Subtyping older adults starting long-term care using the nationally standardized survey for care-needs certification in Japan

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Acknowledgements

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Introduction

- Older adults requiring long-term care (LTC) are increasing worldwide.[1]
- They have coexisting diseases and disabilities.[2]
- Identifying subgroups and their prognoses can help developing more tailored care plans.
- No established classification exists for older adults requiring LTC.

Aim

1) Identify distinct subgroups using unsupervised machine learning
2) Examine differences in prognosis by the subgroups

1) GBD 2019 Ageing Collaborators. BMJ. 2022. 2) Ito Y et al., *Sci Rep*. 2024.

Methods

- **Study Design:** Retrospective cohort study.
- **Data source:** Survey data for care-need certification (linked to LTC and medical insurance claims data)
- **Participants:** Community-dwelling adults aged ≥65 years who received the survey and started LTC in a Japanese city, between October 2014 and March 2019.
  (Population of 240,383, with 19.4% of people aged ≥ 65)

Japan established long-term care system in 2000

Japan: Universal Health Care at 50 years 4

Population ageing and wellbeing: lessons from Japan's long-term care insurance policy

Nanako Tamiya, Haruko Noguchi*, Akihiro Nishi, Michael R Reich, Naoki Ikegami, Hideki Hashimoto, Kenji Shibuya, Ichiro Kawachi, John Creighton Campbell*

Japan's population is ageing rapidly because of long life expectancy and a low birth rate, while traditional supports for elderly people are eroding. In response, the Japanese Government initiated mandatory public long-term care insurance (LTCI) in 2000, to help older people to lead more independent lives and to relieve the burdens of family carers. LTCI operates on social insurance principles, with benefits provided irrespective of income or family situation; it is unusually generous in terms of both coverage and benefits. Only services are provided, not cash allowances, and recipients can choose their services and providers. Analysis of national survey data before and after the programme started shows increased use of formal care at lower cost to households, with mixed results for the wellbeing of carers. Challenges to the success of the system include dissatisfaction with home-based care, provision of necessary support for family carers, and fiscal sustainability. Japan's strategy for long-term care could offer lessons for other nations.

Lancet 2011; 378: 1183–92

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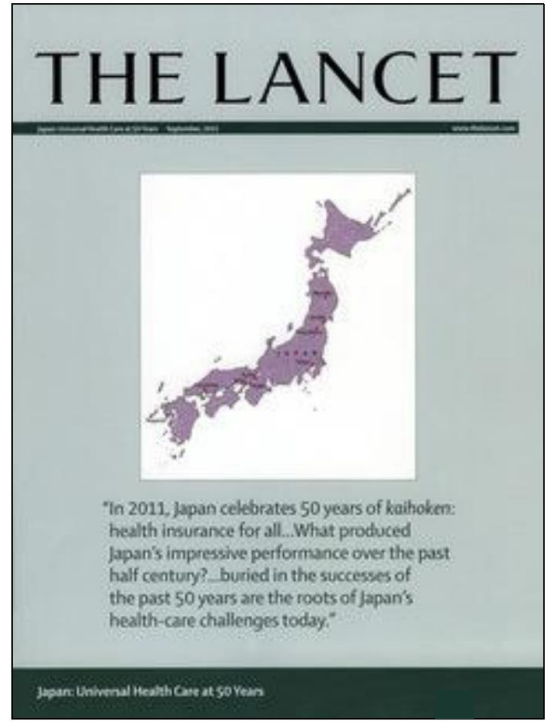
See Comment *Lancet* 2011; **378:** 1051

