



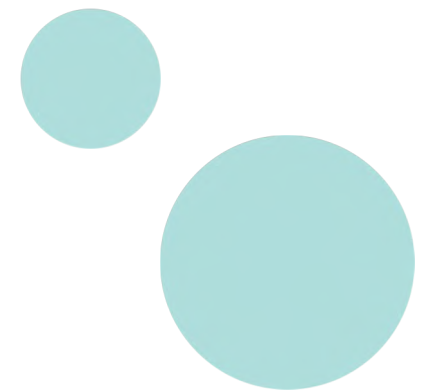
**FNS - Cloud**

Food Nutrition Security

# “Healthwise”

**Tool for type-2 diabetes and hypertension risk assessment  
and personalised dietary and lifestyle feedback (Task 5.4.2. )**

Konstantinos Tserpes (HUA)  
Matzourana Argyropoulou (HUA)  
QIB, Nutritics & UCD





# FNS - Cloud

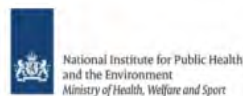
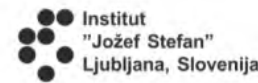
Food Nutrition Security





# FNS - Cloud

Food Nutrition Security



**FNS - Cloud**  
Food Nutrition Security



Food Nutrition Security Cloud (FNS-Cloud) has received funding from the European Union's Horizon 2020 Research and Innovation programme (H2020-EU.3.2.2.3. – A sustainable and competitive agri-food industry) under Grant Agreement No. 863059 – [www.fns-cloud.eu](http://www.fns-cloud.eu)



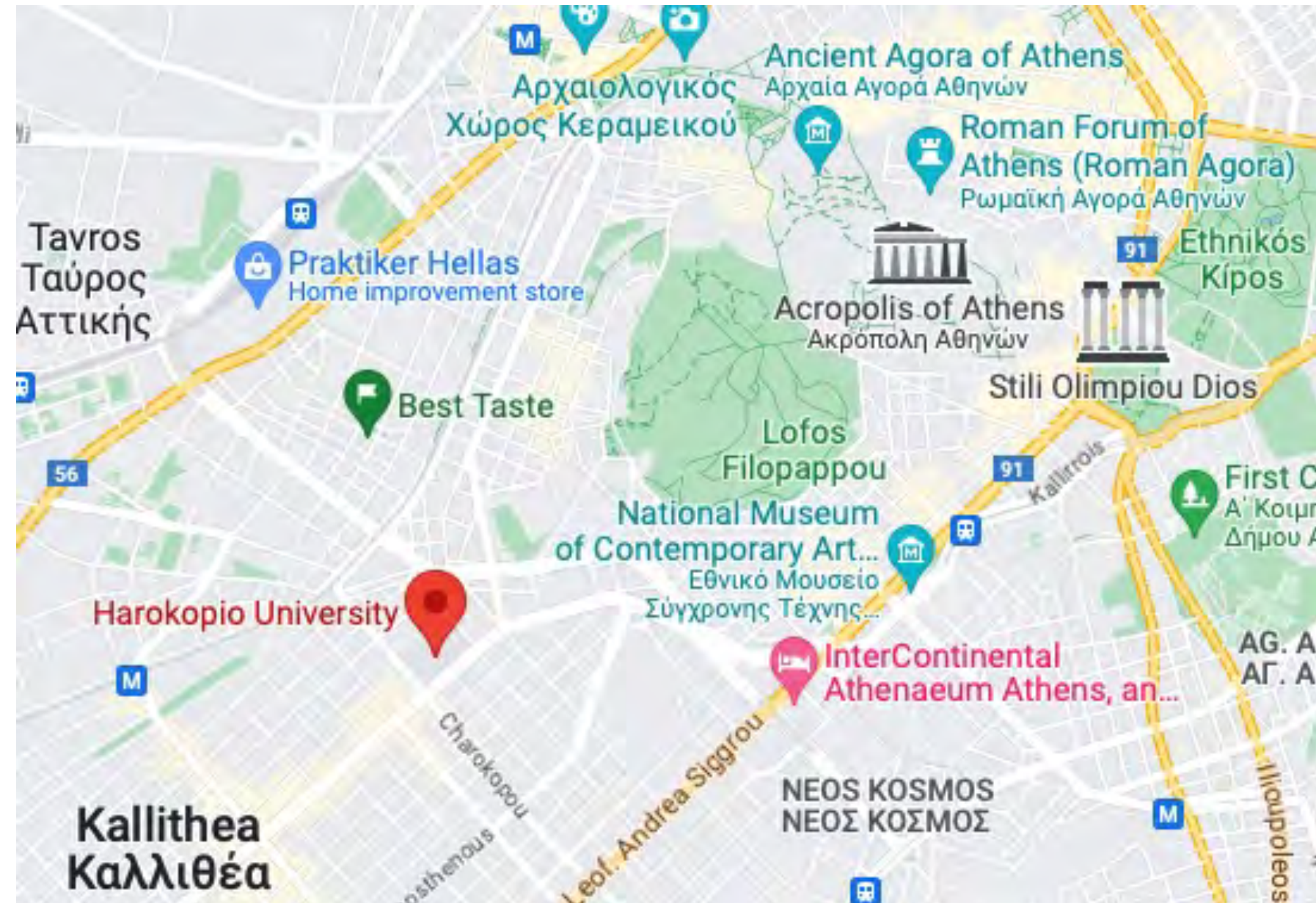
# Harokopio University of Athens



Founded by the national benefactor  
Panagis Harokopos in 1919

Operating in its current legal (public  
university) form since 1990

Located in a 2-hectares estate endowed by  
the founder in Kallithea, a municipality near  
Athens downtown.





