The role of lifestyle on past and future mortality in Europe

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Importance of lifestyle factors

› Europe: > 85 % of all deaths due to NCDs (WHO 2011)
› Caused by smoking, excessive alcohol consumption, unhealthy diets, physical inactivity (WHO 2011)
› In the EU, smoking, alcohol and obesity are the most important preventable risk factors (WHO 2009)
› Important differences btwn countries and sexes in the importance of these lifestyle factors
› This impact is changing over time
Changing importance of lifestyle factors

› Smoking epidemic => strong wave pattern (prevalence; mortality); Northwestern European men (Lopez et al. 1994; Thun et al. 2012)

› Obesity epidemic => prevalence tripled since 1980 (WHO 2007); wave-shaped epidemic (Xu & Lam 2018); current signs of stagnation (Rokholm et al. 2010)

› Alcohol => adult men Eastern Europe; high and fluctuating mortality (Rehm et al. 2009); recent declines (Trias Llimós et al. 2018)

› Importance of the birth cohort dimension for describing and explaining past trends in smoking-, alcohol- and obesity-attributable mortality (e.g. Janssen & Kunst 2005, Trias-Llimós et al. 2017; Vidra et al. 2018).
Importance for mortality forecasting

› These changes in lifestyle-attributable mortality are important for mortality forecasting (e.g. Janssen et al. 2013; Bongaarts 2014).

› Mostly by means of extrapolation (Booth & Tickle, 2008; Stoeldraijer et al. 2013)

› When past trends non-linear due to lifestyle factors, different historical period => different outcome (Janssen & Kunst, 2007; Stoeldraijer 2018)

› No non-linearity in the future
Objectives

› To estimate the impact of the smoking, alcohol and obesity ‘epidemics’ on current mortality levels and past trends

› To project future smoking, alcohol and obesity-attributable mortality

› To project all-cause mortality taking into account the impact of lifestyle ‘epidemics’
Data

› 30 European countries, by sex and age, 1950-2016
› Age and sex-specific lifestyle-attributable mortality fractions
  • Smoking (1950-2014; 35-100 M; 40-100 F) => indirectly estimated using lung cancer mortality data from WHO (Peto et al. 1992; Janssen et al. 2013)
  • Alcohol (1990-2016; 20-100) => rates from Global Burden of Disease Study 2017 (20-64) and age pattern at highest ages using cause-specific mortality data from WHO.
  • Obesity (1975-2016; 20-100) => PAF formula applied to prevalence data (NCD Risk Factor Collaboration study 2017) and RR of dying from obesity (Lobstein et al. 2010).
  • Smoothing over age
  • Three lifestyle factors combined => multiplicative approach

› All-cause mortality and exposure from HMD (past trends: August 27, 2018; projection: May 1, 2019)
Past impact lifestyle-attributable mortality (separately and combined)
<table>
<thead>
<tr>
<th></th>
<th>PGLE Smoking</th>
<th>PGLE Alcohol</th>
<th>PGLE Obesity</th>
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<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
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<tr>
<td>Europe</td>
<td>3.76</td>
<td>2.27</td>
<td>1.28</td>
</tr>
<tr>
<td>Western Europe</td>
<td>2.40</td>
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<tr>
<td>Eastern Europe</td>
<td>4.92</td>
<td>3.40</td>
<td>1.37</td>
</tr>
</tbody>
</table>

PGLE estimates, 2010
Trends age-standardised smoking, alcohol, and obesity-attributable mortality fractions
Trends age-standardised lifestyle-attributable mortality fractions, 1990-2016 (20-100)
Comparison trends e0 all-cause mortality vs trends e0 non-lifestyle attributable mortality
Future lifestyle-attributable mortality
Methods – future fractions I

Novel projections that take into account the wave pattern of epidemics

Smoking & Alcohol =>

- APC (Cairns et al. 2009) applied to attributable mortality fractions with a generalized logit link function
- projection $k_t$ by quadratic curve with correlated errors or by decline after peak (best ARIMA)
- projection $g_c$ by extrapolating recent trend (best ARIMA) after burning the outer cohorts

Obesity

- LC applied to transformed logit of prevalence
- projection by linearly extrapolating past trend speed of change over time (1st order diff.)

