Epidemiology of the metabolic syndrome in Luxembourg

findings from ORISCAV-LUX study

Ala’a Alkerwi, MD, PhD

Nicolas Sauvageot, Marie-Lise Lair, Anne-Françoise Donneau, Adelin Albert, Michèle Guillaume
Outline

1. Scope of the problem
2. Rationale/motivation
3. Research objectives
4. Research methods
5. Results
6. Conclusion
7. Publications
Outline

1. Scope of the problem
2. Rationale/motivation
3. Research objectives
4. Research methods
5. Results
6. Conclusion
7. Publications
Metabolic Syndrome (MS)

MS is a multiplex cardio-metabolic disorder which clusters together in the same individual more often than might be expected by chance.
Insulin resistance-based definitions

Obesity-based definitions

WHO

EGIR

ATPIII

R-ATPIII

IDF

JIS 2009
3 or more of the following 5 criteria

1) $\uparrow$ TG $\geq$ 150 mg/dl or treatment

2) $\downarrow$ HDL-C $< 40$ mg/dl $\quad$♂ $<$ 50 mg/dl $\quad$♀ or treatment

3) $\uparrow$ SBP $\geq$ 130 mmHg
   DBP $\geq$ 85 mmHg or treatment

4) $\uparrow$ FPG $\geq$ 100 mg/dl or treatment

5) Waist Circumference (WC, cm): population-specific cut-off points

simpler and more operational
Cardiovascular disease (CVD) risk prediction

Traditional risk assessment tools

- Framingham
- PROCAM
- SCORE
- others

Age, gender, family history, smoking
- BP
- LDL-C, HDL-C
- Diabetes
Cardiovascular disease (CVD) risk prediction

Traditional risk assessment tools

<table>
<thead>
<tr>
<th>Framingham</th>
<th>PROCAM</th>
<th>SCORE</th>
<th>others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, gender, family history, smoking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDL-C, HDL-C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metabolic Syndrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal obesity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Traditional tools do not capture additional risk (obesity)
- MS alone cannot improve prediction of global CVD risk
- Neither MS nor risk tools can properly assess global CVD risk
The “building blocks” of global cardiometabolic risk, with adaptation from Després et al 2008
Outline

1. Scope of the problem
2. Rationale/motivation
3. Research objectives
4. Research methods
5. Results
6. Conclusion
7. Publications
Grand Duchy of Luxembourg

9 December 2010

Geographical context

3 geographical districts
2586 km²

493,500 inhabitants
Luxembourgers 56.3%
Foreigners 43.7%
## Causes of mortality in Luxembourg (2007)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular disease</td>
<td>36.9%</td>
</tr>
<tr>
<td>Respiratory diseases</td>
<td>7.5%</td>
</tr>
<tr>
<td>Cancers</td>
<td>27.6%</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>3.0%</td>
</tr>
<tr>
<td>Gastrointestinal diseases</td>
<td>4.6%</td>
</tr>
<tr>
<td>Neurological disorders</td>
<td>3.2%</td>
</tr>
<tr>
<td>Metabolic disorders</td>
<td>2.2%</td>
</tr>
<tr>
<td>External causes</td>
<td>7.2%</td>
</tr>
<tr>
<td>Other</td>
<td>7.9%</td>
</tr>
<tr>
<td>Cancers</td>
<td>27.6%</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>3.0%</td>
</tr>
<tr>
<td>Gastrointestinal diseases</td>
<td>4.6%</td>
</tr>
<tr>
<td>Neurological disorders</td>
<td>3.2%</td>
</tr>
<tr>
<td>Metabolic disorders</td>
<td>2.2%</td>
</tr>
<tr>
<td>External causes</td>
<td>7.2%</td>
</tr>
<tr>
<td>Other</td>
<td>7.9%</td>
</tr>
</tbody>
</table>

Directorate-General of Health, Luxembourg, 2007
Cardiovascular mortality in Europe

20-69 years

Highest mortality among the Western countries

European detailed mortality database (DMDB)
Copenhagen, WHO Regional Office for Europe, 2006
MS (ATP III definition)

Worldwide public health challenge

↑ Diabetes
↑ Obesity
Lifestyle
No data for Luxembourg
Outline

1. Scope of the problem
2. Rationale/motivation
3. Research objectives
4. Research methods
5. Results
6. Conclusion
7. Publications
Objectives

Inductive exploratory approach

- Investigate the epidemiological profile of MS in the general resident population of Luxembourg

- Identify the potential socio-economic and behavioral determinants of MS

“Group at risk”

« Evidence-based interventions »
Outline

1. Scope of the problem
2. Rationale/motivation
3. Research objectives
4. Research methods
5. Results
5. Conclusion
7. Publications
Observation of Cardiovascular Risk Factors in Luxembourg