## Departments



Economics &  
Sustainable  
Development



Nutrition and Dietetics



Geography



Informatics and  
Telematics



**FNS - Cloud**  
Food Nutrition Security



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# A healthcare scientist's point of view

- FNS as a service
  - to create useful digital tools for people across Europe
- ...to expand our knowledge on nutrition, food system and sustainability.

# An application provider's point of view

- FNS as a service
  - pick FNS data and services
  - ...and models!
  - create/extend own (meta-)service
- ...to generate added value data workflows



# Approach towards Healthwise

- Develop a web-based tool...
- ...accessible over the public internet
- ...that allows...
  - individuals to:
    - assess their HTN and T2D risk scores
    - receive personalized diet and activity recommendations
- ...based on data-backed scientific outcomes (models)
  - researchers to:
    - execute experiments with the models on their own datasets





# 1<sup>st</sup> model approach

...to develop and validate two risk assessment indices for the identification of adults with IR (European IR Risk Index) and grade 2 and 3 HTN (European HTN Risk index) via demographic, anthropometric, dietary and lifestyle parameters in a large European cohort.








*nutrients*



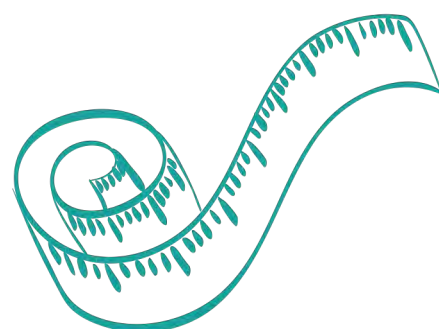
Article

## Development and Validation of Two Self-Reported Tools for Insulin Resistance and Hypertension Risk Assessment in a European Cohort: The Feel4Diabetes-Study

Spyridon Kanellakis <sup>1</sup>, Christina Mavrogianni <sup>1</sup>, Kalliopi Karatzi <sup>1</sup>, Jaana Lindstrom <sup>2</sup>, Greet Cardon <sup>3</sup> , Violeta Iotova <sup>4</sup> , Katja Wikström <sup>2</sup>, Samyah Shadid <sup>5</sup>, Luis A. Moreno <sup>6,7,8,9</sup> , Kaloyan Tsochev <sup>4</sup>, Éva Bíró <sup>10</sup> , Romyana Dimova <sup>11</sup>, Emese Antal <sup>12</sup>, Stavros Liatis <sup>13</sup>, Konstantinos Makrilakis <sup>13</sup> , Yannis Manios <sup>1,\*</sup> and on behalf of the Feel4Diabetes-study group <sup>†</sup>



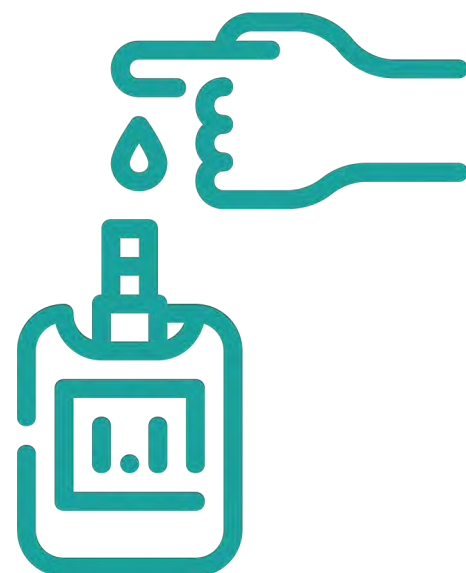
## Descriptive characteristics of the European IR Risk Index and European HTN Risk Index