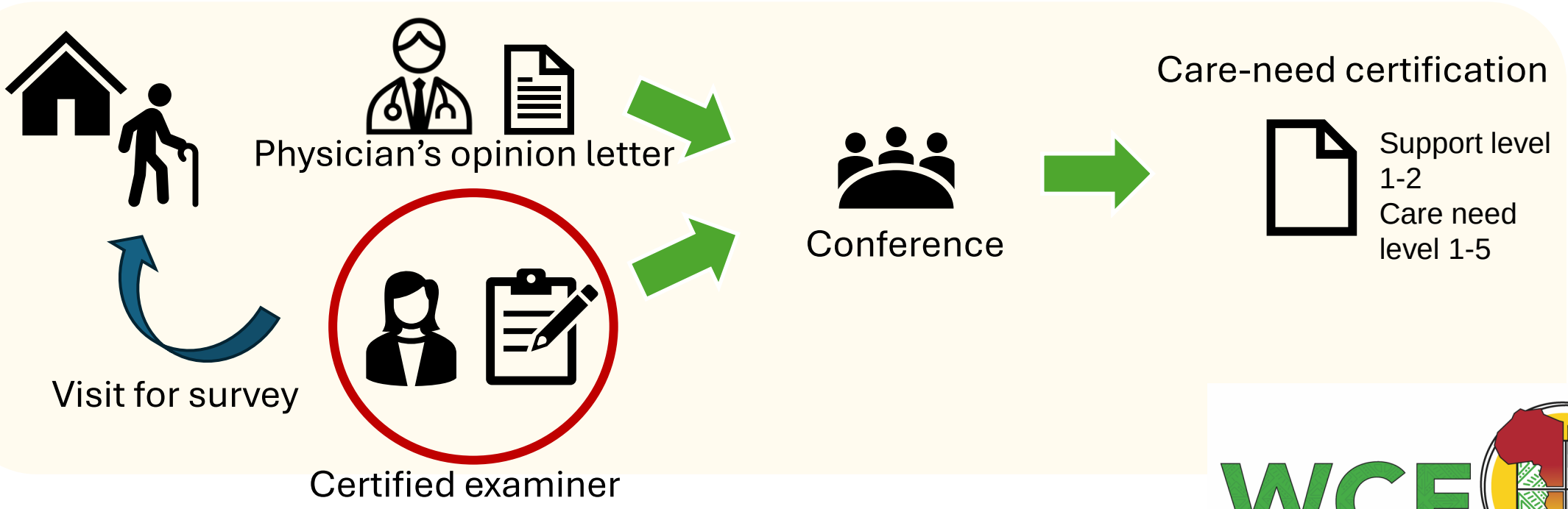
See Series *Lancet* 2011; **378:** 1094 and 1106



Methods

- **Data source:** Survey data for care-need certification (linked to LTC and medical insurance claims data)

Flow of care-need certification in Japan



Methods:
74 items of Survey data for care-need certification

Dimensions	Example of the items
1. Physical function (38 items)	
Body function / Bed mobility (20)	paralysis, walking, standing up
Daily life function [ADL] (12)	moving, eating, dressing
Instrumental activities of daily living function [IADL] (6)	Daily decision making, shopping, cooking
2. Cognitive function (9 items)	understand daily routine, short-term memory, being lost
3. Behavioral problems (15 items)	making up a story, reversal of day and night, resisting advice or care
4. Medical procedures (12 items)	intravenous infusion, oxygen therapy, tube feeding

Methods

- **Statistical analysis**:

1. Subtyping: latent class analysis
2. Longitudinal analysis: multivariable regression models

Methods: Latent class analysis

- **Modeling**
  - Starting with a two-cluster model and increasing the number of clusters until the model's smallest subtype size was < 5% of the study population
- **Determination of the optimal number of subtypes**
  - Bayesian Information Criterion (BIC), Akaike's Information Criterion (AIC) (smaller values of those indicate better model fit)
  - Elbow method (plot a fit statistic and identify where the fit visually changes)
- **Classification accuracy**
  - Assessing based on the average posterior probability of subtype membership with 0.8 suggesting clear classification (calculated as the mean of the members' posterior probabilities)
- **Measures for naming**
  - Observed/expected (O/E) ratios ≥ 2 and exclusivity ≥ 25%

Methods

- **Statistical analysis**:

1. Subtyping: latent class analysis
2. Longitudinal analysis:

Outcomes	Multivariable regression models
1) Death	Cox regression
2) Hospitalization	Competing-risk Cox regression
3) Nursing home admission	Competing-risk Cox regression
4) Care-need level deterioration	Logistic regression