- 1st nationwide cross-sectional survey (November 2007-January 2009)
- Population of residents (18-69 years) of Luxembourg
- Stratified random sample of 1432 participants
Method of data collection

1st step
- Mailing (invitation/information) with coupon-answer

2nd step
- Phone contact
- Appointement
- Investigation centre
- Questionnaire
  - IPAQ
  - FFQ
  - AUDIT

3rd step
- Waist and hip circumferences
- Weight
- Height
- Blood pressure
- Hair sample
- Urine
- Blood
The distribution of selected subjects in each stratum is proportional to their distribution in the source population.
Outline

1. Scope of the problem
2. Rationale/motivation
3. Research objectives
4. Research methods
5. Results
6. Conclusion
7. Publications
Comparison of participants to source population according to gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Population</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>50.4%</td>
<td>48.7%</td>
</tr>
<tr>
<td>Women</td>
<td>49.6%</td>
<td>51.3%</td>
</tr>
</tbody>
</table>

$P = 0.19$

Sample representativeness (1)
Sample representativeness (2)

Comparison of participants to source population according to district

<table>
<thead>
<tr>
<th>District</th>
<th>Population</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg</td>
<td>73.7</td>
<td>73.0</td>
</tr>
<tr>
<td>Diekirch</td>
<td>14.8</td>
<td>15.1</td>
</tr>
<tr>
<td>Grevenmacher</td>
<td>11.5</td>
<td>11.9</td>
</tr>
</tbody>
</table>

$P = 0.82$
Comparison of participants to source population according to age groups

P < 0.0001
Sample representativeness (4)

To assess whether the health status affected the response rate

Comparison between participants and non-participants

- Demographic indicators (profession, nationality)
- Morbidity indicators (prescribed medications, hospital admission and medical measures)

National medical administrative database
Sample representativeness (4)

Conclusion*

Investigated clinical profile (hospital admission and cardiovascular health-related medical measures) was **comparable** in both groups (participants vs non-participants)

Response rate does **not invalidate** the results

Allows **generalizing** the findings for the population

*Alkerwi et al. BMC Medical Research Methodology 2010, 10:80*
### Metabolic syndrome

#### R-ATP III definition

3 or more of the following criteria

<table>
<thead>
<tr>
<th>↑ WC</th>
<th>≥ 102 cm</th>
<th>≥ 88 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓ HDL-C</td>
<td>&lt; 40 mg/dl</td>
<td>&lt; 50 mg/dl</td>
</tr>
<tr>
<td>or treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>↑ TG</td>
<td>≥ 150 mg/dl</td>
<td>or treatment</td>
</tr>
<tr>
<td>↑ SBP</td>
<td>≥ 130 mmHg</td>
<td>or treatment</td>
</tr>
<tr>
<td>↑ DBP</td>
<td>≥ 85 mmHg</td>
<td></td>
</tr>
<tr>
<td>↑ FPG</td>
<td>≥ 100 mg/dl</td>
<td>or diagnosed diabetes</td>
</tr>
</tbody>
</table>
Epidemiological profile (2)

Prevalence of metabolic syndrome by gender

Prevalence (%) of metabolic syndrome by gender:

- **Women**: 24.7%
- **Men**: 30.8%

Statistical significance: $P < 0.0001$
Prevalence of metabolic syndrome by gender and age

**Epidemiological profile (3)**

24.7% **P<0.0001**

Prevalence (%) by age and gender:
- **18-69 years**
  - Women: 18.5%
  - Men: 30.8%
- **18-29 years**
  - Women: 7.5%
  - Men: 0.9%
- **30-39 years**
  - Women: 7.8%
  - Men: 17.1%
- **40-49 years**
  - Women: 16.3%
  - Men: 34.4%
- **50-59 years**
  - Women: 34.2%
  - Men: 52.1%
- **60-69 years**
  - Women: 49.8%
  - Men: 60.4%

**P<0.0001**
Prevalence of metabolic syndrome components

- Abdominal obesity: Women 35.1%, Men 26.3%, *P*=0.0002
- Raised TG: Women 14.7%, Men 16.2%, *P*<0.0001
- Low HDL-C: Women 21.3%, Men 29.0%, *P*<0.0001
- High BP: Women 62.5%, Men 42.2%, *P*<0.0001
- Hyperglycaemia: Women 14.4%, Men 29%, *P*=0.014