- 2000 onwards; 1985 onwards Eastern European women

Ages up to 84
Methods – future fractions II

› Generalized / transformed => implementing bounds
  • Smoking => men LB 5% smoking prevalence; women UB max level women DK (not Hungary)
  • Alcohol => different LBs by country and sex
  • Obesity => LB age-specific prevalence 1975

› For ages 85 -100 => linear extrapolation of the logit of the fractions/prevalence for ages 75-84

› 500 simulations (for now)

› Multiplicative approach to combine the projected fractions for the three separate lifestyles
Projection smoking-attributable mortality fractions (SAMF)
Projection alcohol-attributable mortality fractions (AAMF)

Selected countries:
- Hungary

Graphs showing age-standardised and age-specific AAMF for men and women, with projections from 1990 to 2065.
Projection obesity-attributable mortality fractions (OAMF)

Selected countries

Ireland

Age-standardised OAMF

Age-specific OAMF

Selected countries

Men

Women

Year

1975 1990 2005 2020 2035 2050 2065

Year

1975 2000 2025 2065

Year

1975 2000 2025 2065

20 30 40 50 60 70 80 84

UK Ireland Denmark Belgium Finland Spain France Hungary Poland Slovenia
Projected lifestyle-attributable mortality fractions
Projected lifestyle-attributable mortality fractions - men
Projected lifestyle-attributable mortality fractions - women
Final projection
Methods – final projection methodology

- Coherent forecast of non-lifestyle-attributable mortality rates (Li-Lee); 1990 onwards; ages 0-100. Common = women in France, Spain, Italy. $k_{t_i} \rightarrow$ RW with no drift (non-stationary).
- Combining them:
  $$m(x, t)^{\text{allcause}} = m(x, t)^{\text{non-lifestyle}} \cdot \left( \frac{1}{1-LAMF(x,t)} \right)$$ (Janssen et al. 2013)
- For ages 100+ => Kannisto model of old-age mortality (Thatcher et al. 1998)
- Comparison with direct forecast of all-cause mortality (individual LC and coherent Li-Lee) and with individual LC forecast of non-lifestyle-attributable mortality
Comparisons different projections Hungary
Effect lifestyle when individually forecasting mortality (LC)

Belgium women

Spain
Effect lifestyle when coherently forecasting mortality (LiLee)

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
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<tbody>
<tr>
<td></td>
<td>Projected eo 2065</td>
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<td>Li and Lee</td>
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<td>Allcause direct</td>
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<td>91.4</td>
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<td>90.6</td>
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<td></td>
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<td>93.0</td>
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<td></td>
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<td>Spain</td>
<td>80.1</td>
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<td>89.4</td>
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<td>Poland</td>
<td>73.7</td>
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<td>Hungary</td>
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<td>87.8</td>
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To conclude
Overall conclusion

› Smoking, alcohol and obesity have a strong effect on both past and future mortality levels and trends in Europe

› Mortality projections that take into account likely future changes in smoking, alcohol and obesity result in higher future eo and - when projecting coherently - in larger convergence between sexes
Discussion

› Preliminary results
› Wave-shaped assumption for alcohol
› Wave-shaped epidemic does require – for obesity and alcohol - continued policy action
› Recent stagnations in life expectancy and its causes are not taken into account
› Importance of the lower bounds
› LC and Li-Lee => illustration of the effects
Thank you

www.futuremortality.com
More info past trends lifestyle “epidemics”


See as well: www.futuremortality.com/publications

For a printed copy of one or both PhD theses or the PDF of the smoking manuscript => f.janssen@rug.nl
References (1)

References (2)

References (3)


References data


› Human Mortality Database. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Available from: www.mortality.org.


› World Health Organization Statistical Information System (WHOSIS). Health statistics and health information systems. Available at: www.who.int/whosis/
Descriptive model smoking epidemic


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Descriptive model obesity epidemic

Figure 1: Model of the obesity epidemic. The criteria used to define the stages of the epidemic are based on the level of obesity prevalence and obesity-attributed mortality. Assuming 60 years between the current Stage 1 and Stage 2 to peak at a prevalence of 60%.
Figure 1  Age-standardized liver cirrhosis mortality rate in eight European countries, aged 15–94 years, 1950–2011, by sex

Trias-Llimós et al. 2017
Hungary – observed & projected fractions

Age-standardised fractions (20-100)
Spain – observed & projected fractions

Age-standardised fractions (20-100)
Next steps

› Finetuning (smoothing; HCD data for alcohol CEE)
› If possible extend the timeseries for alcohol => longer timeseries non-lifestyle attributable mortality
› Smoking: implement lower bound among women
› Different age pattern of the lower bounds
› Numerous sensitivity analyses, e.g. different estimation of lifestyle-attributable mortality combined; different assumption projection alcohol-attributable mortality.
› Examine the effect of the separate lifestyle factors on future eo
› Take into account past trends in mortality compression and delay into the final mortality forecast