The Adjusted Morbidity Groups (GMA):
an exhaustive and severity-balanced tool for risk assessment

Damià Valero-Bover[1,2], Emili Vela[1,2], Montse Clèries[1,2], David Monterde[2,3], Gerard Carot-Sans[1,2], Isaac Cano[4,5,6], Jordi Piera-Jiménez[1,2], Pol Pérez Sust[1]

[1] Servei Català de la Salut, Barcelona, Spain. [2] Digitalization for the Sustainability of the Healthcare System (DS3), Sistema de Salut de Catalunya, Barcelona, Spain. [3] Institut Català de la Salut, Barcelona, Spain. [4] Hospital Clínic de Barcelona, Spain. [5] Institut d'Investigacions Biomèdiques Agust Pi i Sunyer (IDIBAPS), Spain. [6] Department of Medicine, University of Barcelona (UB), Spain

Background

The Adjusted Morbidity Groups (GMA) is a case-mix tool that considers all chronic diseases and recent acute diagnostic codes [1, 2]. It stratifies individuals into mutually exclusive health-risk groups. Additional outputs at the individual level:

- Number of chronic diseases
- Number of organ systems affected by a chronic disease
- Clinical summary label
- Multimorbidity index (i.e., a weighted measure of all diagnostics)

GMAs are used as a population-based tool for health-risk assessment and as an input measure for explaining relevant healthcare outcomes.

The tool has been validated in several published studies, which compare the GMA with other stratification tools and assess its predictive capacity of key health and resource use outcomes [3, 4, 5, 6].

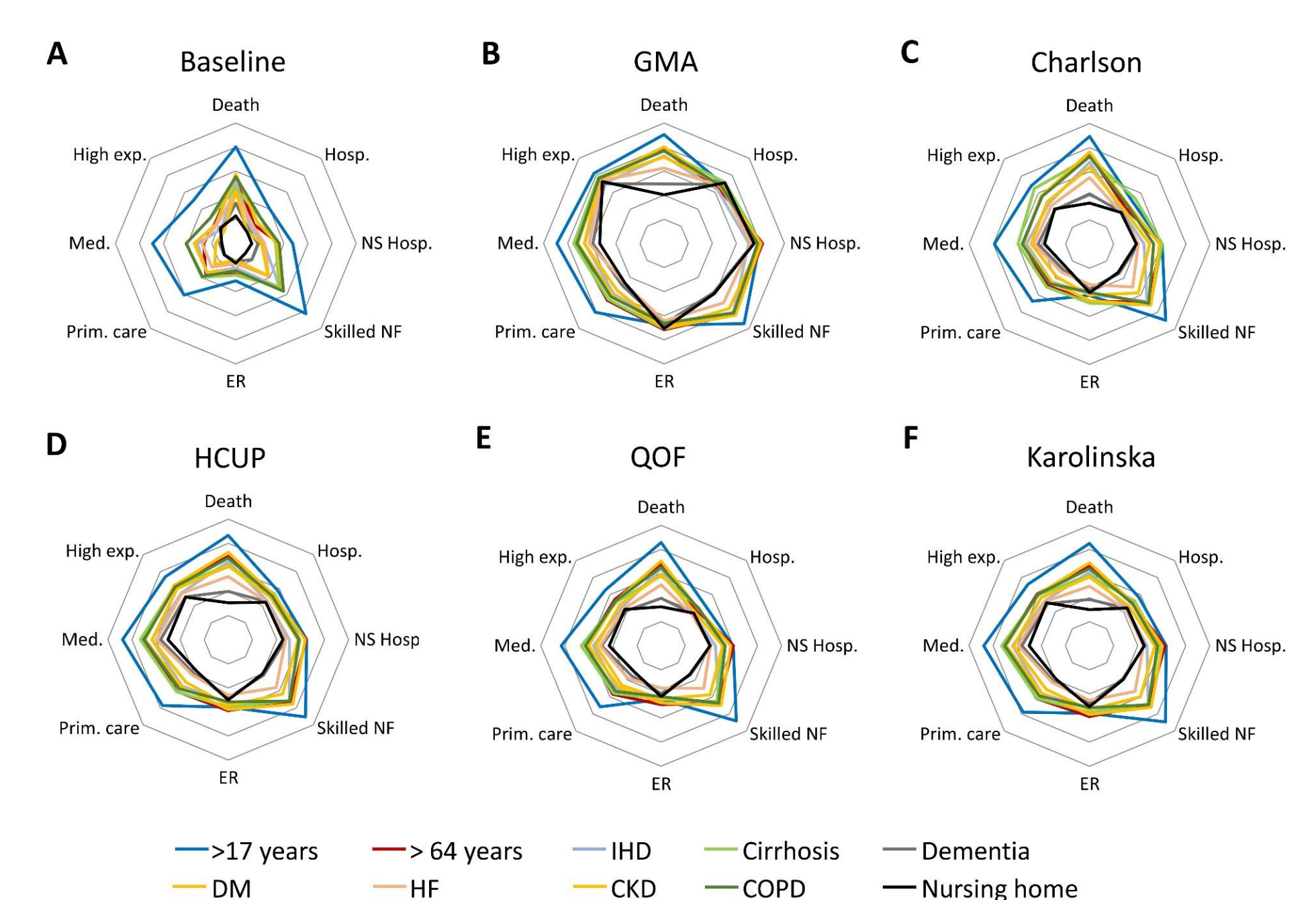## Performance of Multimorbidity Measures