Epidemiological profile (4)
**Metabolic syndrome – Logistic regression**

**Socio-economic factors**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age and gender adjusted odd ratio</th>
<th>OR</th>
<th>95% CL</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced/separated</td>
<td>0.78</td>
<td>0.48</td>
<td>1.25</td>
<td>0.667</td>
</tr>
<tr>
<td>Widowed</td>
<td>1.23</td>
<td>0.58</td>
<td>2.56</td>
<td></td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>2.33</td>
<td>1.57</td>
<td>3.48</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Secondary</td>
<td>1.50</td>
<td>1.04</td>
<td>2.17</td>
<td></td>
</tr>
<tr>
<td><strong>Work status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>4.15</td>
<td>1.15</td>
<td>15.02</td>
<td>0.037</td>
</tr>
<tr>
<td>Sick leave, disabled, unemployed</td>
<td>1.77</td>
<td>0.85</td>
<td>3.71</td>
<td></td>
</tr>
<tr>
<td><strong>Housewives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.40</td>
<td>1.51</td>
<td>3.81</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Subjective economical status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult</td>
<td>1.55</td>
<td>1.06</td>
<td>2.28</td>
<td>0.024</td>
</tr>
<tr>
<td><strong>Objective economical status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below risk of poverty</td>
<td>1.75</td>
<td>1.21</td>
<td>2.53</td>
<td>0.003</td>
</tr>
</tbody>
</table>

*Reference category:* married, university level of education, employed, working women, easy subjective economical status, above risk of poverty threshold
## Epidemiological profile (6)

### Metabolic syndrome – Logistic regression

#### Lifestyle factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age and gender adjusted odd ratio</th>
<th>OR</th>
<th>95% CL</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smokers</td>
<td></td>
<td>1.49</td>
<td>1.05</td>
<td>2.10</td>
</tr>
<tr>
<td>Former smokers</td>
<td></td>
<td>1.12</td>
<td>0.79</td>
<td>1.59</td>
</tr>
<tr>
<td>Number of cigarettes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-20 cigarettes daily</td>
<td></td>
<td>1.41</td>
<td>0.89</td>
<td>2.22</td>
</tr>
<tr>
<td>More than 20 cigarettes daily</td>
<td></td>
<td>2.23</td>
<td>1.11</td>
<td>4.48</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately active</td>
<td></td>
<td>1.37</td>
<td>0.99</td>
<td>1.89</td>
</tr>
<tr>
<td>Inactive</td>
<td></td>
<td>1.53</td>
<td>1.04</td>
<td>2.26</td>
</tr>
</tbody>
</table>

Reference category: non-smokers, less than 10 cigarettes/day, physically active
Epidemiological profile (7)

Metabolic syndrome – Logistic regression
Family history

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age and gender adjusted odd ratio</th>
<th>OR</th>
<th>95% CL</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>1.61 1.17 2.22</td>
<td>1.61</td>
<td>1.17</td>
<td>2.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.004</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2.40 1.71 3.36</td>
<td>2.40</td>
<td>1.71</td>
<td>3.36</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1.15 0.82 1.63</td>
<td>1.15</td>
<td>0.82</td>
<td>1.63</td>
</tr>
<tr>
<td>Cerebro-vascular accident</td>
<td>1.03 0.72 1.47</td>
<td>1.03</td>
<td>0.72</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Reference category: no family history of (hypertension, diabetes, myocardial infarction, CVA)
## Epidemiological profile (8)

### Metabolic syndrome – Logistic regression

#### Dietary factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age and gender adjusted odd ratio</th>
<th>OR</th>
<th>95% CL</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fat, % E</td>
<td>&lt;15 or &gt;30</td>
<td>0.84</td>
<td>0.55</td>
<td>1.29</td>
</tr>
<tr>
<td>Satured fat, % E</td>
<td>≥10</td>
<td>0.60</td>
<td>0.39</td>
<td>0.91</td>
</tr>
<tr>
<td>Poly unsatured fat, % E</td>
<td>&lt;6 or &gt;10</td>
<td>1.17</td>
<td>0.87</td>
<td>1.56</td>
</tr>
<tr>
<td>Mono unsatured fat, % E</td>
<td>&lt;10 or &gt;14</td>
<td>1.03</td>
<td>0.73</td>
<td>1.45</td>
</tr>
<tr>
<td>œ6/œ3 ratio</td>
<td>&gt;5.5</td>
<td>4.91</td>
<td>0.82</td>
<td>29.45</td>
</tr>
<tr>
<td>Cholesterol, mg/day</td>
<td>≥300</td>
<td>1.10</td>
<td>0.81</td>
<td>1.49</td>
</tr>
<tr>
<td>Total carbohydrates, % E</td>
<td>&lt;55 or &gt;75</td>
<td>1.45</td>
<td>0.77</td>
<td>2.71</td>
</tr>
<tr>
<td>Simple sugar, % E</td>
<td>≥10</td>
<td>0.27</td>
<td>0.13</td>
<td>0.56</td>
</tr>
<tr>
<td>Total protein, % E</td>
<td>&lt;10 or &gt;15</td>
<td>1.56</td>
<td>1.14</td>
<td>2.15</td>
</tr>
<tr>
<td>Sodium, g/day</td>
<td>&gt;2</td>
<td>0.93</td>
<td>0.62</td>
<td>1.34</td>
</tr>
<tr>
<td>Fruits and vegetables, g/day</td>
<td>&lt;400</td>
<td>0.96</td>
<td>0.70</td>
<td>1.31</td>
</tr>
<tr>
<td>Total fibres, g/day</td>
<td>≤25</td>
<td>1.02</td>
<td>0.76</td>
<td>1.37</td>
</tr>
<tr>
<td>Soluble fibre, g/day</td>
<td>&lt;10</td>
<td>0.89</td>
<td>0.45</td>
<td>1.76</td>
</tr>
</tbody>
</table>

