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THE ITALIAN MULTIMORBIDITY INDEX

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ITALIAN GBD INITIATIVE



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Italian?



Population Health Metrics

BioMed Central

Research

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Disability weights for comorbidity and their influence on Health-adjusted Life Expectancy

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Archives of Public Health

RESEARCH Open Access

Accounting for multimorbidity can affect the estimation of the Burden of Disease: a comparison of approaches

Henk B. M. Hilderink[1*], Marjanne H. D. Plasmans[1], Bianca E. P. Snijders[1], Hendriek C. Boshuizen[1,2], M. J. J. C. (René) Poos[1] and Coen H. van Gool[1]

Italian assessment of different approaches

Andreella *et al. Population Health Metrics* (2023) 21:18
https://doi.org/10.1186/s12963-023-00317-7

Population Health Metrics

RESEARCH Open Access

A novel comorbidity index in Italy based on diseases detected by the surveillance system PASSI and the Global Burden of Diseases disability weights

Angela Andreella[1*], Lorenzo Monasta[2] and Stefano Campostrini[1]

Also adopted in Hungary

scientific reports

(2025) 15:512 | https://doi.org/10.1038/s41598-024-84374-4

Check for updates

OPEN

The diabetes mellitus comorbidity index in European Union member states based on the 2019 European Health Interview Survey

Nóra Kovács[1,6], Nour Mahrouseh[1,6], Lorenzo Monasta[2], Angela Andreella[3], Stefano Campostrini[4] & Orsolya Varga[1,5]✉

Tested three approaches

- **i.e., Additive, Maximum, and Multiplicative**
- **Using data from a National Surveillance system – PASSI** (Progress of Healthcare Authorities for Health in Italy)
- The impact on a person's life of a given disease depends on the **severity** of this disease.
- The GBD provides weights for 371 diseases and injuries, whereas PASSI only examines ten NCDs.
- For each disease analyzed, the GBD provides **different weights depending on the severity** of the disease (health outcomes).

What we had: we considered the following questions from PASSI

- “**Has a doctor ever diagnosed or confirmed you with one or more of the following diseases?**”
  - **10 conditions: diabetes**, kidney failure, bronchitis/emphysema/respiratory failure, myocardial infarction/cardiac ischemia/coronary artery disease, tumor (including leukemias and lymphomas), chronic liver disease/cirrhosis, stroke/cerebral ischemia, heart diseases (e.g., valvulopathy decompensation), bronchial asthma, and arthrosis/arthritis (e.g., rheumatoid, arthritis, gout, lupus, fibromyalgia).

- “**How is your overall health?**”
  - ordinal categorical variable that takes values between 1 and 5, where 1 means excellent self-reported health and 5 means very bad self-reported health.

Example of diabetes

- GBD uses different weights, depending on the severity of diabetes.
- To choose which of these weights to associate with the individual who declared having diabetes in PASSI, we used the perceived health variable detected in PASSI.
  - If perceived health 1 to 3, we use the smallest DW.
  - If it was 4, we used the average.
  - If it was 5, we used the maximum DW.
- We thus assumed that if a subject declared very bad health and more than one disease, both diseases strongly impact the subject’s life

- If an individual declares more than one disease, we combine the selected disability weights by three types of combination functions:

$$D_j^{\text{sum}} = \sum_{i=1}^{10} W_{ij} \qquad (1)$$

$$D_j^{\max} = \max_{i=1,\ldots,10} W_{ij} \qquad (2)$$

$$D_j^{\text{mult}} = 1 - \prod_{i=1}^{10} (1 - W_{ij}). \qquad (3)$$

- Wij = the disability weight associated with the detected disease *i* in PASSI for subject *j*.
- 10 conditions: i = 1, . . . , 10
- j = 1, . . . , n with *n* = total number of subjects interviewed.

- Wij = 0 if subject *j* does not declare the disease *i*.

- If subject *j* declares more than one disease, that is, $|\{i \in \{1, \ldots, 10\} : W_{ij} = 0\}| > 1$ where $|\cdot|$ stands for the cardinality of the set, we combine {Wij} following the approaches proposed by Hilderink and colleagues [31] to create a combined disability weight Dj = f (W1j , . . . ,W10j) for each subject *j* .

This approach allows us to incorporate socio-economic variables included in PASSI

- Incorporating DWs in the index construction, as an alternative to directly analyzing the perceived health variable alone, enables the assessment of varying impacts of diverse illnesses on sub-groups of individuals.

- The comorbidity index is a “semi-continuous” multimodal skewed nonnegative variable with several zero values.

