
18
19 338 by education and income, respectively, play a key role in a healthy lifestyle, and thereby delaying the
20
21 339 onset of metabolic conditions and NCDs.

22 340 We used the most simple absolute and relative measures of disparities in health to illustrate the
23
24 341 existing disparities in Belgium, and in this way avoid the value-laden of an arbitrary choice. Our findings
25
26 342 might be limited by participants' self-reporting. Reporting risks and diseases is subjected to not only the
27
28 343 actual presence of it, but also participant-related characteristics like health knowledge, ability to recall,
29
30 344 willingness to report, and in case of health problem, frequency of contact with physician and
31
32 345 disadvantages experienced in everyday life. This shortcoming of self-reports has been acknowledged
33
34 346 by the first Belgian Health Examination Survey (BELHES), conducted for the first time by Sciensano in
35
36 347 2018.³⁷ Early findings of the BELHES showed that one-third of the population suffers from high blood
37
38 348 pressure, half from high cholesterol levels and one-tenth from T2DM, while according to the self-reports
39
40 349 only 15%, 20% and 6%, respectively.³⁸ This potential bias might differentially affect our population strata,
41
42 350 with a misclassification likely to occur to a larger extent in the most disadvantaged group, leading to an
43
44 351 underestimation of the true disparity. Besides, our findings provide a general profile of the high-risk
45
46 352 groups, and therefore cannot be directly extrapolated to all individuals belonging to certain strata, for
47
48 353 example within the low educated prevalence of risks and outcomes might differ not only by age group
49
50 354 and sex³⁰, but also by background psychosocial factors, such as marital status, household composition,
51
52 355 social support and job strain, that may operate in the pathway between socio-demographic factors and
53
54 356 NCD outcomes.³⁹ Furthermore, the present study could not address the differential mortality by SES
55
56 357 indicators because of the impossibility of individual linkage of census data with the most recent BHIS,
57
58 358 as previously done.⁴⁰

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2
3 359 In cross-sectional studies, there is a potential bias for reverse causality bias, potentially
4
5 360 explaining our contra-intuitive finding of a higher reported T2DM prevalence when having none dietary
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7 361 risks and being abstainers/occasional drinker, since among those with T2DM around 60% of them
8
9 362 followed a diet for this condition, as also inquired by the BHIS. While excessive alcohol use (*i.e.* drinking
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11 363 very high amounts of alcohol weekly) is a well-recognised risk factor for NCDs, the light-to-moderate
12
13 364 levels of alcohol consumption remain controversial.⁴¹ In fact, zero consumption is nowadays ever more
14
15 365 regarded as the consumption amount fitting a healthy lifestyle, since estimated protective effects for
16
17 366 some health conditions at low levels are outweighed by increased risks of other health-related harms,
18
19 367 including cancer.⁴²

20
21 368 Our study implies that over a wide range of risk and health indicators important population strata
22
23 369 to target are the elderly, the low educated, the low income strata, and the immigrants, of which only the
24
25 370 former is an unfortunately unavoidable disparity difficult to argue to be unjust.⁴³ Narrowing the disparities
26
27 371 by socio-economic position and nationality should be the focus of health policy programmes, likely with
28
29 372 interventions based on the principles of proportionate universalism,⁴⁴ *i.e.* a universal action with a
30
31 373 targeted intervention component tailored to tackle the driving root causes either simultaneously or
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33 374 sequentially, with due consideration to the upstream determinants of health that may lie outside the
34
35 375 health sector (e.g. illiteracy, unemployment, the barrier to healthcare consumption).⁴⁵

36 376

37 377 **CONCLUSION**

38
39 378 In conclusion, health status is not only a product of individual choice but also related to the
40
41 379 population strata where a person belongs to, with this defined particularly by the socio-demographic
42
43 380 factors influencing lifestyle. In addition, the tendency of lifestyle risks to cluster strengthens the need for
44
45 381 health promotion programmes that tailor multiple targets and aim at reaching the socio-economic
46
47 382 disadvantaged for narrowing health disparities.

