Aphekom

Health impact assessment of air pollution

Excel tool – Short-term

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1. Objectives

The Aphekom HIA Excel sheets were developed as tools for performing standardized health impact assessment (HIA) of air pollution using the latest scientific evidence. In order to use this tool, routine health and air quality monitoring data are required. Guidelines for creating appropriate databases are part of the WP5 deliverables. For further information on the HIA methods and data within Aphekom, you should refer to the detailed Aphekom report.

The present document provides information on how to use the Excel sheet for computing:

- the short-term impact of PM10 on total non-external mortality and on cardiac and respiratory hospitalizations
- the short-term impact of ozone on total non-external mortality and on cardiac and respiratory hospitalizations

We advise you to go through this document before using the tool.

Please take care not to modify the Excel sheets as this is likely to disrupt all calculations. If you encounter any problem with the tools, please contact Magali Corso (m.corso@invs.sante.fr) or Mathilde Pascal (m.pascal@invs.sante.fr).

2. Methods

2.1. The health impact function

For the different outcomes, the health impact function will be:

$$\Delta y = y_0(1 - e^{-\beta \Delta x})$$

Where *Δy* is the outcome of the HIA
y_0 is the baseline health data
Δx is the modification of the concentration defined by the scenario.
β is the concentration response functions.
RR per 10 µg/m^3 =exp(10* β)

The results are then adjusted on the number of years *N* to give a yearly estimate

$$\Delta y^{scenario}_{outcome\ yearly} = \frac{\Delta y^{scenario}_{outcome}}{N}$$

The results are then adjusted on the total population to give a yearly estimate per 100 000.

$$\Delta y^{scenario}_{outcome\ yearlypop} = \frac{\Delta y^{scenario}_{outcome\ yearly}}{pop}$$

The method to compute *Δx* differs between pollutants.

2.2. The short-term impacts of PM10

Δx is computed on yearly averages. Only the N years with less than 25% of missing values will be used for the computation of the environmental data (Δx) health reference data (y_0).

Two scenarios are considered;

- Scenario 1, where the PM10 yearly mean is decreased by 5 µg/m^3. In that case, Δx = 5 µg/m^3
- Scenario 2, the PM10 yearly mean is decreased to 20 µg/m^3. In that case,
  $\Delta x = ([PM10]_{mean} - 20\ \mu g/m^3)$
  $\Delta x = 0$ if $[PM10]_{mean} < 20$

2.3. The short-term impacts of Ozone

Δx is computed on the accumulated excess concentrations above a threshold, using the ozone 8 hours-daily values. We used the days for which a valid ozone concentration is available, within the years for which we have more than 75% of valid data. **Please check that missing data are not concentrated during summer**.

Three scenarios are considered

- Scenario 1, where all the maximum 8-hours concentrations >160 are decreased to 160 µg/m^3. In that case, for each day i,
  if $[O_3]_i \geq 160$ µg/m^3, $Oi=([O_3]_i-160)$
  if $[O_3]_i < 160$ µg/m^3, $Oi=0$
  $$\Delta x = \frac{\sum_{i=1}^{N} O_i}{N}$$
- Scenario 2, where all the maximum 8-hours concentrations >100 are decreased to 100 µg/m^3. In that case
  if $[O_3]_i \geq 100$ µg/m^3, $Oi=([O_3]_i-100)$
  if $[O_3]_i < 100$ µg/m^3, $Oi=0$
  $$\Delta x = \frac{\sum_{i=1}^{N} O_i}{N}$$
- Scenario 3, where the ozone yearly mean is decreased by 5 µg/m^3. In that case, Δx = 5 µg/m^3

Scenarios and concentration-response functions (CRFs) are detailed in Table 1.

Table 1- Scenarios and CRFs used in the Excel sheet.