Comparison of explanatory performance in predicting relevant healthcare outcomes.

Five measures of multimorbidity were added to a **baseline model** based on **age, gender, and socioeconomic status**:

- GMA
- Charlson index score
- HCUP
- QOF
- Karolinska

N = Adult population of Catalonia (6M).

The GMA index had higher performance and consistency across subpopulations than the rest of multimorbidity measures [6].

Figure 1: Radar plot of the performance (AUC-ROC) of each multimorbidity measure in explaining all-cause death associated with chronic conditions.
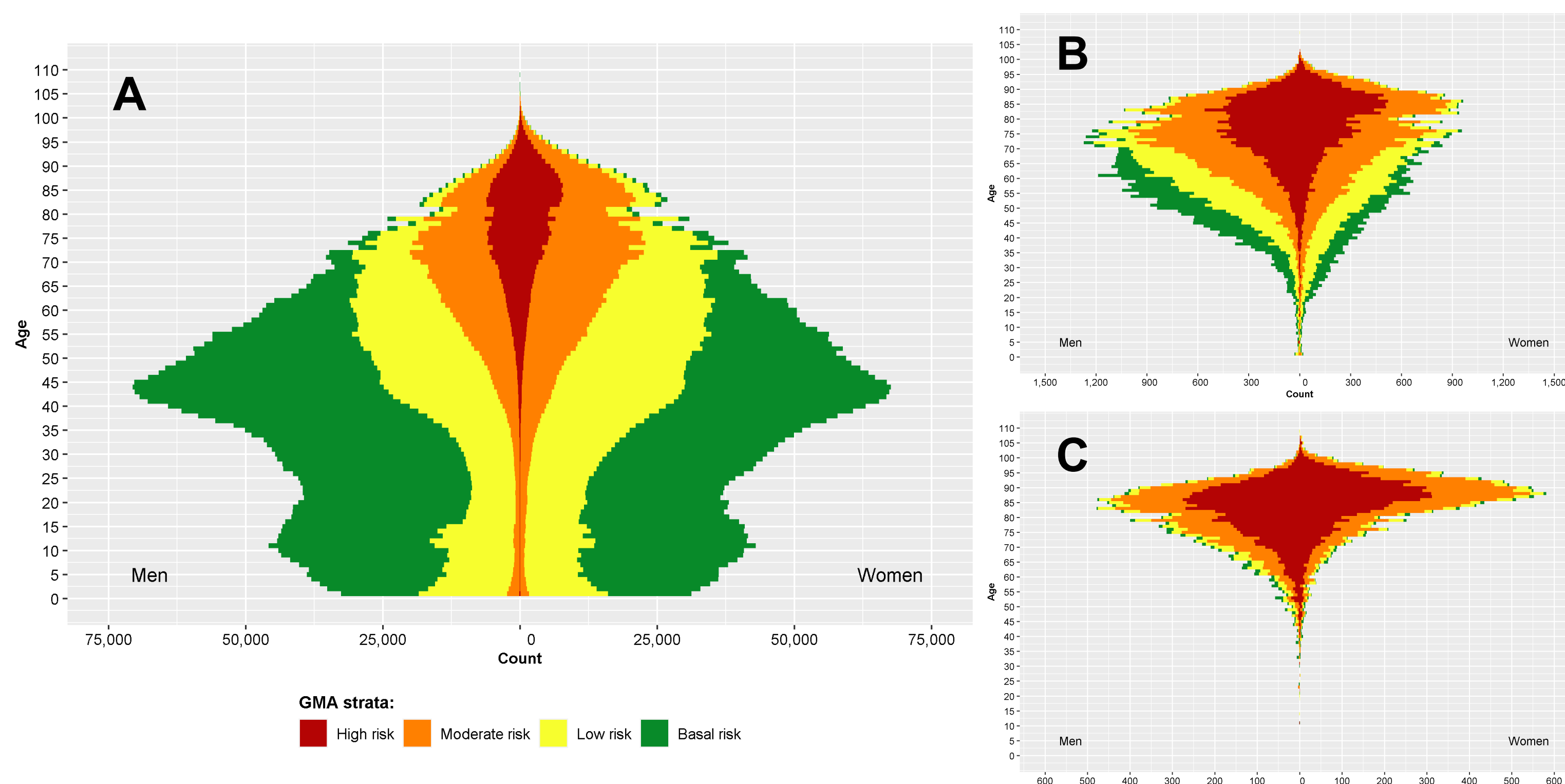
Stratification of the Catalan population

