

Algorithms & formulae

How to calculate absolute and relative risks. All the numbers we need (from official medical guidelines and scientific literature).

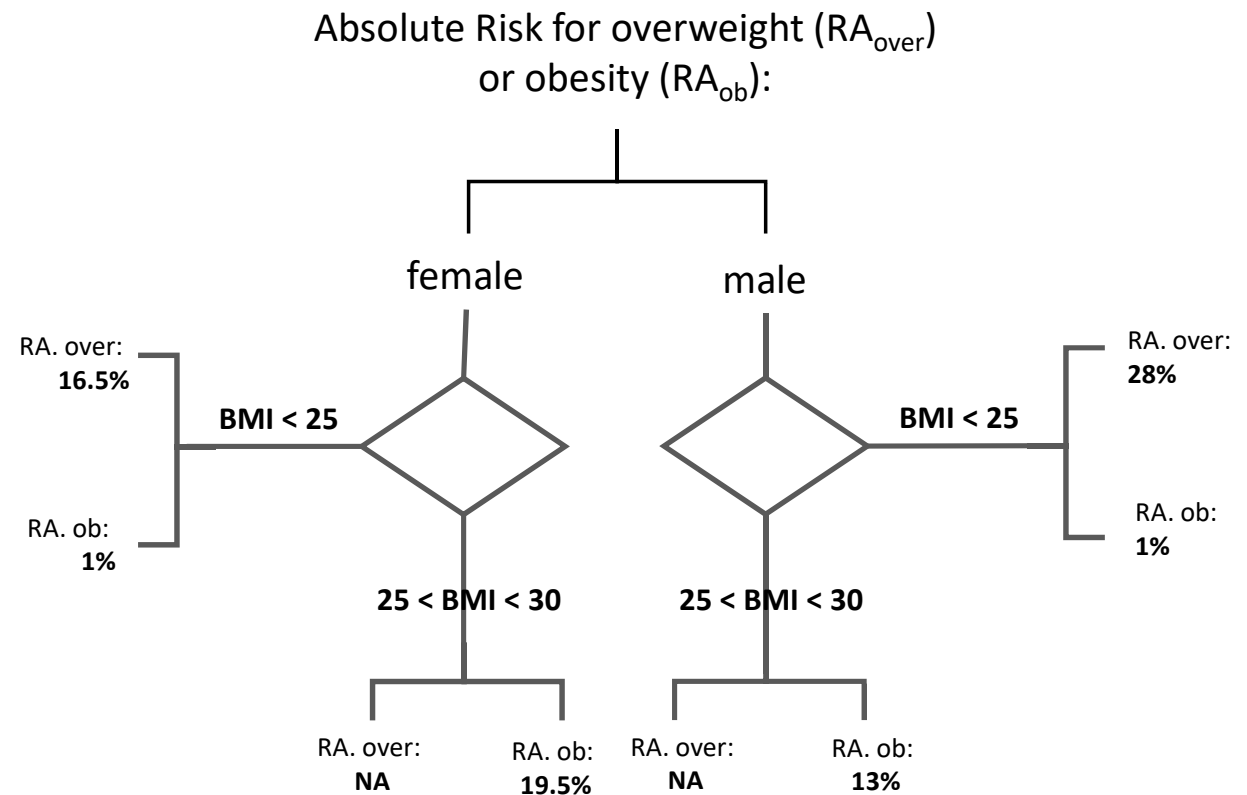
Obesity risk.