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505 **TABLES & FIGURES**506 **TABLE 1** Characteristics (weighted %) of the Belgian population, aged 25-84 years, according to
507 survey year.

	Year of the survey						<i>p</i> -trend ^a
	1997	2001	2004	2008	2013	2018	
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 \geq 25kg/m ²	45.4	48.8	48.1	50.9	51.7	52.7	<0.001
Obesity, BMI \geq 30kg/m ²	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.

514 **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 (<i>p</i> -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 (<i>p</i> -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 (<i>p</i> -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 (<i>p</i> -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		<i>p</i> -change ^c
	High	Low	High	Low	2013	2018	
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.

530 LEGEND OF FIGURES

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

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

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

541
 542 **Figure 2** Significant 20-year time trends in the relative health disparities, expressed in age-standardised
 543 prevalence ratios between distal groups calculated from periodic national-representative health
 544 interview surveys, from lifestyle risks to non-communicable diseases according to socio-demographic
 545 strata, from 1997 until 2018 in Belgium.

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

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

554 2A: Lifestyle risks

555 2B: Metabolic risks

556 2C: Non-communicable diseases

557

558 LEGEND OF SUPPLEMENTARY MATERIALS

559

560 **Supplementary Table 1** Components and scoring of the lifestyle risk index ^{a,b}.

561 Abbreviations: SSB, sugar-sweetened beverages

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

564

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

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

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

576 2A. Age-related relative health disparities: adults aged 75-84 years versus 25-34 years (reference)

577 2B. Sex- related relative health disparities: women vs men (reference)

578 2C. Region of residence-related relative health disparities: Wallonia vs Flanders (reference)

579 2D. Region of residence-related relative health disparities: Brussels vs Flanders (reference)

580 2E. Nationality-related relative health disparities: non-Belgian Europeans vs Belgians (reference)

581 2F. Nationality-related relative health disparities: non-Europeans vs Belgians (reference)

582 2G. Education-related relative health disparities: low vs high (reference)

583 2H. Income-related relative health disparities: Quintile 1 vs Quintile 5 (reference)

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3 **585 Supplementary Tables 3** Trends in health disparities related to the prevalence of lifestyle risks,
4 **586** metabolic risks, and major non-communicable diseases according to socio-demographic strata and
5 **587** measured as age-standardised percentage point differences between distal groups.

6 **588** Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary diseases; CVD, cardiovascular diseases; NCDs,
7 **589** non-communicable diseases; SSBs, sugar-sweetened beverages; T2DM, type 2 diabetes mellitus. Empty cell represents absence
8 **590** of the variable in the particular survey year (*i.e.* dietary risks and high cholesterol levels from 1997 to 2008, and asthma and
9 **591** chronic bronchitis, COPD, emphysema in 1997), and otherwise non-analysed outcomes because less than 20 survey participants
10 **592** in any specific strata reported having the outcome of interest in the particular survey year.

11 **593** ^a Trends calculated using the *p*-value of time*strata interaction term in a survey-weighted age-adjusted logistic regression model
12 **594** for lifestyle and metabolic risks and NCD prevalence and using the *p*-value of the Mann-Kendall trend test for NCD-related
13 **595** mortality rates, and interpreted as a *p*-value for change when only two time points available.

14 **596** 3A. Age-related absolute health disparities: adults aged 75-84 years versus 25-34 years (reference)

15 **597** 3B. Sex-related absolute health disparities: women vs men (reference)

16 **598** 3C. Region of residence-related absolute health disparities: Wallonia vs Flanders (reference)

17 **599** 3D. Region of residence-related absolute health disparities: Brussels vs Flanders (reference)

18 **600** 3E. Nationality-related absolute health disparities: non-Belgian Europeans vs Belgians (reference)

19 **601** 3F. Nationality-related absolute health disparities: non-Europeans vs Belgians (reference)

20 **602** 3G. Education-related absolute health disparities: low vs high (reference)

21 **603** 3H. Income-related absolute health disparities: Quintile 1 vs Quintile 5 (reference)