	Development Cohort Mean $\pm$ SD	Validation Cohort Mean $\pm$ SD	<i>p</i> Value
European IR Risk Index ( <i>n</i> = 1581)	<i>n</i> = 1076	<i>n</i> = 505	
Age (years)	40.7 $\pm$ 5.29	40.6 $\pm$ 5.15	0.666
BMI (kg/m <sup>2</sup> )			
male	29.7 $\pm$ 3.97	29.2 $\pm$ 4.39	0.172
female	27.3 $\pm$ 5.69	27.3 $\pm$ 5.67	0.985
Waist circumference (cm)			
male	102.7 $\pm$ 9.93	101.0 $\pm$ 11.64	0.068
female	88.7 $\pm$ 13.31	89.1 $\pm$ 12.95	0.619
HOMA-IR	2.0 $\pm$ 2.40	1.9 $\pm$ 1.39	0.340
SBP (mmHg)	116.8 $\pm$ 16.20	116.4 $\pm$ 15.47	0.673
DBP (mmHg)	77.7 $\pm$ 11.39	77.0 $\pm$ 10.37	0.242
European HTN Risk Index ( <i>n</i> = 1350)	<i>n</i> = 906	<i>n</i> = 444	
Age (years)	40.1 $\pm$ 5.34	40.3 $\pm$ 5.47	0.590
BMI (kg/m <sup>2</sup> )			
male	29.2 $\pm$ 3.58	29.1 $\pm$ 3.89	0.224
female	27.1 $\pm$ 5.04	27.2 $\pm$ 5.48	0.930
Waist circumference (cm)			
male	102.8 $\pm$ 10.77	101.7 $\pm$ 12.07	0.330
female	87.6 $\pm$ 13.17	88.7 $\pm$ 13.41	0.268
HOMA-IR	2.2 $\pm$ 2.80	2.0 $\pm$ 1.46	0.145
SBP (mmHg)	117.5 $\pm$ 17.06	116.7 $\pm$ 16.51	0.466
DBP (mmHg)	77.9 $\pm$ 12.13	76.8 $\pm$ 11.06	0.092



**BMI & WC have a major contribution in assessing IR risk**




HOMA-IR Model	b	p Value	Cut-Offs	Points Allocated
→ BMI	-	0.001	<25 kg/m <sup>2</sup>	0
	0.340		25–30 kg/m <sup>2</sup>	9
	0.680		>30 kg/m <sup>2</sup>	19
→ Waist Circumference (women and men respectively)	-	0.003	<80 cm or <94 cm	0
	0.118		80–88 cm or 94–102 cm	3
	0.236		>88 cm or >102 cm	7
Screen time	-	0.001	<2 h/day	0
	0.113		≥2 h/day	3
Sex	-	0.023	female	0
	0.066		male	2
Breakfast	-	0.001	≥5 times/week	0
	0.095		<5 times/week	3
Sugary drinks (1 portion = 250 mL)	-	0.018	<1 portion/week	0
	0.063		≥1 portion/week	2
Walking (3 days/ week for at least 30 min)	-	0.033	Yes	0
	0.057		No	2
Vigorous physical activity (3 days/ week for at least 10 min)	-	0.002	Yes	0
	0.084		No	2
Maximum total points				40

b: standardizes-coefficient; BMI: Body Mass Index; HOMA-IR: Homeostatic Model Assessment of Insulin Resistance Index.



...also in  
assessing HTN  
risk



Hypertension Model	b	p Value	Cut-Offs	Points Allocated
 BMI	-	0.001	<25 kg/m <sup>2</sup>	0
	0.308		25–30 kg/m <sup>2</sup>	10
	0.616		>30 kg/m <sup>2</sup>	20
Sex	-	0.001	female	0
	0.204		male	6
Vigorous physical activity (3 days/ week for at least 10 min)	-	0.091	Yes	0
	0.048		No	2
Legumes	-	0.001	≥1 cup/week	0
	0.254		<1 cup/week	8
Alcohol (1 portion = 125 mL of wine, 330 mL of beer or 40mL of hard liquor)	-	0.020	<3 portions/week	0
	0.069		≥3 portions/week	2
Age	-	0.099	<40 years	0
	0.047		≥40 years	2
Maximum total points				40

b: standardizes-coefficient; BMI: Body Mass Index; HTN: Hypertension.

# Interpretation

## Total risk score (Maximum score = 40 points) IR Risk Index

0-23 points	There is a small risk of having insulin resistance. Insulin resistance is a prognostic indicator for the occurrence of Diabetes Mellitus. However, you should not forget that healthy diet and physical activity should be of great concern to you as they are the best shield in the prevention of diabetes.
23-31 points	There is an increased risk of having insulin resistance. Insulin resistance is a prognostic indicator for the development of Diabetes Mellitus. To avoid the occurrence of Diabetes Mellitus, it is important to increase your physical activity, lose weight and adopt healthy eating habits (Mediterranean diet, eating breakfast, avoiding sugary drinks, etc.). It is advisable to visit your doctor for further testing.
32-40 points	There is a very high risk of having insulin resistance. For this reason, it is necessary to contact your doctor and dietitian immediately. At the same time, you should modify your diet and physical activity as they will suggest.





# Interpretation

## Total risk score (Maximum score = 40 points) HTN Risk Index

0-25 points	You have a low risk of having grade 2 or 3 hypertension. However, you should not forget that healthy diet and physical activity should be of great concern to everyone.
26-40 points	You have an increased risk of having grade 2 or 3 hypertension and you should consult your doctor for advice. It is important to increase your physical activity (at least 30 minutes of moderate-intensity aerobic exercise, 5-7 times / week) and lose excess weight, as obesity is directly linked to the onset of hypertension. It would also be advisable to reduce the consumption of alcoholic beverages and salt. At the same time, you should increase the consumption of legumes, fruits and vegetables.





