THE MEDITERRANEAN DIET
AT THE TIME OF THE ECONOMIC CRISIS:
A MESSAGE FROM THE "MOLI-SANI" STUDY

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NO CONFLICT OF INTEREST TO DECLARE
Inscribed in 2013 (8.COM) on the Representative List of the Intangible Cultural Heritage of Humanity

Country(ies): Cyprus, Croatia, Spain, Greece, Italy, Morocco, Portugal

Decision 8.COM 8.10
The Committee (...) decides that the Mediterranean diet satisfies the criteria for inscription on the Representative List of the Intangible Cultural Heritage of Humanity
Ancel and Margaret Keys
at their home of Pioppi (Cilento, Southern Italy) in 1982

(Courtesy of Prof. Mario Mancini, University of Naples)
From the States to Cilento
looking for the key to longevity

January 13, 1961
Changing the “Western” Diet in Finland: The Finnish Study

Changing the “Mediterranean” Diet in Italy: The Pollica Study

Ferro-Luzzi et al, Am J Clin Nutr 1984

Strazzullo et al, J Hypertension 1986
Average intake of saturated fatty acids at baseline and 25 years mortality rates from CHD: The Seven Countries Study

C = Croatia
D = Dalmatia
F = Finland
G = Greece
K = Crete
I = Italy
J = Japan
N = Netherlands
S = Serbia
U = United States

Kromhout D. Prev Med, 1995
THE PYRAMID OF THE MEDITERRANEAN DIET
The “personality” of Mediterranean Diet is characterized by:

✓ High intake of vegetables, legumes, fruit, dried fruit and whole-grain cereals
✓ Predominant intake of olive oil compared to low intake of animal fats
✓ Habitual intake of fish
✓ Moderate intake of dairy products
✓ Moderate intake of meat and poultry
✓ Regular but moderate intake of ethanol essentially as wine, consumed during meals

✓ A way of thinking to food and life
Geographic gradient for cardiovascular disease

Age standardised coronary event rates in men and women aged 34-65, in populations covered by the MONICA project, 1999

Modified from Ferriman, Lancet 1999
The “common soil” hypothesis

Ischemic cardiovascular disease and several forms of tumors (hormone dependent and gastro-intestinal tract) share common mechanisms and risk factors

Donati, 2003, 2007 and 2010
Iacoviello et al, 2008
The “common soil” hypothesis
Adherence to a Mediterranean Diet and Survival in a Greek Population

Antonia Trichopoulou, M.D., Tina Costacou, Ph.D., Christina Bamia, Ph.D., and Dimitrios Trichopoulos, M.D.

• Total mortality 0.75 (0.64 – 0.87)
• Cardiovascular mortality 0.67 (0.47 – 0.94)
• Cancer mortality 0.76 (0.59 – 0.98)

22,043 Adults; 44 months median follow-up
Adherence to Mediterranean diet and health status: meta-analysis

Francesco Sofi, researcher in clinical nutrition, 1-5 Francesca Cesari, researcher, 1 Rosanna Abbate, full professor of internal medicine, 1-5 Gian Franco Gensini, full professor of internal medicine, 3 Alessandro Casini, associate professor of clinical nutrition 2,4,5

- Total mortality 0.91 (0.89 – 0.94)
- Cardiovascular mortality 0.91 (0.87 – 0.95)
- Cancer occurrence or mortality 0.94 (0.92 – 0.96)
- Parkinson & Alzheimer risk 0.87 (0.80 – 0.96)

12 studies, total of 1,574,299 subjects, 3 to 18 years of follow up, 2 point increase in the score of adherence
Primary Prevention of Cardiovascular Disease with a Mediterranean Diet

Reduction of combined primary end points vs control

Diet (reduced dietary fat)
- Med Diet + olive oil 0.70 (0.54 – 0.92)
- Med Diet + nuts 0.72 (0.54 – 0.96)

