Modelli clinici predittivi per demenza basati sull'intelligenza artificiale: una revisione sistematica

Giorgia Durante

Psicologa dell'Area Neuropsicologica

U.O.C. Geriatria Dolo

Azienda ULSS3 Serenissima, Venezia

CONFLICT OF INTEREST DISCLOSURE

Nothing to declare.

The project has funded by the European Union - Next Generation EU _NRRP M6C2 - Investment 2.1 Enhancement and strengthening of biomedical research in the NHS, under the project identification number PNRR-MCNT1-2023-12378321CUP I73C23000440006.

BACKGROUND

- Progressive global population aging

As result: ↑ **prevalence of dementia**

- **135 million** dementia cases expected by **2050.**

- New case of dementia **every 3 seconds**
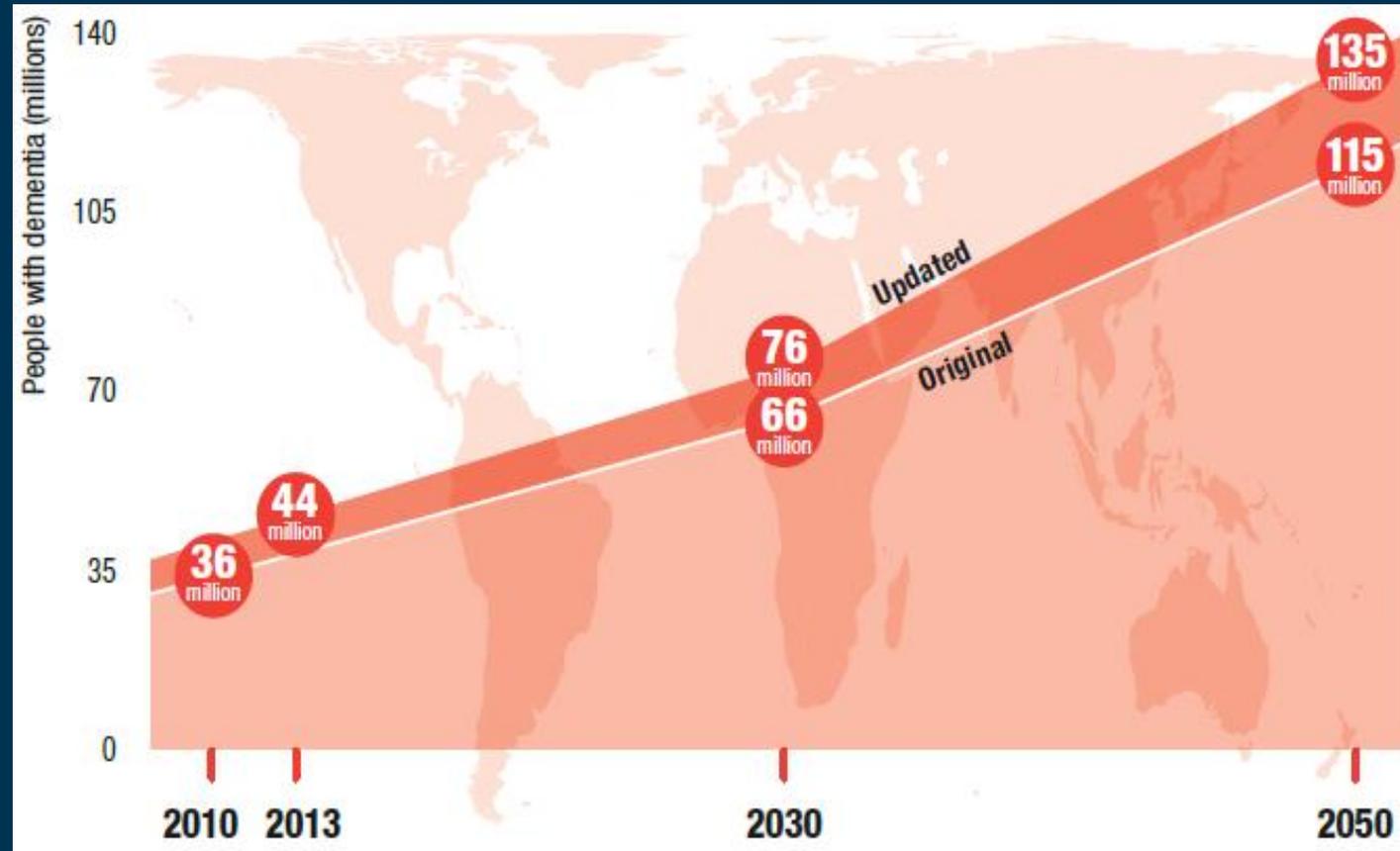
Alzheimer's Disease International. (2013). Policy brief for heads of government: The global impact of dementia 2013–2050

BACKGROUND

- ½ cases of dementia could be **prevented.**

- **Early risk prediction** of dementia is crucial for prevention and clinical care.