## 2<sup>nd</sup> model approach

...to identify lifestyle and dietary risk factors associated with obesity and central obesity by sex and different age groups and feed this information into a publicly available web tool, to provide personalized feedback to users

**→ Lifestyle Correlates of obesity and central obesity in adults  
from two European cohorts**

## Harmonization of Data:

- Dietary intake data collected at baseline from both studies were harmonized and combined to provide estimates of intake for specific food groups
- The serving size of each food group used for this categorization was based on the specified portion size used in the Feel4Diabetes study.

→ Since the dietary intake data from the Food4Me study were available in grams/ day, when necessary, data were converted either to ml/ day or cups/ day using the USDA food database



# Lifestyle Correlates of obesity and central obesity in adults from two European cohorts

stratified by  
age and sex

- Cross-sectional data from the “**Food4Me**” and “**Feel4Diabetes**” studies were combined, including **3566** participants from **11 European countries**.
- Multivariate logistic regression, **stratified by age** (above and below 40 years) **and sex**, was performed to test for associations between the outcome (**obesity and central obesity**) and the exposures of interest.
- **Results: Fruits and vegetables, red and white meat, sweet snacks** consumption along with **physical activity level** and **tv watching** were found to be associated with the **likelihood of overall and central obesity**.

Skoufas and Mavrogianni et al, Clinical Nutrition, 2022 (under review)



# Demographic, anthropometric & lifestyle characteristics by sex and age

	Women (N= 2121)		Men (N= 1445)	
	<40 years (n= 1162)	≥40 years (n= 959)	<40 years (n= 541)	≥40 years (n= 904)
<b>Country, <u>n</u>(%)</b>				
Germany	44 (3.8)	46 (4.8)	31 (5.7)	48 (5.3)
Greece	167 (14.4)	231 (24.1)	100 (18.5)	215 (23.8)
Ireland	73 (6.3)	40 (4.2)	39 (7.2)	39 (4.3)
Netherlands	44 (3.8%)	50 (5.2)	37 (6.8)	60 (6.6)
Poland	90 (7.7)	38 (4.0)	32 (5.9)	17 (1.9)
Spain	135 (11.6)	200 (20.9)	86 (15.9)	242 (26.8)
United Kingdom	68 (5.9)	41 (4.3)	31 (5.7)	22 (2.4)
Belgium	132 (11.4)	68 (7.1)	51 (9.4)	60 (6.6)
Finland	121 (10.4)	85 (8.9)	58 (10.7)	89 (9.8)
Hungary	109 (9.4)	44 (4.6)	30 (5.5)	34 (3.8)
Bulgaria	179 (15.4)	116 (12.1)	46 (8.5)	78 (8.6)
<b>BMI (kg/m<sup>2</sup>)</b>	26.4 (±5.7)	27.9 (±5.5)	27.4 (±4.8)	28.9 (±4.1)
<b>WC (cm)</b>	85.6 (±15.6)	91.6 (±14.4)	96.1 (±14.3)	102.7 (±12.0)
<b>BMI + WC status, <u>n</u>(%)</b>				
NBMI + NWC	467 (40.2%)	251 (26,2%)	191 (35.3%)	129 (14.3%)
HBMI + HWC	695 (59.8%)	708 (73,8%)	350 (64.7%)	775 (85.7%)
<b>Physical activity level, <u>n</u>(%)</b>				
Sedentary/ low	367 (42.4%)	340 (44.3%)	166 (37.3%)	276 (38.1%)
Moderate active/ active	499 (57.6%)	428 (55.7%)	279 (62.7%)	449 (61.9%)
<b>Tv watching, <u>n</u>(%)</b>				
<2h/day	726 (65.9%)	595 (65.5%)	329 (64.1%)	481 (55.7%)
≥2h/day	375 (34.1%)	313 (34.5%)	184 (35.9%)	383 (44.3%)

Skoufas and Mavrogianni et al, Clinical Nutrition, 2022 (under review)