HIA	Air pollution metrics	Health outcome	Ages	RR per 10 µg/m^3	β	Ref
Short-term impacts of PM10	Annual average	All non-external mortality	All	1.006 [1.004-1.008]	0.000598207	WHO, 2004
	Annual average	All respiratory hospitalizations	All	1.0114 [1.0062-1.0167]	0.001133551	Atkinson et al, 2005
	Annual average	All cardiac hospitalizations	All	1.006 [1.003-1.009]	0.000598207	Atkinson et al, 2005
Short-term impacts of O_3	Daily max-8h concentrations	All non-external mortality	All	1.0031[1.0017-1.0052]	0.00030952	Gryparis et al, 2004
	Daily max-8h concentrations	All respiratory hospitalizations	15-64	1.001 [0.991-1.012]	0.00009995	WHO, 2004
	Daily max-8h concentrations	All respiratory hospitalizations	>=65	1.005[0.998-1.012]	0.000498754	WHO, 2004

3. How to use the Excel tool

The tool requires macros to work correctly. In Excel, you can set the level of security that is applied to macro. We suggest that you set a medium level of security when you use the tool, and that you enable the macros.

To set the level of security, go to Tools -> options -> security -> macro security

3.1. Format

The Excel file is made of four sheets, and uses a colour code:

Green = sheets that need your input; environmental data, health data and population data
Blue = sheets containing the hypothesis that will be used for the HIAs. By default, all parameters are set to the ones defined in the Aphekom project. However, you may modify these parameters.
Red = results

A similar code is applied to the cells.

3.2. Input data

Prior to using the tool, you must define your study areas, following WP5 Deliverable D5 – “Guidelines for the definition of the study area”, and collect the following data;
- the total population for the study area
- environmental data for the study area. You should follow WP5 Deliverable D5 “Exposure assessment: data availability, guidelines for the calculation of exposure indicators and the study of the influence of PM correction factors”
- health data for the study area. You should follow WP5 Deliverable D5 “Health data: data availability and guidelines for their use in health impact assessment”

In the examples below, we use data from Marseille for the years 2004-2006.

3.3. Sheet “1-Environmental data”

It is extremely important to respect the format of this sheet when you input your data. Otherwise, the calculations may not work.

You must input your data column by column:

- dates column A, from cell A4
- O_3 concentrations column B, from cell B4
- PM10 concentrations column C, from cell C4

If you need to apply a correction factor to the PM data (correction from the TEOM to the gravimetric method), you have to input the factors in cells C1 (for winter) and G1 (for summer).

The sheets will clean your data, removing text values like NA for instance, and create two columns of valid concentrations for the HIA, labeled O3(year) and PM10(year). It will also compute values of ozone for scenario 1, labeled O3(year)-S1, and for scenario 2, labeled O3(year)-S2.

3.4. Sheet “2-Health data”

Again, it is extremely important to respect the format of this sheet when you input your data. Otherwise, the calculations may not work.

You must input the annual number of cases for each of the health outcomes and age-groups, and for years 2004 to 2006, as illustrated below;

Health Outcome	ICD-9 Codes	ICD-10 Codes	Age Group	2004	2005	2006
Total Non-external Causes Mortality	**001-799**	**A00-R99**	**All Ages**	8 182	8 371	8 126
Cardiac Hospital Admissions	**390-429**	**I00-I52**	**All Ages**	12 528	12 986	13 525
Respiratory Hospital Admissions	**460-519**	**J00-J99**	**All Ages**	9 851	9 946	9 673
Respiratory Hospital Admissions	**460-519**	**J00-J99**	**15-64**	3 550	3 590	3 563
Respiratory Hospital Admissions	**460-519**	**J00-J99**	**65 and over**	3 456	3 668	3 273

3.5. Sheet “3-Population data”

Don’t forget, it is extremely important to respect the format of this sheet when you input your data. Otherwise, the calculations may not work. Filll the green cells as appropriate.

Total Population of the study Area	
All Ages	955 702
15-64	614 045
65 and over	170 302

3.6. Sheet "4-Hypothesis"

This sheet summarizes the scenarios applied, and the RR that will be used. If you want to modify the years used in the HIAs, the scenarios or the RR, please do it on this sheet only, and do not modify the others.

You can modify the years used in the HIA.

Years used in HIA
2004
2005
2006

If you want to modify the scenarios, you should change the parameter column.

Scenarios		
Ozone	**Description of scenario**	**Parameter**
Scenario 1	Values >160=160	160
Scenario 2	Values >100=100	100
Scenario 3	Annual mean decreased by 5	5
PM10	**Description of scenario**	**Parameter**
Scenario 1	Annual mean decreased by 5	5
Scenario 2	Annual mean decreased to 20	20

If you want to change the RR, you can use the RR columns. Be careful that RR should be per 10µg/m^3.

