The PAQ2018 tool

Factsheet and step-by-step instructions

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Factsheet PAQ2018 tool

Introduction

The PAQ2018 tool is developed by the Urban Partnership for Air Quality, Action N°4 – Better Focus on the Protection and on the Improvement of Citizens' Health. For more information about the partnership visit https://ec.europa.eu/futurium/en/air-quality.

The tool is an adaptation of the AirQ+ and GGD tool. The strengths of these tools have been combined in order to make HIA feasible for municipalities of European cities in particular. See chapter 5 for information about the differences with the AirQ+ and GGD tool. The strengths of this tool are the pragmatic usability, its rich model output and its capability of conducting many analyses at once after which all the results become visible at a glance. Compared to the AirQ+ and GGD tool, the output has been extended with DALYs and the health damage in euros. Besides, with the PAQ2018 tool it is possible to calculate the health benefit or loss of two different pollution scenarios.

Characteristics

- Applicable to populations in Western Europe and North America
- Possibility to calculate morbidity health effects of PM_{10} and $PM_{2.5}$
- Possibility to calculate mortality health effects of PM_{10}, $PM_{2.5}$, NO_2 and EC (in decline in life expectancy, YLL, and premature deaths)
- Adjustable age structure
- Adjustable cut-off values (substantiation default values see chapter 2.1.3)
- Adjustable baseline incidence rates
- Possibility to use default values of Europe
- Every health indicator will be calculated within one analysis
- Rich model output: morbidity (also YLD), mortality (in decline in life expectancy, YLL and premature deaths), DALYs, health damage in euros

Data input

Minimally required	**Desirably required**
• Total number of citizens in region • Concentration data of at least one of the pollutants	• Concentration data of all the pollutants • Baseline incidence rates of health indicators in the population

Health output of ambient air pollution

Morbidity health effects due to PM_{10}

- Annual number of days with bronchitis in children (age 6-12 years)
- Incidence chronic bronchitis in adults (age 18+ years)
- Incidence of asthma symptoms in asthmatic children (age 5-19 years)

Morbidity health effects due to $PM_{2.5}$

- Hospitalizations, cardiovascular diseases
- Hospitalizations, respiratory diseases
- Restricted activity days (RADs) (including sick-leave, hospital admission, symptom days)
- Work days lost, working age population (age 20-65 years)
- Lung cancer (age 30+ years)

- Low birth weight (< 2500 g at term)
- Decreased lung function (FEV1) (age 6-12 years) in percentage

Mortality health effects due to PM_{10}, $PM_{2.5}$, NO_2 and EC

- Post-neonatal mortality (age 1-12 months) (due to PM_{10})
- Premature deaths (for all pollutants)
- Decline in life expectancy (for all pollutants)
- Years of life lost (for all pollutants)

What type of question can be answered with this tool?

With this tool, the health benefit/loss of a change in air quality can be assessed. Nonetheless, it is also possible to calculate the health impact of one or several pollutants at one moment in time.

Example question 1

What is the health benefit/loss of a 50% car reduction in Utrecht? In this analysis, cut-off values have been set on 3.9 µg/m^3 for PM_{10}, 2.5 µg/m^3 for $PM_{2.5}$, 5 µg/m^3 for NO_2, and 0.3 µg/m^3 for EC. Incidence data of Utrecht has been used.

The following concentrations have inserted:

Pollutant	Base case (Utrecht 2016)	Scenario Utrecht with 50% car reduction	Calculated concentration difference
PM_{10} (in µg/m^3)	20.41	19.94	0.47
$PM_{2.5}$ (in µg/m^3)	12.69	12.46	0.23
NO_2 (in µg/m^3)	28.95	25.87	3.08
EC (in µg/m^3)	1.22	1.12	0.10

Scenario results:

Health indicator	Health benefit in cases (Mean (95% CI))	Health benefit in share of disease burden in % (Mean (95% CI))
Annual number of days with bronchitis in children (age 6-12 years) (PM_{10})	95 (-30 - 185)	0.3 (-0.1 - 0.6)
Incidence chronic bronchitis in adults (age 18+ years) (PM_{10})	3 (1 - 4)	0.4 (0.2 - 0.6)
Incidence of asthma symptoms in asthmatic children (age 5-19 years) (PM_{10})	225 (51 - 392)	0.1 (0.0 - 0.2)
Hospitalizations, cardiovascular diseases ($PM_{2.5}$)	1 (0 - 2)	0.0 (0.0 - 0.0)
Hospitalizations, respiratory diseases ($PM_{2.5}$)	1 (0 - 2)	0.0 (0.0 - 0.1)
Restricted activity days (RADs) (including sick-leave, hospital emergency admission, symptom days) ($PM_{2.5}$)	6576 (5919 - 7351)	0.1 (0.1 - 0.1)
Work days lost, working age population (age 20-65 years) ($PM_{2.5}$)	2061 (1765 - 2351)	0.1 (0.1 - 0.1)
Lung cancer (age 30+ years) ($PM_{2.5}$)	0 (0 - 0)	0.2 (0.1 - 0.3)
Low birth weight (< 2500 g at term) ($PM_{2.5}$)	1 (0 - 1)	0.3 (0.0 - 0.6)

YLD benefit	4 (2 - 6)
Reduction decline FEV1	0.0% (0.0% - -0.1%)

Health indicator	Health benefit premature deaths (Mean (95% CI))	Health benefit in share of disease burden in % (Mean (95% CI))	Reduction decline in life expectancy in days (Mean (95% CI))	Gained YLL (Mean (95% CI))
Post-neonatal mortality (age 1-12 months) (PM_{10})	0 (0 - 0)	0,2 (0,1 - 0,3)	-	0 (0 - 1)
Mortality due to PM_{10}	4 (1 - 8)	0,2 (0,0 - 0,3)	6 (1 - 10)	46 (6 - 81)
Mortality due to $PM_{2.5}$	4 (2 - 5)	0,1 (0,1 - 0,2)	5 (3 - 6)	39 (26 - 51)
Mortality due to NO_2	16 (8 - 24)	0,6 (0,3 - 0,9)	21 (11 - 32)	174 (89 - 254)
Mortality due to EC	16 (13 - 19)	0,6 (0,5 – 0,7)	21 (17 - 25)	167 (137 - 197)

Gained DALYs (Total YLD + YLL due to $PM_{2.5}$ & NO_2)	216 (117 - 310)
Reduced health damage in €	14,874,516 (8,154,587 – 21,236,649)

Instructions PAQ2018 tool

These instructions are a section of the PAQ2018 tool package developed in the context of the European Urban Partnership for Air Quality (https://ec.europa.eu/futurium/en/air-quality). Next to these instructions, the package contains the PAQ2018 tool in the form of an Excel spreadsheet and a background document report: 'The use of Health Impact Assessment tools in European Cities'. This report contains all the background information of the tool and it is recommended to read it before conducting health impact analysis. In the current document there will be referred to this document as 'report'.

To conduct a health impact assessment (HIA) the following data is the least required:

- Total number of citizens in city/region of interest
- At least one of the annual mean concentrations of PM_{10}, $PM_{2.5}$, NO_2 or EC

The following data is desired for analysis that is more accurate:

- The age structure of the population of interest (see step 1 of the step-by-step instructions below)
- Annual mean concentrations for PM_{10}, $PM_{2.5}$, NO_2 and EC (see step 3 of the step-by step instructions below)
- Baseline incidence rates of the health indicators (see step 4 of the step-by-step instructions below)

The PAQ2018 tool is an Excel spreadsheet with five sheets in which data of your city should be inserted to conduct a health impact assessment analysis. The first sheet 'Instructions' contains the same instruction that can be found in the current document. Therefore, the step-by-step instructions start with the second sheet 'Age Structure'.

Step-by-step instructions

1. Before performing calculations, the age structure of your city should be inserted in the sheet 'Age Structure'. This should contain the total number of people and the number of people per age. If data of your city is only available per merged age group (for example 0-4, 5-10, etc.), it is possible to divide the number of people in that age group by the number of years. If no data is available of the age structure of your city, use the age structure of your country. The age structure of

most European cities can be found on the sheet 'Age Structure' (Eurostat, 2015). The default age structure is set on the situation in the European Union in 2015.

If the age structure is complete, go to the sheet 'Input and Results'. In this sheet, the yellow cells require input data. The green, orange and red cells calculate automatically the results of your HIA based on the inserted data.

2. In cell B5, the total number of citizens in the region of interest should be entered. It is important to note that the results are only reliable for populations and not for individuals.