## Dietary characteristics by sex & age



	Women (N= 2121)		Men (N= 1445)	
	<40 years (n= 1162)	≥40 years (n= 959)	<40 years (n= 541)	≥40 years (n= 904)
<b>Fruits and Vegetables</b> (servings of ½ cup/day)	2.8 (1.3, 5.0)	3.0 (1.6, 6.0)	2.6 (1.3, 5.0)	2.3 (1.0, 5.0)
<b>Low fat dairy</b> (servings of 120 ml/day)	1.0 (0.0., 2.1)	1.0 (0.0, 2.3)	1.0 (0.0, 2.2)	1.0 (0.0, 2.0)
<b>Total dairy</b> (servings of 120 ml/day)	2.0 (1.0, 3.0)	2.0 (1.0, 3.0)	2.0 (0.9, 3.1)	2.0 (0.7, 3.0)
<b>Whole grain foods</b> (servings of 30g/day)	1.9 (0.4, 3.0)	1.8 (0.0, 3.0)	2.0 (0.0, 4.0)	1.3 (0.0, 4.0)
<b>Non whole grain foods</b> (servings of 30g/day)	0.8 (0.0, 2.0)	0.9 (0.0, 2.0)	1.26 (0.2, 3.0)	1.0 (0.0, 3.0)
<b>Nuts and seeds</b> (servings of 30g/day)	0.5 (0.5, 1.5)	0.7 (0.5, 1.5)	0.5 (0.5, 1.5)	0.5 (0.5, 1.8)
<b>Red meat</b> (servings of 120g/day)	4.0 (2.0, 6.0)	4.0 (2.1, 6.0)	6.0 (4.0, 9.0)	5.4 (3.0, 8.4)
<b>White meat</b> (servings of 120g/day)	3.0 (1.1, 4.0)	2.5 (1.1, 4.0)	3.0 (1.3, 5.0)	3.0 (1.3, 4.5)
<b>Sweet Snacks</b> (serving/week)	3.5 (2.0, 7.1)	3.5 (2.0, 7.5)	3.5 (2.0, 8.7)	3.5 (2.0, 6.0)
<b>Salty Snacks</b> (serving/week)	1.4 (0.5, 2.3)	0.5 (0.5, 2.0)	2.0 (0.5, 3.5)	1.1 (0.5, 2.0)
<b>Alcohol</b> (serving /week)	1.0 (0.0, 4.0)	1.6 (0.0, 4.7)	4.0 (1.0, 9.0)	4.8 (1.9, 10.2)
<b>Coffee</b> (servings of 250ml/day)	0.8 (0.1, 1.5)	1.0 (0.4, 2.0)	0.9 (0.1, 2.0)	1.3 (0.6, 2.0)
<b>Sugary drinks</b> (servings of 250ml/week)	0.0 (0.0., 2.0)	0.0 (0.0, 1.0)	0.9 (0.0, 3.6)	0.1 (0.0, 2.0)
<b>Non sugary drinks</b> (servings of 250ml/week)	2.0 (0.0, 5.0)	2.0 (0.0., 5.0)	2.0 (0.6, 5.7)	2.0 (0.0, 5.5)

Skoufas and Mavrogianni et al, Clinical Nutrition, 2022 (under review)



# Odds ratios to “High BMI & high WC” status according to dietary and lifestyle parameters (stratified by sex and age group)

<u>Lifestyle and dietary parameters</u>		Women (N= 2121)		Men (N= 1445)	
		<40 years (n= 1162)	≥40 years (n= 959)	<40 years (n= 541)	≥40 years (n= 904)
Odds Ratios (95% CI)					
<u>Fruits and Vegetables</u> (servings of ½ cup/day)					
	<1.58 servings	1.00	1.00	1.00	1.00
	1.58-4 servings	0.73 (0.41, 1.28)	1.16 (0.57, 2.35)	0.54 (0.23, 1.22)	<b>0.23 (0.09, 0.60)</b>
	>4 servings	<b>0.34 (0.18, 0.63)</b>	0.71 (0.34, 1.45)	<b>0.17 (0.07, 0.42)</b>	0.85 (0.32, 2.22)
<u>Red meat</u> (servings of 120g/week)					
	<3 servings	1.00	1.00	1.00	1.00
	3-6 servings	<b>1.99 (1.27, 3.10)</b>	<b>1.68 (1.03, 2.75)</b>	0.82 (0.31, 2.12)	1.58 (0.79, 3.17)
	>6 servings	<b>3.09 (1.82, 5.24)</b>	<b>3.58 (1.95, 6.59)</b>	0.98 (0.39, 2.45)	<b>5.23 (2.38, 11.46)</b>
<u>White meat</u> (servings of 120g/week)					
	<1.6 servings	1.00	1.00	1.00	1.00
	1.6-4 servings	1.45 (0.91, 2.31)	<b>2.01 (1.23, 3.28)</b>	1.46 (0.71, 3.00)	1.22 (0.64, 2.32)
	>4 servings	<b>2.29 (1.31, 3.99)</b>	<b>2.25 (1.12, 4.52)</b>	2.05 (0.92, 4.55)	2.62 (0.99, 6.95)
<u>Sweet Snacks</u> (serving/week)					
	<2 servings	1.00	1.00	1.00	1.00
	2-5.5 servings	<b>2.02 (1.10, 3.71)</b>	0.81 (0.43, 1.53)	2.33 (0.88, 6.15)	0.58 (0.25, 1.33)
	>5.5 servings	1.39 (0.72, 2.67)	0.93 (0.47, 1.80)	1.13 (0.42, 3.04)	0.67 (0.28, 1.62)
<u>Physical activity level</u>					
	Sedentary/ low	1.00	1.00	1.00	1.00
	Moderate active/ active	1.06 (0.68, 1.66)	0.86 (0.52, 1.40)	<b>0.49 (0.25, 0.93)</b>	<b>0.42 (0.22, 0.79)</b>
<u>TV watching</u>					
	<2h/day	1.00	1.00	1.00	1.00
	≥2h/day	<b>1.58 (1.05, 2.37)</b>	<b>1.88 (1.17, 2.99)</b>	<b>2.25 (1.21, 4.19)</b>	1.54 (0.88, 2.70)