- **AI-driven prediction models** may improve diagnostic and prognostic accuracy.
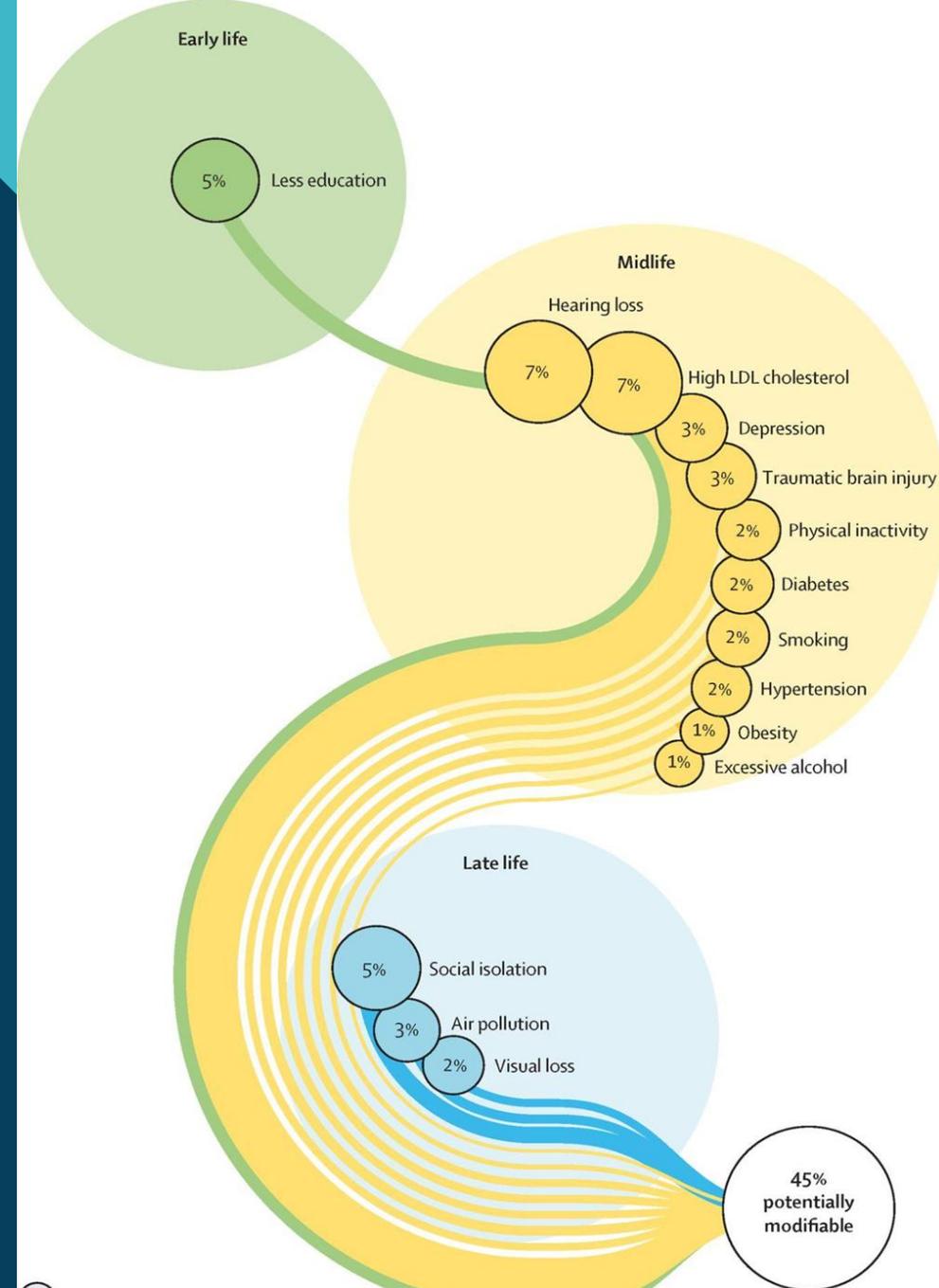
Livingston et al. (2024). *The Lancet, 404*(10452), 572-628

AIM

Systematic review of AI-based prediction models for dementia

Focus on:

- *Performance*
- *Risk of bias*
- *Clinical applicability*

METHODS

Selection Criteria

INCLUSION CRITERIA

- English-language, peer-reviewed articles.
- Validated diagnostic criteria/scales with cut-off.