22 **604**

23 **605 Supplementary Table 4** General characteristics and lifestyle risks (weighted %) of the Belgian
24 **606** population, aged 25-84 years, according to the level of engagement in multiple lifestyle risks (high versus
25 **607** low)

26 **608** Abbreviations: SSB, sugar-sweetened beverages. ^a Engagement in multiple lifestyle risks was summarised in a composite index
27 **609** of four lifestyle risk factors: diet, smoking, alcohol and physical inactivity (see Supplementary Table 1), with each of them scored
28 **610** from 1 to 5, and higher points indicating lifestyle risk present for diet (*i.e.* non-daily fruit and vegetables, and daily snacking and
29 **611** sugar-sweetened beverages), smoking (*i.e.* a heavy smoker), alcohol (*i.e.* excessive alcohol use), physical inactivity (*i.e.*
30 **612** sedentary leisure-time activities). The index ranged from 4 (minimal engagement in lifestyle risks) to 20 (maximal engagement),
31 **613** and was further categorised for the analyses into high engagement in lifestyle risks (12-20) versus low (4-7).

32 **614**

33 **615 Supplementary Table 5** Characteristics (weighted %) of the Belgian population, aged 25-84 years,
34 **616** according to the level of engagement in the individual lifestyle risks of dietary risks, smoking, alcohol
35 **617** and physical inactivity, in 2018.^a

36 **618** ^a Lifestyle risks for diet: having at least one dietary risk present, lifestyle risks for smoking: being a current or former smoker;
37 **619** lifestyle risks for alcohol: being a frequent drinker (at least drinking alcohol weekly); and lifestyle risk for physical inactivity: being
38 **620** physically inactive or lightly active.

39 **621**

40 **622 Supplementary Table 6** Relative health disparities by engagement in individual lifestyle risks,
41 **623** independent of other lifestyle risks, expressed in adjusted age-standardised prevalence ratios.^b

42 **624** ^a Lifestyle risks for diet: having at least one dietary risk present, lifestyle risk for smoking: being a current or former smoker; lifestyle
43 **625** risk for alcohol: being a frequent drinker (at least drinking alcohol weekly); lifestyle risk for physical inactivity: being physically
44 **626** inactive or lightly active. ^b Adjusted for age, sex and the other lifestyle risks.

45 **627**

628 **Contributorship statement**

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

633

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641 Contribution, v) the inclusion of electronic links from the Contribution to third party material where-ever
642 it may be located; and, vi) licence any third party to do any or all of the above.

643

644 **Competing interests declaration**

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

650

651 **Ethics approval**

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

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3 658 **Transparency statement**
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5 659 The lead author affirms that this manuscript is an honest, accurate and transparent account of the study
6
7 660 being reported; that no important aspects of the study have been omitted; and that any discrepancies
8
9 661 from the study as planned (and, if any relevant, registered) have been explained.
10

11 662

12
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14

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18
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21 667 submit the manuscript for publication.
22

23 668

24
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26

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30

31 672

32
33 673 **Dissemination declaration**
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35 674 Not applicable.
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39 676 **Patient and Public Involvement Statement**
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41 677 As a secondary data analysis of the BHIS, this study did not involve patients/participants or the public
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43 678 in the design, conduct or dissemination plans.
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45 679