Skoufas and Mavrogianni et al, Clinical Nutrition, 2022 (under review)



# Questions derived by the analysis...

<p><b>How many servings of Fruits and Vegetables do you consume per day?</b> (1 serving corresponds to ¼ cup)</p>	<p><input type="checkbox"/><sub>1</sub> &lt;1.5 servings  <input type="checkbox"/><sub>2</sub> 1.5-4 servings  <input type="checkbox"/><sub>3</sub> &gt;4 servings</p>
<p><b>How many servings of red meat (e.g., pork, beef, veal, lamb, hamburger or sausages) do you consume per week?</b> (1 serving corresponds to 120g)</p>	<p><input type="checkbox"/> &lt;3 servings  <input type="checkbox"/> 3-6 servings  <input type="checkbox"/> &gt;6 servings</p>
<p><b>How many servings of white meat (e.g., poultry, rabbit) do you consume per week?</b> (1 serving corresponds to 120g)</p>	<p><input type="checkbox"/> &lt;1.5 servings  <input type="checkbox"/> 1.5-4 servings  <input type="checkbox"/> &gt;4 servings</p>
<p><b>How many servings of sweet snacks do you consume per week?</b> (1 serving corresponds to 1 small chocolate bar (40 g) or half a cup of sweets, cookies or 1 scoop of ice cream)</p>	<p><input type="checkbox"/> &lt;2 servings  <input type="checkbox"/> 2-5.5 servings  <input type="checkbox"/> &gt;5.5 servings</p>
<p><b>What is your level of occupational physical activity?</b></p>	<p><input type="checkbox"/> light (e.g., administrative and managerial)  <input type="checkbox"/> moderate (e.g., sales worker)  <input type="checkbox"/> heavy (e.g., equipment operator)</p>
<p><b>What is your level of non-occupational physical activity?</b></p>	<p><input type="checkbox"/> sedentary (little walking/cycling/exercise), moderately  <input type="checkbox"/> active (intense exercise lasting 20–45 min at least twice per week)  <input type="checkbox"/> very active (intense exercise lasting at least an hour per day)</p>
<p><b>How many hours do you watch TV per day?</b></p>	<p><input type="checkbox"/> &lt;2h  <input type="checkbox"/> ≥2h</p>





Home

Risk Assessment

Diet & Activity  
Recommendations

My Account

Privacy Note

You are not logged in

## Risk assesment tool for Type 2 Diabetes Mellitus and Hypertension & personalized diet and activity recommendation tools

### Feedback

[Feedback form](#)

### About

Healthwise is a web-based app that provides Type 2 Diabetes (T2D) and Hypertension (HTN) risk assessment tools, as well as personalized diet and activity recommendations. These tools are intended to inform and motivate individuals to seek professional assistance for health issues but are not designed to provide a diagnosis or replace the expertise of healthcare professionals. The risk assessment tools estimate an individual's risk score based on statistical data, while the personalized recommendation tool indicates the feasibility of a weight loss program tailored to preferred lifestyle and dietary choices.