7,747 high CVD risk participants, median follow-up 4.8 years
An Italian region is transformed in a scientific laboratory to better understand the equilibrium between genetics and environment on cardiovascular disease and cancer risk.
The Molise region

- A small region
- At the crossroad between northern and southern Italy
- Mediterranean Diet tradition
- Homogeneous genetic heritage
- No Immigration flow
The Moli-sani study

✓ 24,325 people living in Molise
✓ Aged 35 years or more
✓ Recruitment phase: 2005-2010
✓ Follow-up initiated 2010
✓ Study duration: ... ∞ years
Moli-sani end-points

- CARDIO-CEREBROVASCULAR DISEASE
- TUMORS
- COMMON INTERMEDIATE PHENOTYPES

“Common soil” hypothesis
Intermediate phenotypes for both atherosclerotic disease and cancer

- Metabolic syndrome
- Obesity
- Hypertension
- Dyslipidemia
- Diabetes
Demographics of Moli-sani Age

Stefania & Renato, 90 and 99 years, respectively

(52 % women)
A typical “Moli-sani” day: the admission

Volunteers arrived fasting at Campobasso or Termoli Hospital outpatient facilities devoted to the Moli-sani Project

Volunteers signed the informed consent and received a bar-code
A typical “Moli-sani” day: biological sample drawing

- **Blood**, to analyze plasma and serum hematocellular and hemostatic variables, and to extract DNA

- **Urine**, to evaluate metabolic and nutrient levels
A typical “Moli-sani” day: clinical tests

- Electrocardiogram
- Spirometry
- Blood pressure
- Weight and height (BMI)
- Body fat distribution
A typical “Moli-sani” day: paper-less questionnaires

Anamnestic questionnaire explored the condition of each volunteer from a clinical and lifestyle point of view.

EPIC-modified Food Frequency Questionnaire provided detailed information about type and amount of one-year recall food consumption.
A typical “Moli-sani” day: \textit{Laboratory tests}

\begin{itemize}
\item[\textbf{Biological tests}]
  \begin{itemize}
  \item Blood cell counts
  \item Cholesterol, HDL, LDL, TG
  \item Glucose
  \item C Reactive Protein
  \item D-dimers
  \end{itemize}
\end{itemize}

\begin{itemize}
\item DNA extraction
\end{itemize}

\begin{itemize}
\item Biological samples stored in liquid nitrogen
\end{itemize}
The Moli-sani Bio-Bank

700,000 **blood** samples in 4,080 goblets filled-in 28 paillettes per person:

- 8 red for plasma EDTA
- 6 blue for plasma citrate
- 8 yellow for serum
- 6 green for pellet

**Urine samples:**

3-hr morning collection

- 4 vials, 5 ml per person
Dietary patterns, cardiovascular risk factors and C-reactive protein in a healthy Italian population

F. Centritto $^a$, L. Iacoviello $^{a,*}$, R. di Giuseppe $^a$, A. De Curtis $^a$, S. Costanzo $^a$, F. Zito $^a$, S. Grioni $^b$, S. Sieri $^b$, M.B. Donati $^a$, G. de Gaetano $^a$, A. Di Castelnuovo $^a$, on behalf of Moli-sani Investigators

Nutrition, Metabolism & Cardiovascular Diseases (2009) 19, 697–706
A *posteriori* dietary pattern in the Moli-sani population

**Mediterranean style pattern**
- OLIVE OIL
- COOKED VEGETABLES
- RAW VEGETABLES
- LEGUMES
- SOUPS
- FISH
- POTATOES
- FRUITS
- BOUILLON
- WHITE MEAT
- CRUSTACEANS, MOLLUSCS
- CRISP BREAD, RUSKS
- NUTS AND DRIED FRUITS
- YOGURT
- SNACKS
- FRESH CHEESE

**Western diet pattern**
- OLIVE OIL
- WHITE MEAT
- PASTA AND OTHER GRAINS
- COOKED TOMATOES
- RED MEAT
- ANIMAL FATS
- OTHER SAUCES
- WINE
- BREAD
- BEER
- OFFALS
- PROCESSED MEAT
- SEASONED CHEESE
- BREAKFAST CEREALS
- YOGURT