3. The next step is to insert the concentrations of the pollutants you want to calculate the health risks of. It is not necessary to calculate the health effects of all the pollutants. Analysis can be done for only one or several pollutants. See report chapter 2.1.2 for information about concentration data input.

   If only the concentration of PM_{10} or $PM_{2.5}$ is known, the missing value can be calculated by using a conversion factor specific for your city (generally between 0.4 and 0.8). If this conversion factor is not available, the European urban average of 0.65 can be used ($PM_{2.5}$=0.65*PM_{10} or PM_{10}=1.54*$PM_{2.5}$) (De Leeuw & Horálek, 2009).

   The PAQ2018 tool has default cut-off values of 3.9 µg/m^3 for PM_{10}, 2.5 µg/m^3 for $PM_{2.5}$, 5 µg/m^3 for NO_2, and 0.3 µg/m^3 for EC. Below the cut-off value no health risks are being calculated. The default values are based on the most recent recommendations (see report chapter 2.1.2). These values can be adjusted if desired (sheet 'Input and Results', cells I8-I11).

It is possible to do calculations for 1 scenario or compare 2 scenarios:

a) To calculate the health risks of a situation at one moment in time (for example: what are the health risks of air pollution of the current situation in my city?) only the concentrations for scenario 1 has to be entered, ignore the rest of the sheet.
b) It is also possible to calculate the health risk of a change in concentration between two moments in time (for example: the health risks of due to a certain air quality measure, see example below) at the same location. For this calculation fill in the concentration of the first moment for scenario 1 (old situation) and the concentration of the second moment for scenario 2 (new situation). The third box shows the calculated difference in concentrations and gives the health benefits or losses.

4. The next step is to insert the incidences of your city or country in cells I15-I17, I19-I24, I35 and I37. In order to get the most accurate health risk assessment, it is wishful to insert most recent incidence data of the city/region of interest. If city specific data is not available, an instruction on how to find country data is described on the right side of the cells under 'Instruction for country incidences' (cells L13-L24).

   If the reference is 'WHO, HFA', go to the Health for All database explorer, which can be found on the website: https://gateway.euro.who.int/en/hfa-explorer/. Go to 'Select indicators' and search for the indicator shown on the sheet under 'Instruction for country' on the right side of the cell. Consequently, go to 'Select country' and select your country. For example, if the incidence of health indicator 'hospitalizations, cardiovascular disease' is needed, search for 'hospital discharges, circulatory system disease' in the WHO HFA database, as mentioned in cell L19.

For the health indicator 'Annual number of days with bronchitis in children (age 6-12 years)', the countries Bulgaria, Czech Republic, Hungary, Netherlands, Poland, Russia, Slovakia, and Switzerland should input their country data from the PATY study (Hoek *et al.*, 2012) table 2, column bronchitis. Other countries can use the total value of 18600 per 100000 cases of bronchitis in children.

The incidence for mortality per 100.000 people of the 30+ population can be found on the sheet 'Incidence mortality 30+' for every EU-28 country.

The remaining health outcomes can be either the same for every country, or the value to be entered can be found next to the cell under 'Default Value Europe'.

5. Now, the results of the health impact assessment are shown for either only scenario 1, or for both scenarios and the difference between these scenarios (i.e. the health benefit/loss). How this is calculated can be found on the sheet 'Model', or in chapter 5 of the background report. All the results are shown as the mean and the 95% confidence interval.

   The morbidity part (green cells) give the attributable cases, share of disease burden in percentage and total years lost due to disability (Total YLD) for health outcomes associated with exposure to PM_{10} and $PM_{2.5}$. The decline in lung function is presented in percentages.

   The mortality part (orange cells) show the mortality health indicators, including post-neonatal mortality, premature deaths (plus share of disease burden), decline in life expectancy and years of life lost (YLL).

   The DALYs and health damage in € are shown in the red cells for scenario 1, scenario 2, and the difference between the scenario's.

The results function as a screening for calculating the health effects of reductions in air pollution and should be interpreted with care. It is therefore recommended to read the background document that is part of the PAQ2018 tool package. Limitations are:

- The input data carries uncertainties
- There is a lag in time between reduction in air pollution and health benefits, which is not implied in the tool
- There is no difference in risk for susceptible groups
- The health indicators calculated do not include all the possible health effects due to air pollution

Disclaimer

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