### Contact

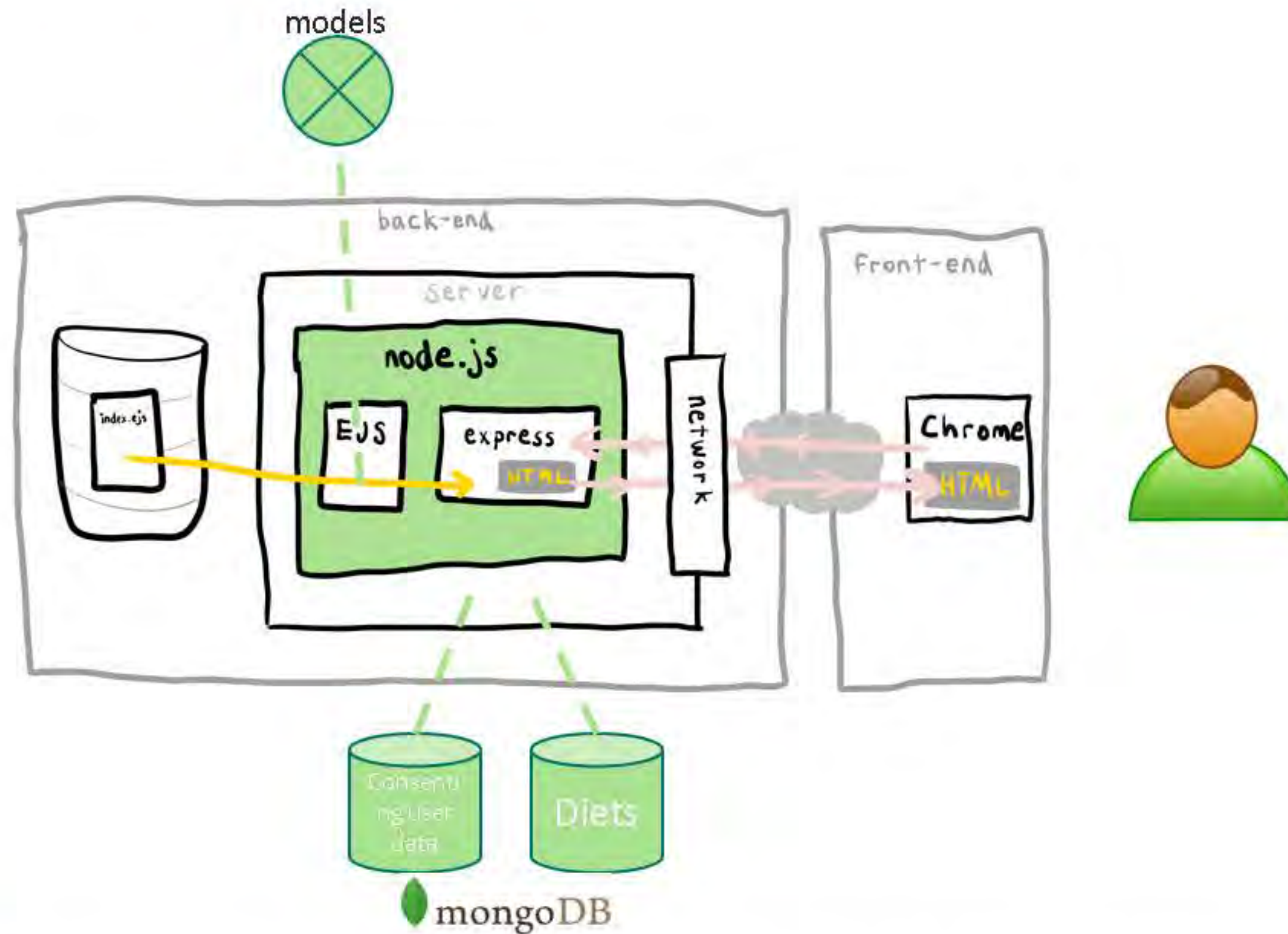
info -at- hua -dot- gr

### App Features

- ✓ Estimate Type 2 Diabetes and Hypertension risk
- ✓ Set personalized goals:
- ✓ Get personalized recommendations on physical activity and/or diet plans
- ✓ Keep track of progress on goals

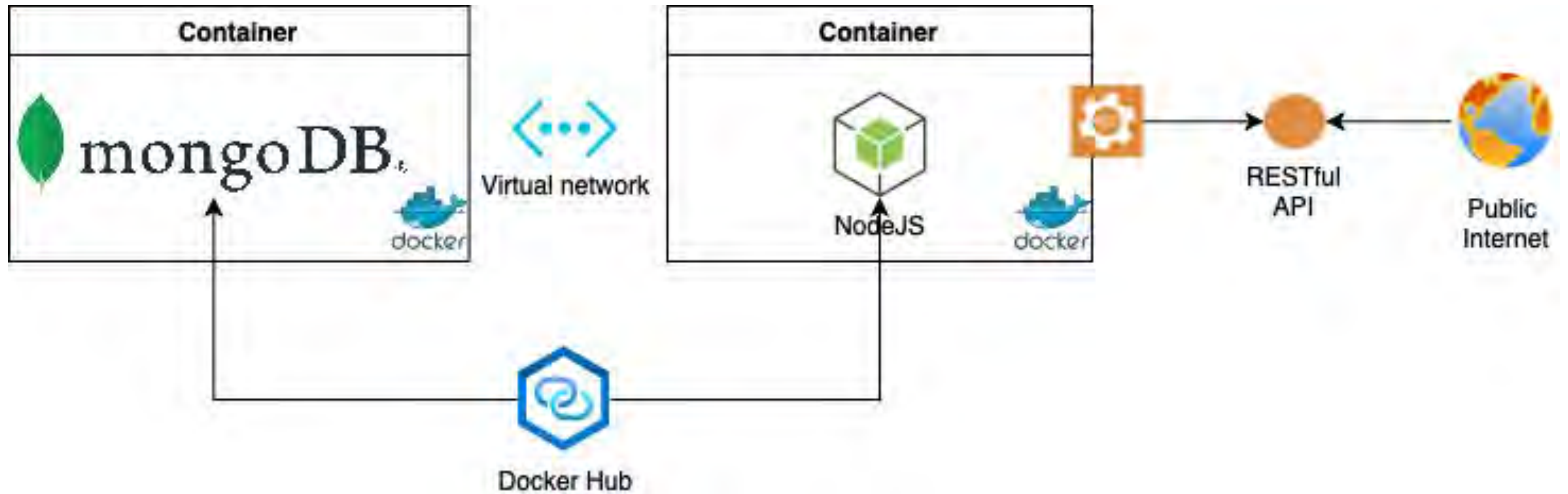
Can I help you?