**Sweet diet pattern**
- PATATE
- CARNE BIANCA
- CARNE ROSSA
- GRASSI ANIMALI
- PANA
- BIRRA
- UOVA
- MARGARINA
- INSACCATI
- DOLI
- OLI VEGETALI
- SNACKS
- FRESH CHEESE
- CRUSTACEANS, MOLLUSCS
- CRISP BREAD, RUSKS
- NUTS AND DRIED FRUITS
- YOGURT
- MAIONESE
- FORMAGGI
- PIZZA
- PESCE CONSERVATO
- SUCCHI DI FRUTTA
- COFFEE
- SOFT DRINKS

Centritto F et al, NMCD 2009
MEDITERRANEAN STYLE PATTERN

OLIVE OIL
COOKED VEGETABLES
RAW VEGETABLES
LEGUMES
SOUPS
FISH
POTATOES
FRUITS
BOUILLON
WHITE MEAT
CRUSTACEANS, MOLLUSCS
CRISP BREAD, RUSKS
NUTS AND DRIED FRUITS
YOGURT
SNACKS
FRESH CHEESE

TOTAL CHOLESTEROL
LDL CHOLESTEROL
SYSTOLIC BLOOD PRESSURE
DIASTOLIC BLOOD PRESSURE
TRIGLYCERIDES
BLOOD GLUCOSE
C REACTIVE PROTEIN
CARDIOVASCULAR RISK (MEN)

A posteriori dietary pattern and metabolic risk of cardiovascular disease

Centritto F et al, NMCD 2009
A *posteriori* dietary pattern and metabolic risk of cardiovascular disease

**WESTERN DIET PATTERN**

- Olive oil
- White meat
- Pasta and other grains
- Cooked tomatoes
- Red meat
- Animal fats
- Other sauces
- Wine
- Bread
- Beer
- Offals
- Processed meat
- Seasoned cheese

**TOTAL CHOLESTEROL**
**LDL CHOLESTEROL**
**TRIGLYCERIDES**
**BLOOD GLUCOSE**
**C REACTIVE PROTEIN**
**CARDIOVASCULAR RISK (MEN)**
**CARDIOVASCULAR RISK (WOMEN)**

Centritto F et al, NMCD 2009
Reduction of low grade inflammation, mainly linked to fiber content and anti-oxidant effect of diet

Bonaccio et al, Blood 2014
Mediterranean diet and mortality in subjects with diabetes

Risk of overall mortality

Bonaccio et al, 2014
Despite its great advantages for disease prevention, the adherence to the Mediterranean diet is decreasing.
Adherence to Mediterranean diet in the Moli-sani cohort (MAI index)

<table>
<thead>
<tr>
<th></th>
<th>WOMEN</th>
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<tbody>
<tr>
<td></td>
<td>25th PERCENTILE</td>
<td>50th PERCENTILE</td>
<td>75th PERCENTILE</td>
<td></td>
</tr>
<tr>
<td>NICOTERA (1960)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>POLLICA (1967)</td>
<td>3.3</td>
<td>6.0</td>
<td>10.0</td>
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<tr>
<td>MOLI-SANI (2009)</td>
<td>2.0</td>
<td>2.6</td>
<td>3.6</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>MEN</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>25th PERCENTILE</td>
<td>50th PERCENTILE</td>
<td>75th PERCENTILE</td>
<td></td>
</tr>
<tr>
<td>NICOTERA (1960)</td>
<td>5.4</td>
<td>7.5</td>
<td>10.8</td>
<td></td>
</tr>
<tr>
<td>POLLICA (1967)</td>
<td>3.2</td>
<td>6.0</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>MOLI-SANI (2009)</td>
<td>2.5</td>
<td>3.6</td>
<td>5.4</td>
<td></td>
</tr>
</tbody>
</table>
Adherence to Mediterranean diet and anthropometric and metabolic parameters in an observational study in the ‘Alto Molise’ region: The MOLI-SAL project