Simple evaluation of overweight/obesity risk
(*Framingham cohorts and
Ramachandran et al, Ann.Intern.Med. 2005*)

parameter	values
Gender	Male Female
BMI	< 25 25 – 30 > 30

$$\text{BMI} = \frac{\text{Weight (Kg)}}{(\text{height (m)})^2}$$

Normopeso: $18.5 < \text{BMI} < 25$



parameter	limits	points
Age [years]	< 45	0
	45 – 54	2
	55 – 64	3
	> 64	4
BMI	< 25	0
	25 – 30	1
	> 30	3
Waist (men) [cm]	< 94	0
	94 – 102	3
	> 102	4
Waist (women) [cm]	< 80	0
	80 – 88	3
	> 88	4
Daily Motion	Yes	0
	No	2
Daily Veggies	Yes	0
	No	1
Hypertension drugs	Yes	2
	No	0
Hi blood glucose (self)	Yes	5
	No	0
Diabetics (parents, siblings)	Yes	5
	No	0
Diabetics (relatives)	Yes	3
	No	0

T2D risk.

Complete evaluation of the 10-years risk of developing type 2 diabetes

(ESC-EASD Guidelines, EHJ 2007, 28:88-136)

Absolute Risk (RA_{t2d}) computation:

Total points	Absolute Risk t2d	Qualitative Risk
- 7	1 %	Low
8 - 11	4 %	Mid – low
12 - 14	17 %	Moderate
15 - 20	33 %	High
20 -	50 %	Very high

Hypertension risk.

Evaluation of the 4-years risk of developing hypertension
(Parish et al. *Annals of int. Med.* 2008, Framingham Heart Study)

Parameters (X)	β_i Coeff.	Value	Parameters (X), optimal ($RA_{hyp-OPT}$)
Age [years]	β_1	-0.156412	Age [years]
Gender [M=0; F=1]	β_2	-0.202933	Gender [M=0; F=1]
BMI	β_3	-0.033881	22.5
Press. Max. [mmHg]	β_4	-0.059330	110
Press. Min. [mmHg]	β_5	-0.128468	70
Smoker [NO=0; YES=1]	β_6	-0.190731	0
Familiarity [NO=0; YES=1]	β_7	-0.166121	0
Age * Press. Min.	β_8	0.001624	Age [years] * 70
Survival baseline	S	0.876925	0.876925
Intercept	I	22.949536	22.949536

Absolute Risk (RA_{hyp}) computation:

$$RA_{hyp} = 1 - \exp \left(- \exp \frac{(\ln(4) - (I + \sum_1^8 \beta_i * X_i))}{S} \right)$$

with constant values:

$$RA_{hyp} = 1 - \exp \left(- \exp \frac{(\ln(4) - (22.949536 + \sum_1^8 \beta_i * X_i))}{0.876925} \right)$$

CVD risk.

Evaluation of the 10-years risk of developing cardio vascular diseases
(Framingham Heart Studies, ESC-EASD Guidelines)

Parameters (X)	β_i Coeff.	Value (male)	Value (female)
Age [years]	β_1	0.076	0.079
Press. Max. [mmHg]	β_2	0.013	0.016
Total Colest. [mg/dL]	β_3	0.006	0.003
HDL [mg/dL]	β_4	-0.013	-0.015
Smoker [NO=0; YES=1]	β_5	0.508	0.773
Diabetes [NO=0; YES=1]	β_6	0.462	0.339
Hypertens. drugs [NO=0; YES=1]	β_7	0.490	0.590
Survival baseline	S	0.953	0.989
Gamma	G	6.583	6.016

Absolute Risk (RA_{cvd}) computation:

$$RA_{cvd} = 1 - S^{\exp(\sum_1^n \beta_i * X_i - G)}$$

with constant values:

$$RA_{cvd(males)} = 1 - 0.953^{(e^{(\sum_1^7 \beta_i * X_i - 6.583)})}$$

$$RA_{cvd(females)} = 1 - 0.989^{(e^{(\sum_1^7 \beta_i * X_i - 6.016)})}$$

Population average and individual risks

Once all 4 absolute risks (RA) have been computed, we need to determine the corresponding mean absolute risks of the population (mRA). Population mean risks are given in the table for each health area (values from EsCardio & ISS). Then Individual Relative Risks (RR) are calculated according to the ratios below.