The GMA tool computes a numerical index that summarizes the patient's comorbidity burden and can be used to stratify the overall population into four health risk groups.

GMA risk groups, corresponding to the 50th, 80th and 95th percentiles of the distribution of the numerical index, correlate with relevant health and resource utilization outcomes:

Table 1: Distribution of health and resource outcomes by GMA risk groups

	%N	%Hospitalization	%Mortality	Primary Care visits	%Expenses
High risk	5	58.4	11.2	22.4	38.8
Moderate risk	15	6.6	1.1	12.6	32.2
Low risk	30	2.4	0.1	6.6	23.7
Basal risk	50	0.5	0.0	1.7	8.3
BASELINE	100	4.9	0.8	5.9	100

GMA health risk groups can be used as a predictor to identify subpopulations most at risk of dying or being hospitalized, in order to prevent their transmission of COVID-19. Most hospitalizations and deaths correspond to high and moderate GMA health risk groups.

Figure 2: Age- and gender-distribution across GMA risk groups. A: Reference population (i.e., Catalonia, 7,697,069 inhabitants). B: COVID-19 hospital admissions. C: COVID-19 deaths

Risk Model for COVID-19

The GMA stratification tool was tailored for grouping the general population into four mutually exclusive risk groups of poor outcomes in COVID-19 patients, based on 3 multivariate models: hospital admissions, transfer to intensive care unit (ICU), and mortality.

From the crossover of the 3 probabilities (hospitalization, ICU and death), we obtain 4 mutually exclusive risk strata.

$N_{MODELLING}$ = Population of Catalonia (7.5M).

$N_{VALIDATION}$ = PCR-confirmed after developing the model (~220K).
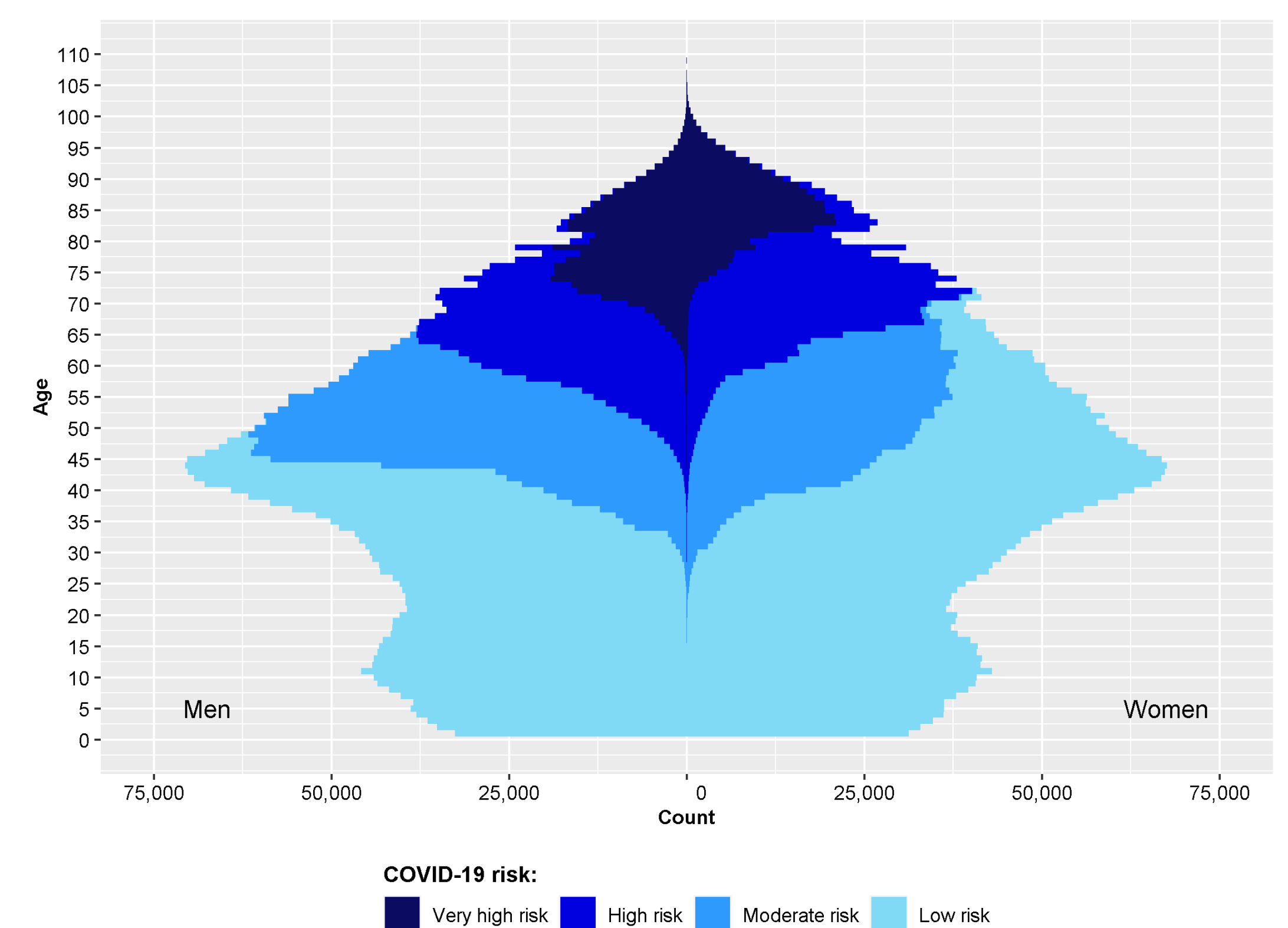
Figure 3: Age- and gender-distribution of the reference population (i.e., Catalonia, 7,697,069 inhabitants) across COVID-19 risk groups