- We then decided to use a non-parametric approach to analyze the importance of covariates in the three models: random forest regression.

Move from representative surveillance data to microdata for real-world YLD and YLL calculation

Applied to microdata, this allows not only to consider socio-economic variables, but also to use better evaluations of health state and sequelae, and update the individual applied burden every year. Emilia-Romagna experiment.

Fortuna *et al. Population Health Metrics* (2025) 23:42
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Population Health Metrics

RESEARCH Open Access

Patient-centred estimation of multimorbidity in chronic disease populations: a novel approach integrating global burden of disease metrics and healthcare administrative data

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Emilia-Romagna experiment

- Thirty major chronic diseases at the individual patient level
- YLDs, YLLs & DALYs
- A panel of medical specialists established the criteria for assigning the level of severity, and thus a specific DW, to each chronic disease
- The patient-centred YLD metric was estimated as the cumulative of the combined DWs over the previous ten years
- We also measured the Disability Weight Fraction of each coexisting disease (DWF)

Emilia-Romagna experiment

1 Identification of prevalent chronic disease cases from healthcare administrative databases.

2 Alignment of ICD9-CM codes of chronic diseases under study with GBD diagnostic categories.

3 Attribution of severity levels (mild, moderate, severe) to each year of disease and association with GBD DWs.

4 Computation of yld for patients with 1 chronic disease:
yld=ΣjDWij *[i = i-th disease, j = j-th year (from 1 to disease duration)]*

Disease *i*										
Year (*j*)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
yld=ΣjDWij	–	–	–	–	–	*DWij*	*DWij*	*DWij*	*DWij*	*DWij*

Example

Dementia										
Year (*j*)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
yld=ΣjDWij	–	–	–	–	–	***0·069***	***0·069***	***0·377***	***0·377***	***0·449***

yld = 0·069+0·069+0·377+ 0·377+ 0·449 = 1·341

5 Computation of yld for multimorbid patients:
yld=ΣjDW_combj *[j = j-th year (from 1 to last year of disease duration)]*

Disease 1										*DW1j*
Disease 2										*DW2j*
Disease *i*										*DWij*
Year (*j*)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
yld=ΣjDW_combj	–	–	–	–	–	–	–	*DW_combj*	*DW_combj*	*DW_combj**

**DW_combj = 1-(1-DW1j)*(1-DW2j)*(1-DWij)*

Example

Dementia								*0·069*	*0·069*	*0·069*
Heart failure									*0·072*	*0·179*
CKD										*0·104*
Year (*j*)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
yld = 0·954	–	–	–	–	–	–	–	***0·069***	***0·20***[1]	***0·685***[2]

yld = 0·069+0·20+0·685 = 0·954

[1]***DW_comb***$_{2021}$ *= 1-(1-0·069)*(1-0·072) =* ***0·20***

[2]***DW_comb***$_{2022}$ *= 1-(1-0·069)*(1-0·179)*(1-0·104) =* ***0·685***

dwfi = (ΣjDWij/ΣijDWij)

dwf$_{dementia}$ *= (0·069+0·069+0·069)/((0·069+0·069+0·069)+(0·072+0·179)+0·104) =* ***0·368 (36·8%)***

dwf$_{heart\ failure}$ *= (0·072+0·179)/((0·069+0·069+0·069)+(0·072+0·179)+0·104) =* ***0·446 (44·6%)***

dwf$_{CKD}$ *= 0·104/((0·069+0·069+0·069)+(0·072+0·179)+0·104) =* ***0·185 (18·5%)***

dwai = dwfi*yld

dwa$_{dementia}$ *= 0·368*0·954 =* ***0·351***

dwa$_{heart\ failure}$ *= 0·446*0·954 =* ***0·426***

dwa$_{CKD}$ *= 0·185*0·954 =* ***0·177***

6 Computation of yll due to premature death, based on age- and sex-specific life expectancy.

7 Computation of dalys:
dalys=yld+yll

Challenges

- Assuming self-reported diagnoses are ok.
- Assuming perceived health state is an objective measure
- Assuming that self-reported perceived health state can approximate severity if combined with self-reported diagnoses.
- How many conditions can we estimate?

- **Move from representative surveillance data to total YLD calculation.**

- **Applied to microdata, these allows not only to consider socio-economic variables, but also to use better socio-economic variables, and update the individual applied burden every year. Emilia-Romagna experiment.**

- Still, how many conditions can we estimate? Good for NCDs in aging population?
- In Italy, only at the Regional level we have the potential for this level of data linkage, and not all Regions have the capacity.