Reference categories are those who respect the WHO recommendations, 2003
<table>
<thead>
<tr>
<th>Variable</th>
<th>Fully adjusted odd ratio</th>
<th>OR</th>
<th>95% CL</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1.09</td>
<td>1.07</td>
<td>1.11</td>
</tr>
<tr>
<td>Gender</td>
<td>Men</td>
<td>3.08</td>
<td>2.12</td>
<td>4.47</td>
</tr>
<tr>
<td>Level of education</td>
<td>Primary</td>
<td>1.93</td>
<td>1.18</td>
<td>3.15</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>1.34</td>
<td>0.86</td>
<td>2.09</td>
</tr>
<tr>
<td>Physical activity</td>
<td>Inactive</td>
<td>1.93</td>
<td>1.18</td>
<td>3.17</td>
</tr>
<tr>
<td></td>
<td>Moderately active</td>
<td>1.49</td>
<td>1.01</td>
<td>2.12</td>
</tr>
<tr>
<td>Family history</td>
<td>Diabetes</td>
<td>2.46</td>
<td>1.62</td>
<td>3.73</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>1.44</td>
<td>1.00</td>
<td>2.08</td>
</tr>
<tr>
<td>Total protein</td>
<td>&lt;10 or &gt; 15</td>
<td>1.59</td>
<td>1.09</td>
<td>2.31</td>
</tr>
<tr>
<td>Simple sugar</td>
<td>&gt;10</td>
<td>0.25</td>
<td>0.09</td>
<td>0.63</td>
</tr>
</tbody>
</table>
Conclusion

• The MS is an important health problem in Luxembourg (24.7%)

• MS increases remarkably with age in both genders

• Significant gender-specific differences

• Low education level, physical inactivity, inadequate protein diet and family history of diabetes and hypertension were the most important determinants of the MS

• Lifestyle-oriented intervention might be the promising approach for the primary prevention of MS
Added-values of the study

- First reliable source of information for Luxembourg
- Provides scientific evidence for public health decision-makers
- Increases Luxembourg visibility at international level
- Model to reproduce the study in the neighboring regions
- Reinforcement of international collaboration
- Generates new hypotheses for future research
Peer-reviewed publications

1) Alkerwi et al., Alcohol consumption and the prevalence of metabolic syndrome: A meta-analysis of observational studies, Atherosclerosis, 2009 vol. 204, no2, pp. 624-635.


3) Alkerwi et al., Comparison of participants and non-participants to the ORISCAV-LUX population-based study on cardiovascular risk factors in Luxembourg, Medical Research Methodology 2010, 10:80.


6) Alkerwi et al., Dietary, behavioral and socio-economic determinants of the metabolic syndrome among adults in Luxembourg: finding from ORISCAV-LUX study”, Public Health Nutrition, doi:10.1017/S1368980011002278

Financial support

LE GOUVERNEMENT DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de la Culture, de l'Enseignement supérieur et de la Recherche

LE GOUVERNEMENT DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de la Santé

Programme Core 2010

www.crp-sante.lu
Acknowledgements

Ministry of Health, Directorate of Health, Luxembourg
Ministry of Research, Luxembourg
General Inspectorat of Social Security
National Fund of Research
Luxembourgish Association of Cardiology, Luxembourg
Laboratory of the CHL, Luxembourg
Centre Hospitalier Emile Mayresch
Hôpital Saint Louis d’Ettelbruck
Hôpital Saint Joseph de Wiltz
Ligue Luxembourgeoise de Prévention et d’Action Médico-Sociale
Hellef Doheem, Luxembourg
School of Public Health, University of Liège, Belgium
CRP-Santé, Luxembourg
Thanks for your attention