46
47 680 **Data Sharing Statements**
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49 681 Data of the Health Interview Surveys, conducted by Sciensano, are not publicly available, but access to
50
51 682 data is possible through request to the Privacy Commission. More information can be retrieved via
52
53 683 <https://his.wiv-isp.be/SitePages/Home.aspx>. Also, publicly available datasets were utilized in this study:
54
55 684 Standardised Procedures for Mortality Analysis – Belgium (SPMA), developed by Sciensano, accessible
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57 685 via <https://spma.wiv-isp.be/SitePages/Home.aspx>.
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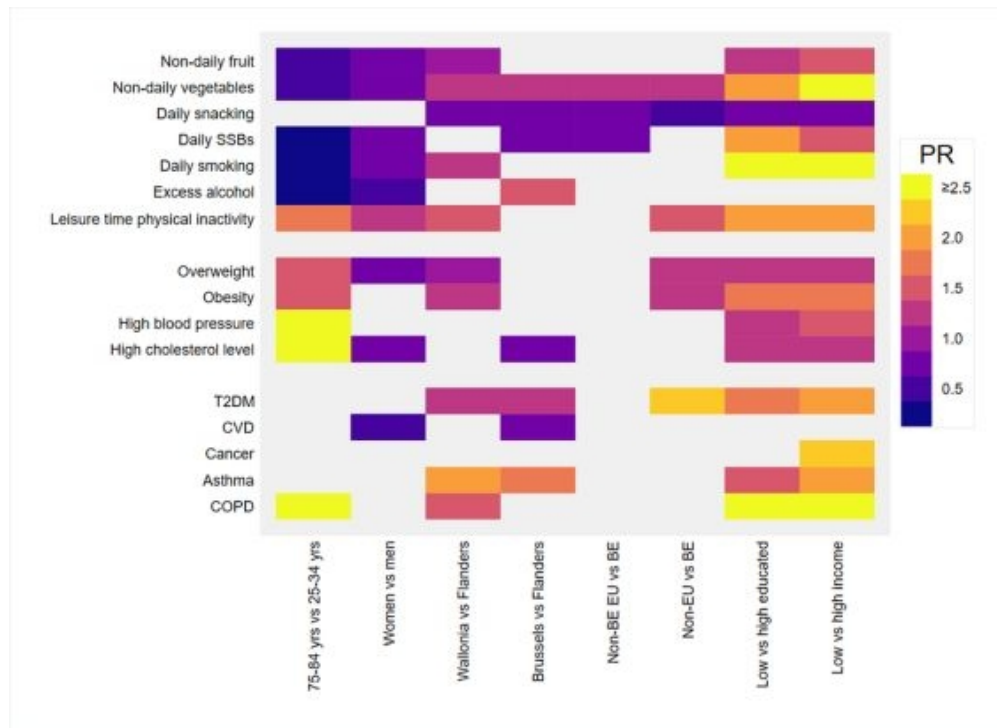


Figure 1 Heatmap of the relative health disparities, expressed in age-standardised prevalence ratios between distal groups, from lifestyle and metabolic risks to non-communicable diseases according to socio-demographic strata in 2018 in Belgium. Colours depicted the strength of the disparity with the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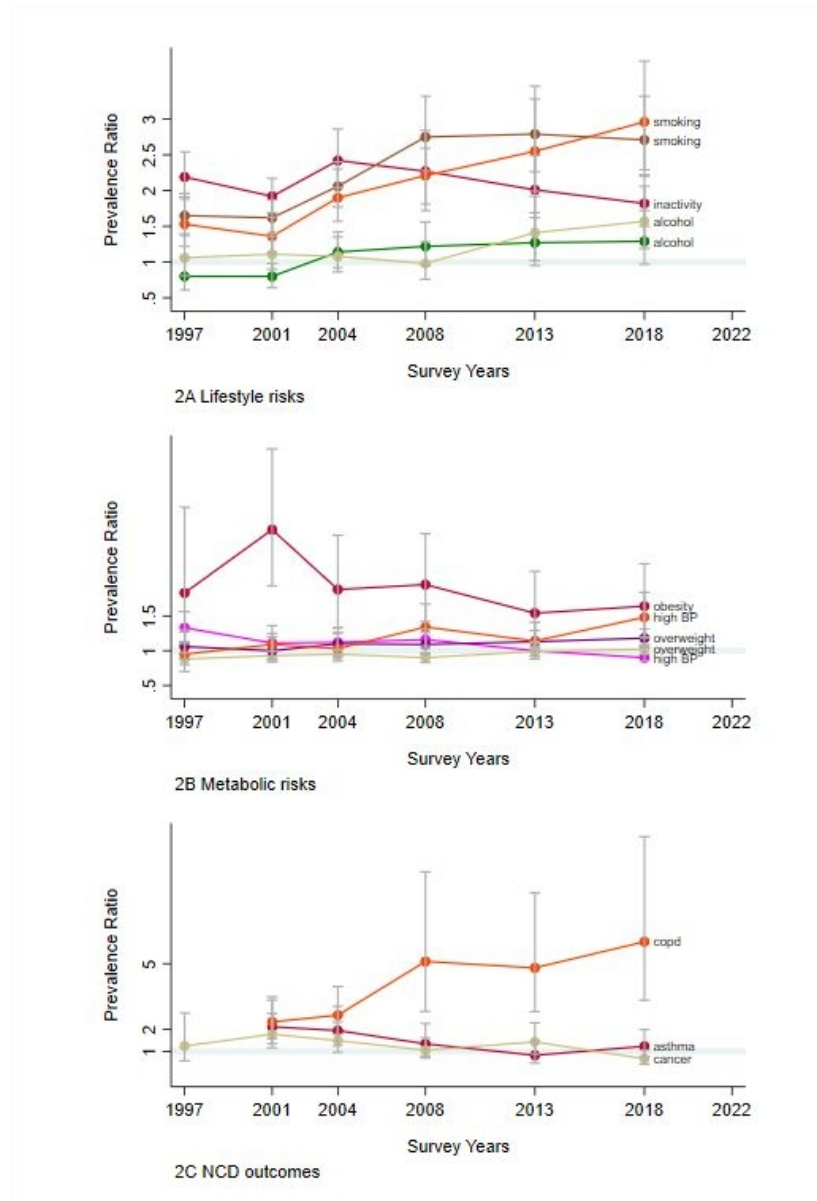