# Conceptual Architecture





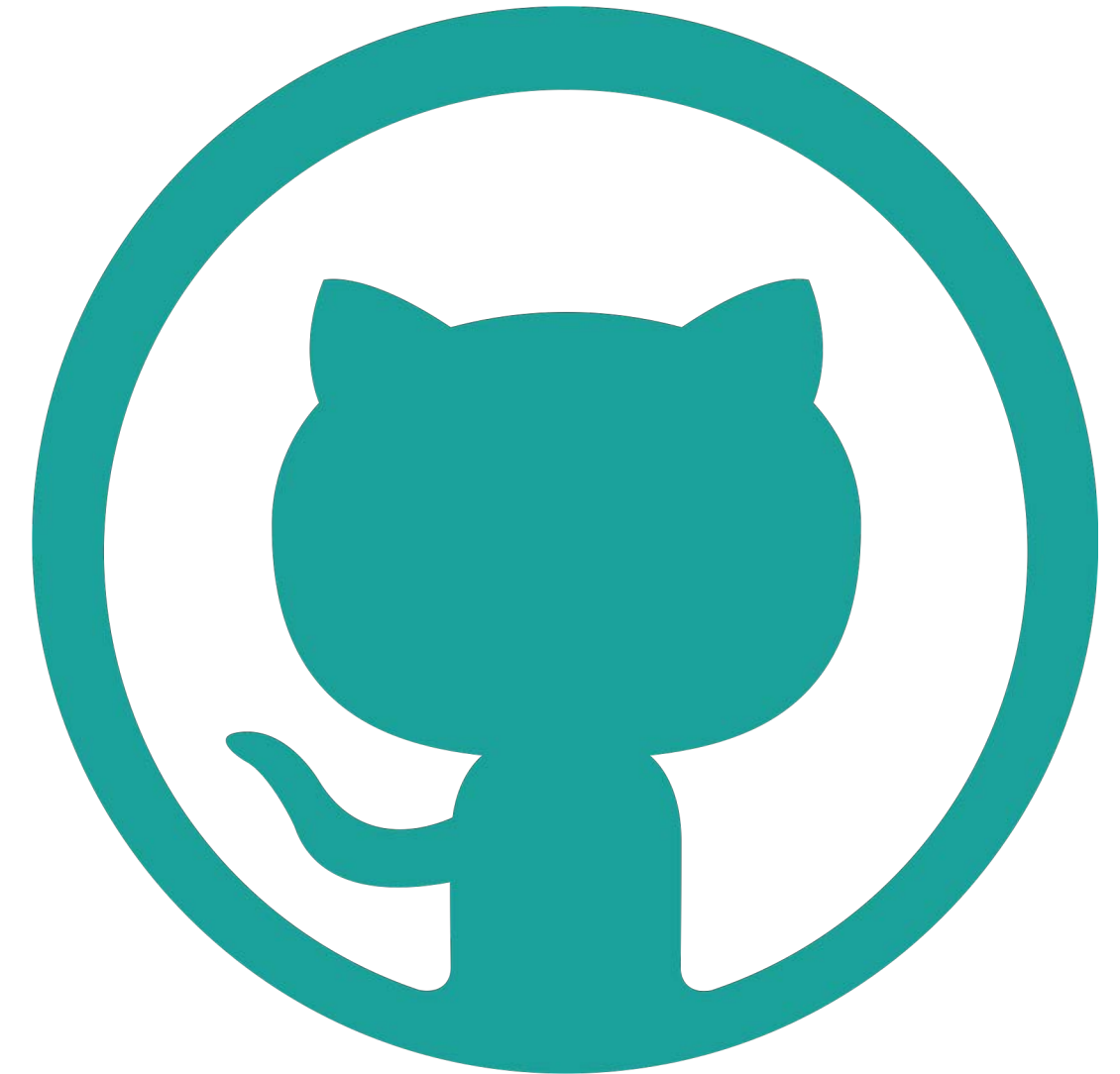
# Deployment



# Code



<https://github.com/tserpes/fns-cloud>



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# Usability Assessment



- Demonstration of the tool
- Focus Group session
- Hands-on Activities
- Live demonstration

- Record feedback from user experience
- Update the tool and improve the user experience and content



# UX/UI



The tool is available here  
<http://healthwise.hua.gr/>



Explore the various functions

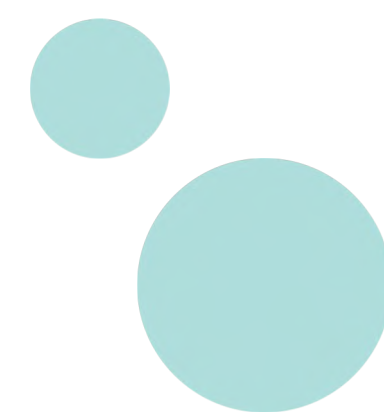


Provide feedback regarding the  
user experience

[Google form](#)



# Thank you very much for your attention!



Don't forget to follow us:



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[www.fnscloud.eu](http://www.fnscloud.eu)

[www.myfnscloud.eu](http://www.myfnscloud.eu)