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Validity of air pollution annoyance to assess long-term exposure to air pollution in Belgium

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- **Limited validity of self-reported air pollution annoyance for assessing individual exposure to air pollution directly**
- **Prediction models based on survey data do not provide very accurate predictions of the individual exposure but allows to classify individuals in 3 levels of exposure with a good accuracy**
- **Weak contribution of environmental annoyance variables in prediction models**

To assess individual air pollution exposure, one possibility is to interpolate air pollution measures at the residence through a Geographical Information System. However, this might imply cumbersome administrative procedures. Data on air pollution annoyance from surveys can be an alternative to assess individual exposure to air pollution. This research investigates the association between air pollution annoyance and individual modelled air pollution exposure. It also investigates the accuracy of statistical models to predict the individual modelled exposure to air pollution based on survey data.

Method

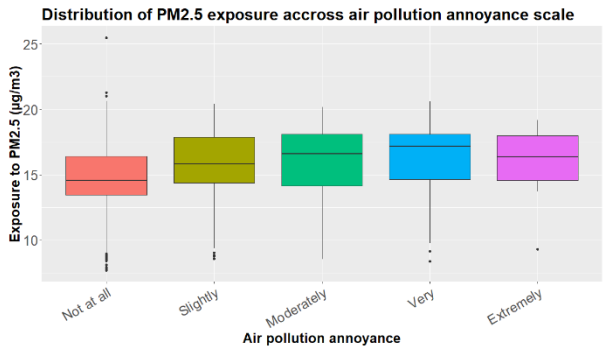
- Belgian Health Interview Survey (HIS 2013; >15 years ; n = 6497) coupled with annual means of air pollution concentration at the residence (PM, NO_2, BC)
- Self-reported air pollution annoyance (five-point Likert scale)
- Statistical analysis: Spearman coefficient; uni- & multivariate linear regression (training & test data); elastic net variable selection among socio-economic status (SES), environmental annoyance, region, urban level and health status; confusion matrix & Kappa coefficient to test the performance of the model to classify individuals in 3 groups of exposure (tertiles)

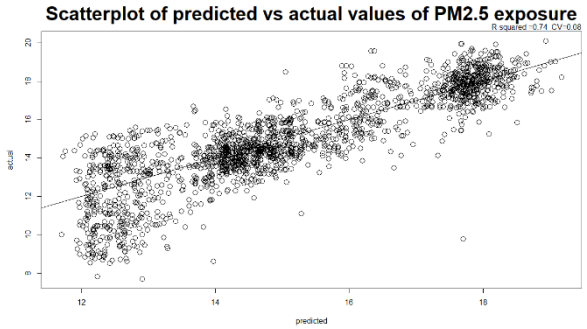
Results

- Spearman coefficients: significant but weak association between air pollution annoyance and individual air pollution exposure
  $PM_{2.5}$: 0.20, PM_{10}: 0.18, NO_2: 0.24, BC: 0.23 (p>0.001)
- Air pollution annoyance explains 2-5% of the variability of individual air pollution exposure

Multivariate predictive models

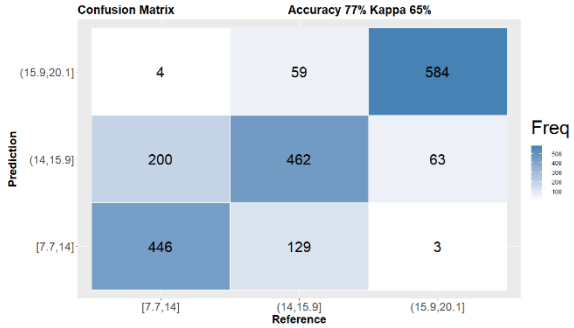
- Prediction error varies between 8% ($PM_{2.5}$) and 18% (BC)
- Variability of the individual modelled exposure explained by the model varies between 60% (PM_{10}) and 74% ($PM_{2.5}$)
- SES, region & urban level are the most important contributors in the model





Performance of the model to classify individuals in 3 levels of exposure

PM2.5



	Low (7.7-14)	High (14-15.9)	Very high (15.9-20.1)
SENSITIVITY	69%	71%	90%
SPECIFICITY	90%	80%	95%
VPP	77%	64%	90%
VPN	85%	85%	95%
PREVALENCE	33%	33%	33%
BALANCED ACCURACY	79%	75%	92%

- Kappa coefficients indicate a good agreement between the two classification groups. PM2.5:0.65 , PM10: 0.62, NO2: 0.63, BC: 0.55
- Higher performance to detect highly exposed people

Discussion

- Data on environmental annoyance from survey not strongly associated with individual air pollution exposure. However, they remain important to study the impact of the environment on heath
- The importance of SES in the prediction model highlights the environmental inequalities in Belgium
- Model validation should be performed using the 2018 HIS dataset

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