Figure 2 Significant 20-year time trends in the relative health disparities, expressed in age-standardised prevalence ratios between distal groups calculated from periodic national-representative health interview surveys, from lifestyle risks to non-communicable diseases according to socio-demographic 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 risks 2B: Metabolic risks 2C: Non-communicable diseases

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SUPPLEMENTARY TABLES

Supplementary Table 1 Components and scoring of the lifestyle risk index ^{a,b}.

Lifestyle risks	Components' scoring	Points
	Dietary risks	Four present
- Non-daily fruit	Three present	5 points
- Non-daily vegetables	Two present	4 points
- Daily SSBs	One present	3 points
- Daily snacking	No dietary risks	2 points
	Smoking	Current heavy smoker
		Current non-heavy smoker or occasional smoker
		Former smoker quitting < 10 years ago
		Former smoker quitting ≥ 10 years ago
		Never smoked
	Alcohol consumption	≥ 22 servings a week
		15-21 servings a week
		8-14 servings a week
		1-7 servings a week
		Occasional drinkers and abstainers
	Physical inactivity	Sedentary activities
		Leisure time sport < 4 hours a week or light activities
		Intensive training or leisure time ≥ 4 hours a week
		5 points
		4 points
		3 points
		2 points
		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	<i>p</i> -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					0.64 (0.53; 0.90)	0.59 (0.46; 0.75)	0.383
Daily snacking					0.91 (0.78; 1.11)	1.10 (0.93; 1.30)	0.186
Daily SSBs					0.33 (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)	0.33 (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)	0.91 (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/m ²	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/m ²	1.83 (1.10; 3.06)	2.74 (1.93; 3.90)	1.88 (1.33; 2.66)	1.95 (1.42; 2.68)	1.51 (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)	17.1 (10.9; 27.1)	13.9 (8.81; 21.8)	0.072
High cholesterol levels					12.1 (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)	0.81 (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					0.72 (0.72; 0.82)	0.75 (0.70; 0.79)	0.504
Non-daily vegetables					0.72 (0.63; 0.78)	0.72 (0.66; 0.79)	0.919
Daily snacking					1.04 (0.93; 1.07)	1.04 (0.96; 1.12)	0.408
Daily SSBs					0.65 (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)	0.72 (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)	1.21 (1.12; 1.42)	1.33 (1.21; 1.46)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	0.72 (0.67; 0.78)	0.77 (0.73; 0.82)	0.74 (0.70; 0.78)	0.76 (0.72; 0.81)	0.72 (0.72; 0.81)	0.76 (0.72; 0.80)	0.729
Obesity, BMI ≥ 30 kg/m ²	0.98 (0.81; 1.18)	1.07 (0.93; 1.23)	1.10 (0.96; 1.26)	1.10 (0.96; 1.26)	1.08 (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)	1.08 (0.88; 1.13)	0.94 (0.85; 1.05)	0.003
High cholesterol levels					0.91 (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							
Myocardial infarction				0.46 (0.27; 0.78)	0.50 (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					0.48 (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)	0.92 (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)	1.05 (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)	1.05 (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)	1.02 (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)	0.72 (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)	0.47 (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)	0.82 (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)	0.55 (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)	1.05 (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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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					1.14 (1.01; 1.36)	1.29 (1.13; 1.48)	0.293
Daily snacking					1.00 (0.92; 1.10)	0.88 (0.79; 0.97)	0.060
Daily SSBs					1.14 (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)	1.23 (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)	1.24 (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)	1.30 (1.17; 1.53)	1.57 (1.40; 1.76)	0.333
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	1.08 (1.00; 1.18)	1.09 (1.03; 1.16)	1.13 (1.06; 1.21)	1.05 (0.99; 1.13)	1.00 (1.00; 1.14)	1.08 (1.01; 1.15)	0.618
Obesity, BMI ≥ 30 kg/m ²	1.37 (1.11; 1.69)	1.28 (1.09; 1.49)	1.34 (1.15; 1.56)	1.08 (0.93; 1.26)	1.33 (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)	0.99 (0.79; 1.03)	1.10 (0.97; 1.23)	0.232
High cholesterol levels					0.99 (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							
Myocardial infarction				1.57 (0.87; 2.83)		1.96 (1.01; 3.83)	
Coronary artery disease				1.30 (0.85; 1.97)	1.54 (0.87; 2.67)	1.28 (0.75; 2.19)	
Other serious heart disease					0.81 (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)	0.80 (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)	1.70 (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)	1.60 (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)	1.11 (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)	1.23 (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)	0.99 (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)	2.00 (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 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/m ²	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/m ²	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							