Results: Flow chart

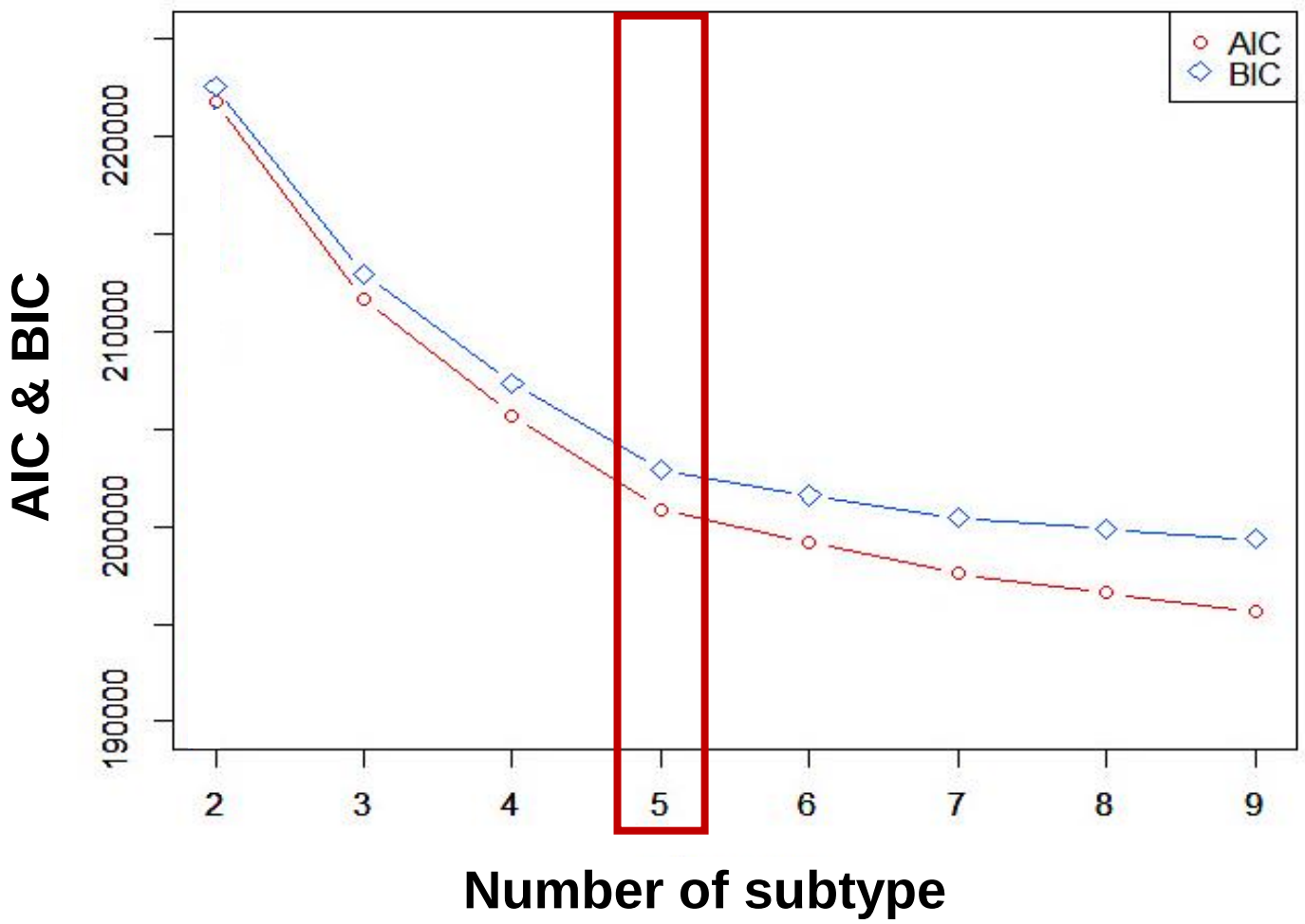
People aged ≥65 years who who received the care-need certification survey and started long-term care in a Japanese city between October 2014 and March 2019 (n=4,480)

long-term care or medical insurance claims data could not be matched (n=639)

Study population (**n= 3,841**)

- Age years, median (IQR): 83 (77-87)
- Sex, female: 2278 (59.3%)