**di Giuseppe et al, NMCD 2008**
Decline of the Mediterranean diet at a time of economic crisis. Results from the Moli-sani study

M. Bonaccio, A. Di Castelnuovo, A. Bonanni, S. Costanzo, F. De Lucia, M. Persichillo, F. Zito, M. B. Donati, G. de Gaetano, L. Iacoviello, on behalf of the Moli-sani project Investigators

Nutrition, Metabolism, Cardiovasc Dis 2014

![Bar chart showing the prevalence of Italian Mediterranean index ≥5 from 2005 to 2010.](chart.png)

Prevalence %

- 2005: 33.7%
- 2006: 29.7%
- 2007: 19.6%
- 2008: 19%
- 2009: 14.7%
- 2010: 17.3%

Italian Mediterranean index ≥5
Prevalence of high adherence to Mediterranean diet according to the years of recruitment

High adherence = Mediterranean score \( \geq 6 \)

Bonaccio M et al, NMCD 2014
Prevalence of different smoking habits according to the year of recruitment

Bonaccio M et al, NMCD 2014
Prevalence of different levels of physical activity according to the year of recruitment

Bonaccio M et al, NMCD 2014
Adherence to the Mediterranean diet within age groups over time

Bonaccio M et al, NMCD 2014
Mangiare sano costa troppo

di Silvio Garattini

Solo l'uno per cento della popolazione segue una dieta appropriata ricca di vegetali anche a causa delle condizioni economiche che regolano il mercato degli alimentari. In tempi di crisi ci si orienta verso cibi a basso costo
ZUCCHINE DI PACHINO

€ 6 / 13.000 AL CHICO

LATTUGA

€ 5 / 10.000 AL CHICO
Is the Cost of the Mediterranean Diet a Barrier for its Promotion in the Communities?

Christopher Papandreou

Department of Nutrition & Dietetics, Harokopio University of Athens, Greece
Bye Bye Mediterranean Diet, the Poorest Can't Afford It Anymore
Possible causes of the shifting from the Mediterranean diet: socio-economic inequalities
Socio-economic factors in the Moli-sani study

**HOUSEHOLD INCOME (Euros/year)**
- ≤10,000
- 10,000 - 25,000
- 25,000 - 40,000
- > 40,000

**EDUCATION**
- secondary or lower; high school; higher degree

**SOCIAL STATUS**
- dwelling ownership
- ratio between the number of rooms and the number of living-in family members (Room Density), both currently and during childhood
- availability of hot water at home during childhood
Low income is associated with poor adherence to a Mediterranean diet and a higher prevalence of obesity: cross-sectional results from the Moli-sani study

Maria Laura Bonaccio,¹,² Americo Ettore Bonanni,¹ Augusto Di Castelnuovo,³ Francesca De Lucia,¹ Maria Benedetta Donati,²,⁴ Giovanni de Gaetano,²,⁴ Licia Iacoviello,²,³ on behalf of the Moli-sani Project Investigators
Adherence to Mediterranean diet according to household income categories

Mediterranean score $\geq 6$

Bonaccio M et al., BMJ Open. 2012
Household income and adherence to Mediterranean diet: even small gaps make the difference

Bonaccio M et al., BMJ Open. 2012
Income makes the difference independently from educational level

lower

(P = 0.040)

medium-high

(P for trend = 0.040)

Bonaccio M et al., BMJ Open. 2012
The social status is less influential in the adherence to Mediterranean Diet

Odds ratios of having high adherence to Mediterranean diet according to social status

Bonaccio M et al., BMJ Open. 2012
Cardiovascular Risk and Events in 17 Low-, Middle-, and High-Income Countries

Event Rates for Major Cardiovascular Disease

Yusuf et al, NEJM 2014
Beyond money: have information and health awareness any role in people’s eating choices?
Mediterranean diet and mass media exposure