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/m ²	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/m ²	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							
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/m ²	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/m ²	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. ^aTrends 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.

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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/m ²	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/m ²	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							
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. ^aTrends 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/m ²	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/m ²	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							
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 (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. ^aTrends 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.

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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/m ²	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/m ²	4.2% (-0.1%; 8.6%)	11.2% (6.4%; 16.0%)	6.1% (2.5%; 9.7%)	7.7% (3.8%; 11.7%)	5.3% (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	<i>p</i> -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%)	6.9% (3.2%; 9.6%)	8.1% (5.4%; 10.9%)	0.719
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	-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/m ²	-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							
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%)	1.1% (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	<i>p</i> -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/m ²	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/m ²	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% (1.0%; 9.9%)	6.7% (3.2%; 10.2%)	0.315
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	-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/m ²	-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							
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)	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)	5.8 (-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)	10 (-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.

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

	1997	2001	2004	2008	2013	2018	<i>p</i> -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/m ²	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/m ²	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. ^aTrends 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.

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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% (6.5%; 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% (-4.7%; 11.8%)	13.4% (2.9%; 24.0%)	0.249
Metabolic risks							
Overweight, BMI ≥ 25 kg/m ²	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/m ²	-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% (0.3%; 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. ^aTrends 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.

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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/m ²	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/m ²	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%)	4.9% (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%)	1.8% (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%)	3.9% (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%)	4.9% (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 7,746 (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.

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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% (-0.6%; 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% (8.0%; 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/m ²	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% (5.0%; 15.9%)	11.4% (5.6%; 17.2%)	0.453
Obesity, BMI ≥ 30 kg/m ²	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% (6.6%; 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% (-2.6%; 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% (-1.7%; 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- and sex-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.

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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 \geq 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						
\geq 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 \geq 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								

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≥ 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 individual 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.

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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.