Mean Risk (popltn)	Male	female
mRA overweight	19.3 %	14.9 %
mRA obesity	8 %	8 %
mRA t2d	10 %	7 %
mRA hyp	NA (use RA _{t2d-OPT})	NA (use RA _{t2d-OPT})
mRA cvd	8 %	3 %

$$RR_{over} = \frac{RA_{over}}{mRA_{overweight}}$$

$$RR_{ob} = \frac{RA_{ob}}{mRA_{obesity}}$$

$$RR_{t2d} = \frac{RA_{t2d}}{mRA_{t2d}}$$

$$RR_{hyp} = \frac{RA_{hyp}}{RA_{t2d-o}}$$

$$RR_{cvd} = \frac{RA_{cvd}}{mRA_{cvd}}$$

*These are the final
values we need as
output!!!*

*Note the difference
(not the mean!)*

Rlab#5 goals

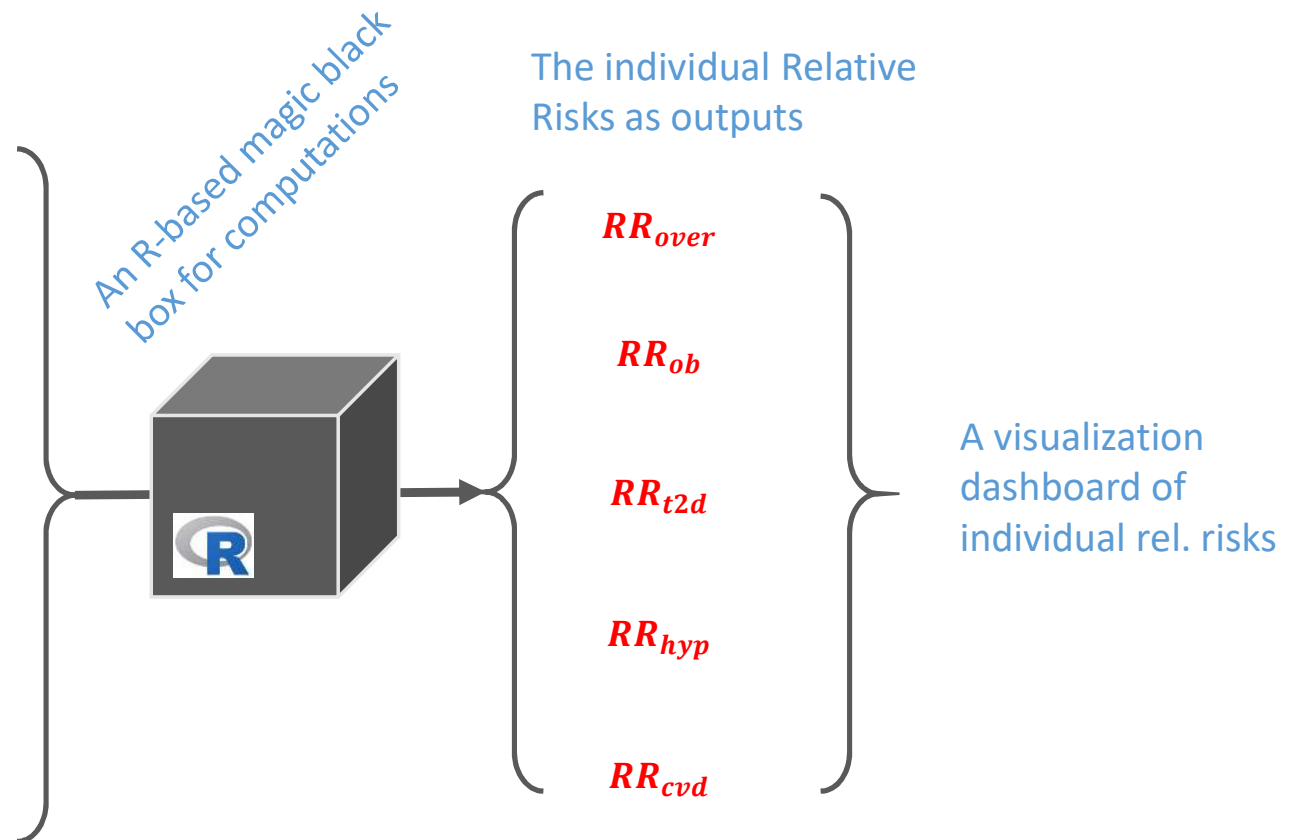
A GUI to input the followings:

QUANTITATIVE INPUTS:

Gender, Age, BMI (height, weight),
Waist,
Blood pressure max & min,
Total cholesterol,
HDL ("good" cholesterol)

CLOSE QUESTIONS (yes/no) INPUTS:

Smoker; Daily motion; Daily veggies;
hypertension drug treatment;
High blood glucose;
Parents or siblings with T2D;
Relatives with T2D;
Parents or relatives with
hypertension;
Self affected by T2D



A note on absolute risks

Let's take as an example the absolute Risk for cardiovascular diseases (RA_{cvd}) computed as:

$$RA_{cvd} = 1 - S^{\exp(\sum_1^n \beta_i * X_i - G)}$$

A calculated value of: $RA_{cvd} = 2.7\%$, means that

(for the individual) the probability to incur into a major cardiovascular problem is 2.7% during the following 10 years, or

(for the population) out of 100 people with exactly the same characteristics (parameters) 2.7 will be hit by a major cardiovascular problem in the next 10 years.

Score card for 10 years risk of fatal CVDs (Low risk european countries - Italy etc.)

		Females										Males										
		non smoker					smoker					non smoker					smoker					
Age																						
Systolic blood pressure (mmHg)	65	180	4	5	6	6	7	9	9	11	12	14	8	9	10	12	14	15	17	20	23	26
		160	3	3	4	4	5	6	6	7	8	10	5	6	7	8	10	10	12	14	16	19
		140	2	2	2	3	3	4	4	5	6	7	4	4	5	6	7	7	8	9	11	13
		120	1	1	2	2	2	3	3	3	3	3	2	3	3	4	5	5	5	6	8	9
			150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300
Systolic blood pressure (mmHg)	60	180	3	3	3	4	4	5	5	6	7	8	5	6	7	8	9	10	11	13	15	18
		160	2	2	2	2	3	3	4	4	5	5	3	4	5	5	6	7	8	9	11	13
		140	1	1	1	2	2	2	2	3	3	4	2	3	3	4	4	5	5	6	7	9
		120	1	1	1	1	1	1	2	2	2	3	2	2	2	3	3	3	4	4	5	6
			150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300
Systolic blood pressure (mmHg)	55	180	1	1	2	2	2	3	3	3	4	4	3	4	4	5	6	6	7	8	10	12
		160	1	1	1	1	1	2	2	2	3	3	2	2	3	3	4	4	5	6	7	8
		140	1	1	1	1	1	1	1	1	2	2	1	2	2	2	3	3	3	4	5	6
		120	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4
			150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300
Systolic blood pressure (mmHg)	50	180	1	1	1	1	1	1	1	2	2	2	2	2	3	3	4	4	4	5	6	7
		160	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	3	4	5
		140	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	3	3	4
		120	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	3
			150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300
Systolic blood pressure (mmHg)	40	180	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2
		160	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
		140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
		120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
			150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300
		Males & females																				
		non smoker					smoker															
Systolic blood pressure (mmHg)	<40	180	3	3	4	5	6	6	7	8	10	12	3	4	5	6	6	7	8	10	12	
		160	2	3	3	4	4	4	5	6	7	8	3	3	4	5	5	6	7	8	10	
		140	1	2	2	2	3	3	3	4	5	6	2	2	2	3	3	3	4	5	6	
		120	1	1	1	2	2	2	2	3	3	4	1	1	1	2	2	2	3	3	4	
			150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300	150	200	250	300	>300