Categories of mass media information exposure

Mediterranean diet and nutrition knowledge

Bonaccio M et al, Appetite 2013
Nutrition knowledge and obesity

Bonaccio M et al, Appetite 2013
Despite its great advantages for disease prevention, the adherence to the Mediterranean diet is decreasing.
Estimating the 10-year risk of cardiovascular disease and its economic consequences, by the level of adherence to the Mediterranean diet: the ATTICA study

<table>
<thead>
<tr>
<th></th>
<th>Adherence to Mediterranean Diet</th>
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<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Coronary risk greater than 10%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Total health care cost (euros)</td>
<td>36,000</td>
</tr>
<tr>
<td>Life-years lost due to disability</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Conclusions

- **Mediterranean diet** reduces the risk of chronic degenerative disease in a progressively aging world;
- Adherence to the Mediterranean diet is inversely associated with a socio-economic gradient;
- Even in a relatively homogeneous region like Molise, slight income disequalities are associated with a different adherence to Mediterranean diet;
- The start of the economic crisis in 2007 has magnified these disequalities and may have a long term impact on population health, particularly in the lower income subgroups.
La DIETA MEDITERRANEA ai tempi della CRISI
Pablo Picasso, Colomba della pace.
MOLI-SANI POPULATION: PREVALENCE OF INTERMEDIATE PHENOTYPES

<table>
<thead>
<tr>
<th>Condition</th>
<th>Women (%)</th>
<th>Men (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS</td>
<td>25.9</td>
<td>28.1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>28.9</td>
<td>27.8</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3.6</td>
<td>6.0</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>7.5</td>
<td>7.7</td>
</tr>
<tr>
<td>CRP ≥ 3</td>
<td>26.1</td>
<td>22.2</td>
</tr>
<tr>
<td>Obesity</td>
<td>30.3</td>
<td>28.2</td>
</tr>
</tbody>
</table>
Demographics of Moli-sani: smoking

Subjects were classified as **non-smokers** if they never smoked, **ex-smokers** if they had smoked in the past and had stopped from at least 1 year and **current smokers** if they were currently smoking on a regular basis.
Demographics of Moli-sani

Obesity (BMI)

Prevalence (%)

- Underweight
- Normal
- Overweight
- Obese

Men Women

Normal: BMI 19-25

Overweight: BMI 25-30

Obese: BMI >30

P<.0001 age adjusted
Demographics of Moli-sani
Obesity (Waist to Hip Ratio)

Not normal:
Women WHR > 0.88
Men WHR > 0.96

P<.0001 age adjusted
Demographics of Moli-sani

Metabolic Syndrome

Definition: at least 3 of:

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist circumference</td>
<td>≥102 cm males</td>
<td>≥88 cm females</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>≥150 mg/dl</td>
<td>Or pharmacological treatment</td>
</tr>
<tr>
<td>HDL-Cholesterol</td>
<td>&lt;40 mg/dl males</td>
<td>&lt;50 mg/dl females</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>SBP ≥130 mmHg</td>
<td>Or pharmacological treatment</td>
</tr>
<tr>
<td></td>
<td>DBP ≥85 mmHg</td>
<td>Or pharmacological treatment</td>
</tr>
<tr>
<td>Fasting blood glucose</td>
<td>≥100 mg/dl</td>
<td>Or pharmacological treatment</td>
</tr>
</tbody>
</table>

P<0.001 age adjusted
Costs of Mediterranean and western dietary patterns in a Spanish cohort and their relationship with prospective weight change

C N Lopez,¹,² M A Martinez-Gonzalez,¹ A Sanchez-Villegas,¹,³ A Alonso,¹,⁴ A M Pimenta,¹,⁵ M Bes-Rastrollo¹

Daily food costs according to quintile of scores on the dietary patterns (euros/1000 kcal)

- Western diet pattern
- Mediterranean pattern
The decline of Mediterranean diet in Mediterranean Countries: the contribution of socio-economic factors


- 11,742 Spanish subjects aged >=18 years
- period of recruitment 2008-2010
- MEDAS score

“The departure from the MD mostly affects the socially disadvantaged and clusters with other unhealthy lifestyles, which may have synergistic undesirable effects on health”.