RR	per		10	µg/m3
Pollutant	**Indicators**	**Lower**	**Central**	**Upper**
O3	Total non-external mortality	1.0017	1.0031	1.0052
	Respiratory hospitalizations (15-64)	0.991	1.001	1.012
	Respiratory hospitalizations (65 and over)	0.998	1.005	1.012
PM10	Total non external mortality	1.004	1.006	1.008
	Total respiratory hospitalizations	1.0062	1.0114	1.0167
	Total cardiac hospitalizations	1.003	1.006	1.009

3.7. Sheet "PM10 results – Scenario 1"

The tool automatically gives an overview of the exposure data for the whole year and by season (winter = October - March, summer = April - September), for all the years and year by year.

Distribution of exposure indicators

		2004	2005	2006
Exposure data	**PM10 (all period)**	**PM10**	**PM10**	**PM10**
Number of day	1096	366	365	365
Minimum	4	5	8	4
Percentile 5	14	13	14	14
Percentile 25	20	20	21	20
Median	27	27	28	27
Percentile 75	35	35	34	35
Percentile 95	48	48	47	48
Maximum	111	111	59	86
Daily mean	29	29	28	29
Standard deviation	11	12	10	12
% Valid data	100	100	100	100

Below, you will find a summary of the number of days with valid data per year. The HIA only uses years with more than 75% of valid data. The annual mean of PM10 per valid year are also reported.

Number of data (N) and the % of available data by year and by pollutant			
Number of days with valid data	**% of days with valid data**	**Year used in the HIA**	**Annual mean of PM10 for years used in the HIA**
366	100.00%	Yes	32
365	100.00%	Yes	32
365	100.00%	Yes	33

For the same *N* years, the tool reports the total health outcomes. You can check the values for all non-external mortality y_{0mort}, all respiratory hospitalizations y_{0resp}, and all cardiac hospitalizations y_{0card}.

	2004	**2005**	**2006**	**Annual mean**
All Non-external Causes Mortality (All ages)	8182	8371	8126	8226
Cardiac Hospital Admissions (All ages)	12528	12986	13525	13013
Respiratory Hospital Admissions (All ages)	9851	9946	9673	9823

The sheet will compute the annual mean and the associated Δx,

	Scenario 1
[Pm10]mean	32
Δ X	5

If you want to modify Δx, please modify the 4-hypothesis sheet and not this one.

Results are presented for each cause of death, with the lower and upper estimates corresponding to the IC95% of the RR.

	All non external mortality - lower	All non external mortality	All non external mortality - upper
Total number of deaths avoided (Δy)	49.3	73.9	98.5
Yearly number of deaths avoided (Δy yearly)	16.4	24.6	32.8
Yearly number of deaths avoided per 100 000 (Δy yearly/pop)	1.7	2.6	3.4

3.8. Sheet "PM10 results – Scenario 2"

The process is similar to the one described in scenario 1.

3.9. Sheet "Ozone results – scenario 1"

As for PM10, the tool automatically gives an overview of the exposure data for the whole year and by season (winter = October - March, summer = April - September), for all the years and year by year.

You may use this table to check that the number of missing values is not concentrated during summer, which might impair the interpretation of the results.

The sheet computes the accumulated concentration above 160 µg/m^3 and the associated *Δx*.

Accumulated value >160	24
Δ X	0.02

If you want to modify *Δx*, please modify the 4-hypothesis sheet and not this one!

Results are reported as a total outcome, outcome adjusted on the number of years, and on the population /100 000 inhabitants, similarly to PM10.

3.10. Sheet "Ozone results – scenario 2"

The process is similar to the one described in Ozone results - scenario 1.

3.11. Sheet "Ozone results – scenario 3"

The process is similar to the one described in PM10 results - scenario 1.

3.12. Graphs and summary tables

The tool produces graphs of the daily concentrations of PM10 (sheet Graph_PM10) and ozone (sheet Graph_Ozone) and summary tables and graphs that can be used in the city report (sheet summary).