The GMA-based risk tool for COVID-19 has high discrimination capacity for the three outcomes [7]:

- Hospital admissions: AUC-ROC = 0.85 (95% CI 0.85 – 0.85)
- ICU transfers: AUC-ROC = 0.86 (0.86 – 0.97)
- Mortality: AUC-ROC = 0.96 (0.96 – 0.96)

Age is not the only variable to consider: >400.000 people under 65 are at high risk for covid-19; 20% of the population between 45 and 64 years.

Discussion

- Clinical complexity does not only rely on age or individual diseases, but in their interaction. GMAs provide a weighted measure of complexity mainly used for risk stratification and prediction of healthcare outcomes.

- GMAs have proven to be a more effective predictive grouping tool than CRGs and ACGs [3, 4] in the Catalan health system, as well as outperforming other multimorbidity measures in explaining relevant health outcomes [6].

- As it is based on quantitative models, so can be easily transferred to other healthcare systems. In Spain, GMAs have been adopted in 13 regions, representing approximately 38M people. Transferability at European level is being considered within the EU Joint Action JADECARE (www.jadecare.eu)

References

[1] Monterde D, Vela E, Clèries M, Grupo colaborativo GMA. [Adjusted morbidity groups: A new multiple morbidity measurement of use in Primary Care]. Atención Primaria. 2016;48:674–82.

[2] Dueñas-Espín I, Vela E, Pauws S, Bescos C, Cano I, Cleries M, et al. Proposals for enhanced health risk assessment and stratification in an integrated care scenario. BMJ Open. 2016;6:e010301.

[3] Monterde D, Vela E, Clèries M, García Eroles L, Pérez Sust P. Validity of adjusted morbidity groups with respect to clinical risk groups in the field of primary care. Aten. Primaria. Elsevier Doyma; 2019;51:153–61.

[4] Monterde D, Vela E, Clèries M, Garcia-Eroles L, et al. Multimorbidity as a predictor of health service utilization in primary care: A registry-based study of the Catalan population. BMC Fam. Pract. BioMed Central Ltd.; 2020;21:39.

[5] Arias-López C, Rodrigo M, Casaña L, et al. Validación del poder predictivo de los grupos de morbilidad ajustada (GMA) respecto de otras herramientas de estratificación de la población, Rev Española de Salud Pública; 2020;94

[6] Vela E, Clèries M, Monterde D, Carot-Sans G, Coca M, et al. Performance of Quantitative Measures of Multimorbidity: A Population-Based Retrospective Analysis, BMC Public Health (In press, accepted); 2021

[7] Vela E, Carot-Sans G, Clèries M, Monterde D, Acebes X, Comella A, et al. Development and performance of a population-based risk stratification model for COVID-19. May 2021, MedRxiv (preprint)

Generalitat de Catalunya

Contact
damia.valero@catsalut.cat

/Salut