<table>
<thead>
<tr>
<th>A</th>
<th>MEDAS score ≥ 9</th>
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<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>12.5</td>
</tr>
<tr>
<td>Women</td>
<td>11.5</td>
</tr>
<tr>
<td><strong>Age, years</strong></td>
<td></td>
</tr>
<tr>
<td>18-44</td>
<td>6.2</td>
</tr>
<tr>
<td>45-64</td>
<td>15.6</td>
</tr>
<tr>
<td>≥ 65</td>
<td>21.1</td>
</tr>
<tr>
<td>P for trend</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td></td>
</tr>
<tr>
<td>No formal/primary</td>
<td>15.5</td>
</tr>
<tr>
<td>Primary</td>
<td>13.9</td>
</tr>
<tr>
<td>Secondary</td>
<td>9.8</td>
</tr>
<tr>
<td>University</td>
<td>12.9</td>
</tr>
<tr>
<td>P for trend</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>BMI, kg/m²</strong></td>
<td></td>
</tr>
<tr>
<td>&lt; 25</td>
<td>9.6</td>
</tr>
<tr>
<td>25-29.9</td>
<td>13.6</td>
</tr>
<tr>
<td>≥ 30</td>
<td>13.2</td>
</tr>
<tr>
<td>P for trend</td>
<td>0.315</td>
</tr>
<tr>
<td><strong>Tobacco smoking</strong></td>
<td></td>
</tr>
<tr>
<td>Never smoker</td>
<td>11.7</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>16.1</td>
</tr>
<tr>
<td>Current smoker</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Physical activity, MET-h/wk</strong></td>
<td></td>
</tr>
<tr>
<td>Tertile 1 (lowest)</td>
<td>9.3</td>
</tr>
<tr>
<td>Tertile 2</td>
<td>13.7</td>
</tr>
<tr>
<td>Tertile 3 (highest)</td>
<td>12.5</td>
</tr>
<tr>
<td>P for trend</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Time watching TV, h/wk</strong></td>
<td></td>
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<tr>
<td>TV Tertile 1 (lowest)</td>
<td>11.3</td>
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<tr>
<td>TV Tertile 2</td>
<td>12.1</td>
</tr>
<tr>
<td>TV Tertile 3 (highest)</td>
<td>13.2</td>
</tr>
<tr>
<td>P for trend</td>
<td>0.001</td>
</tr>
</tbody>
</table>

a Adjusted for sex, age, BMI and energy intake
N=11742
Capire i meccanismi che stanno alla base delle disuguaglianze: analisi delle abitudini di vita

Le abitudini di vita seguono un gradiente socioeconomico e sono distribuite in maniera non equa tra i vari gruppi della popolazione.
Abitudini di vita

- Dieta
- Fumo
- Attività fisica
- Controllo del peso
Principali cause di morte nel mondo

The 10 leading causes of death in the world
2012

- Ischaemic heart disease: 7.4 million
- Stroke: 6.7 million
- COPD: 3.1 million
- Lower respiratory infection: 3.1 million
- Trachea, bronchus, lung: 1.6 million
- HIV/AIDS: 1.5 million
- Diarrhoeal diseases: 1.5 million
- Diabetes mellitus: 1.5 million
- Road injury: 1.3 million
- Hypertensive conditions: 1.1 million

World Health Organization, 2012
Principali cause di morte nei Paesi ad alto reddito

Top 10 causes of death in high income countries
2012

- Ischaemic heart disease: 158
- Stroke: 95
- Trachea, bronchus, lung: 49
- Alzheimer disease and ...: 42
- COPD: 31
- Lower respiratory infections: 31
- Colon rectum cancers: 27
- Diabetes mellitus: 20
- Hypertensive heart disease: 20
- Breast cancer: 16

Deaths per 100,000 population

World Health Organization, 2012