Prediction models that:

- Report estimate of classification-based predictive performance using AI models.
- Must be composite and include at least one clinical factor and an AI tool.

EXCLUSION CRITERIA

- Abstracts, reviews, meta-analyses, studies with models with a single risk predictor, inappropriate statistical methods.
- Prediction models with only one factor.
- Prediction models using mixed approaches.

METHODS
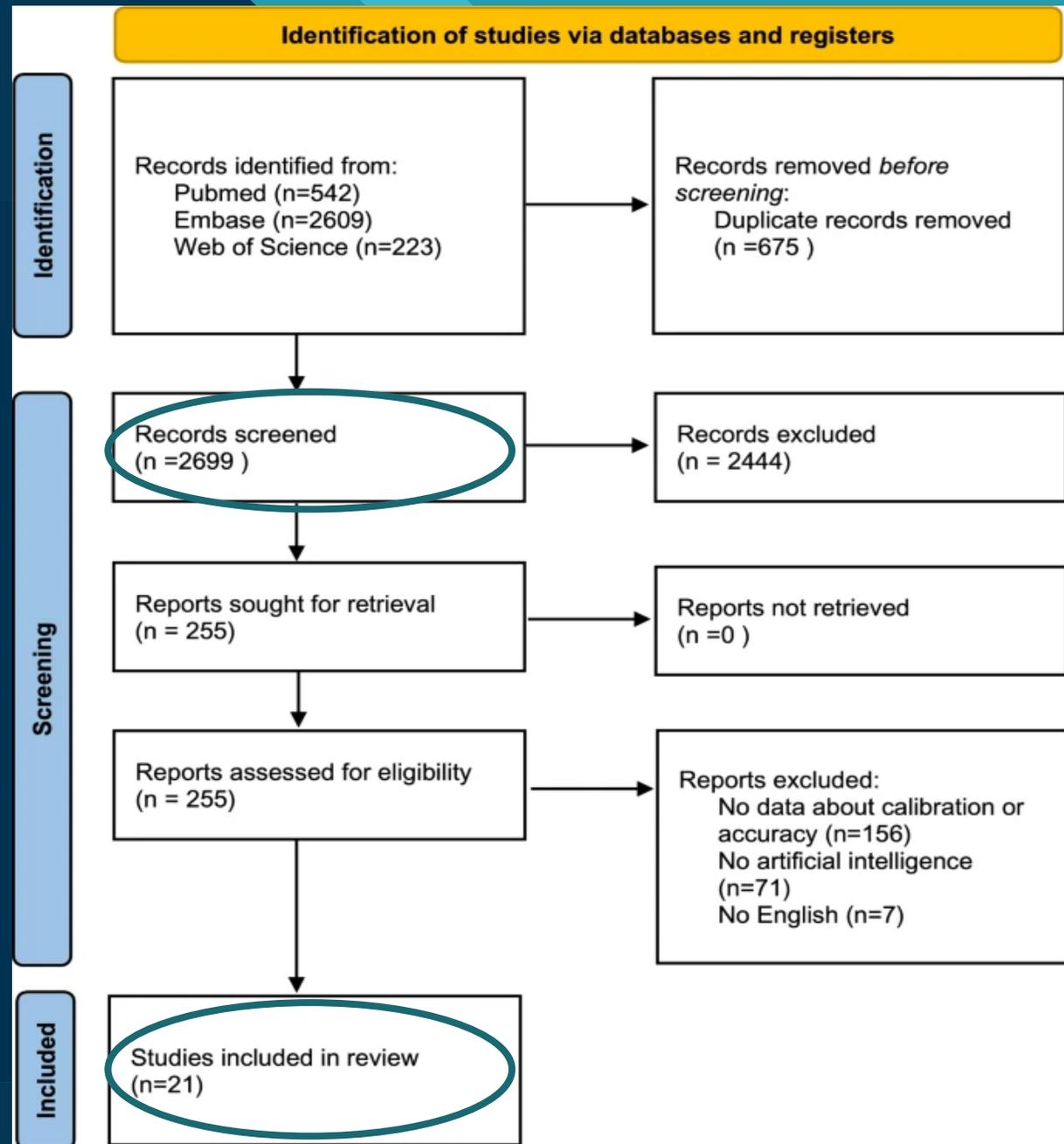
Evaluation of prediction models

      1. Bias and overfitting (sample sizes and predictor selection)

      2. Generalizability

      3. Clinical utility in real-world settings

      Quality assessment: PROBAST

RESULTS

IDENTIFICATION OF STUDIES

Identification of studies via databases and registers

Identification

Records identified from:
Pubmed (n=542)
Embase (n=2609)
Web of Science (n=223)

Records removed *before screening*:
Duplicate records removed (n =675)

Screening

Records screened (n =2699)

Records excluded (n = 2444)

Reports sought for retrieval (n = 255)

Reports not retrieved (n =0)

Reports assessed for eligibility (n = 255)

Reports excluded:
No data about calibration or accuracy (n=156)
No artificial intelligence (n=71)
No English (n=7)

Included

Studies included in review (n=21)

RESULTS

Clinical data:
All studies

Genetic markers:
~50% of studies

Imaging:
- MRI/CT (12 studies)
- PET (4 studies)

Biomarkers:
- CSF (7 studies)
- Blood (5 studies)

	Clinical	Genetics	Cognitive	Structural imaging	Functional imaging	CSF	Blood markers
Blanton 2014	yes	no	yes	no	no	no	no
Buegler 2020	yes	no	yes	yes	no	yes	no
Chun 2022	yes	yes	yes	no	no	no	no
Grassi 2019	yes	no	yes	no	no	no	no
Jahan, 2023	yes	yes	yes	yes	no	yes	no
Jia et al., 2023	yes	no	yes	no	no	no	yes
Kruczyk, 2012	yes	yes	yes	yes	yes	yes	yes
Kuang, 2021	yes	no	yes	no	no	yes	no
Lee, 2024	yes	no	yes	yes	no	no	no
Luo et al., 2024	yes	no	yes	yes	no	no	yes
Mallo 2020	yes	no	no	no	no	no	no
Pena 2021	yes	yes	yes	yes	no	yes	no
Reinke et al., 2023	yes	yes	yes	yes	yes	yes	no
Soo-Jin Lim, 2021	yes	no	yes	no	no	no	no
Sunyang 2021	yes	yes	yes	yes	yes	yes	yes
Tan, 2024	yes	yes	yes	yes	no	no	no
Valsdóttir, 2023	yes	yes	yes	yes	no	no	no
Wang 2022	yes	yes	yes	yes	no	no	no
Wang et al., 2024	yes	yes	yes	yes	yes	no	yes
Yue, 2023	yes	no	no	no	no	no	no
Zhou, 2024	yes	no	no	no	no	no	no

RESULTS

- Mean **variables**: 50 (range: 5 - 300 parameters)
- Average **AUC = 0.845** (good accuracy)
  - ➤ 8 studies AUC > 0.90 (*excellent*)
  - ➤ 7 studies AUC 0.80 – 0.90 (*good*)
  - ➤ 5 studies < 0.80 (*moderate-fair*)

- **Calibration** and **internal validation**
- **External validation**: frequently missing (only 5 studies)

DISCUSSION
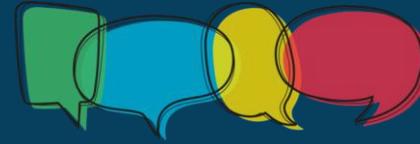
💡 <u>OPPORTUNITIES</u>

✓ **Early identification** of high-risk individuals.

✓ **Timely interventions** and personalized care.

✓ Efficient healthcare **resources allocation.**

DISCUSSION

⚠️ LIMITATIONS

- **Data representativeness.**

- Lack of **external validation** and **overfitting risk.**

- **Interpretability** ("black boxes").

- **Scope** (limited evidence for LBD, vascular, FTD).

- **Practical and ethical issues.**

TAKE HOME MESSAGES

→ **Great potential** of AI-enhanced clinical prediction models for dementia

BUT

- Not yet ready for **routine clinical practice**

- **Lack of** transparency

- Careful consideration of **feasibility** in different healthcare contexts

The future: *validated, explainable, ethical AI*

ACKNOWLEDGEMENTS

RESEARCH TEAM

Thank you for your attention

Check for updates

Clinical prediction models using artificial intelligence approaches in dementia

Nicola Veronese[1,2,3] · Francesco Bolzetta[4] · Livia Gallo[4] · Giorgia Durante[4] · Laura Vernuccio[2] · Carlo Saccaro[1] · Caterina Maria Gambino[2] · Carlo Custodero[5] · Piero Portincasa[5] · Andrea Morotti[6,7] · Alice Galli[6,8] · Chiara Trasciatti[6,8] · Alessandro Padovani[6,7,8,9] · Andrea Pilotto[6,7,8,10] · Mario Barbagallo[1,2]

Scan for full article