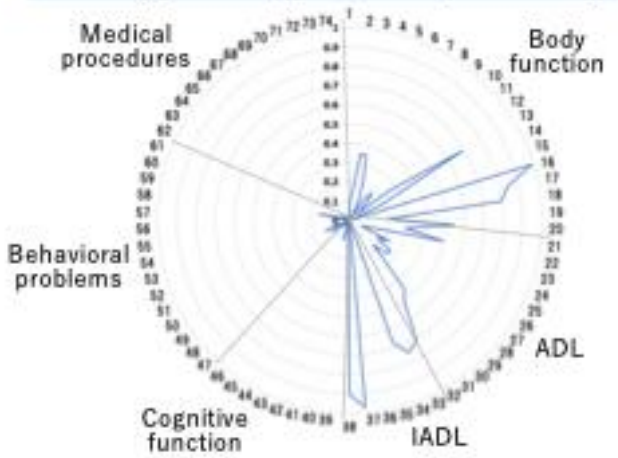
Results: The optimal number of subtypes



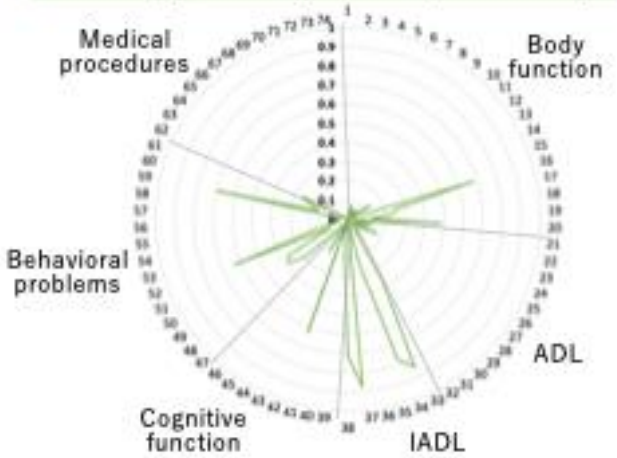
AIC: Akaike's Information Criterion, BIC: Bayesian Information Criterion

Results: Subgroups of participants

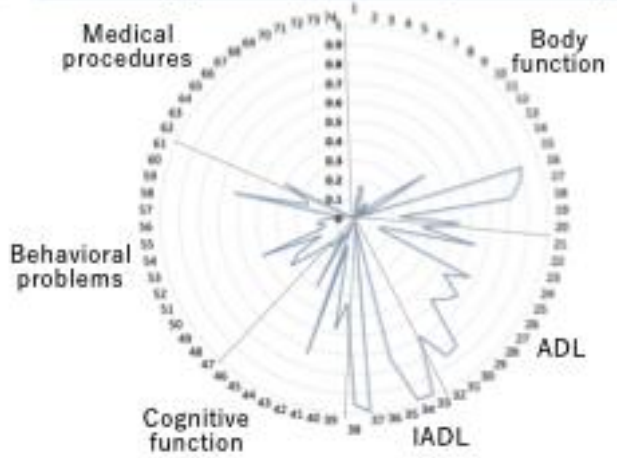
Subtype 1: (n=1258; 32.8%)



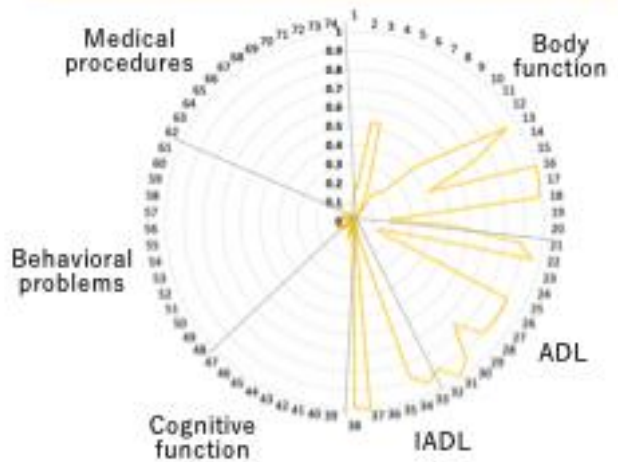
Subtype 2: (n=946; 24.6%)



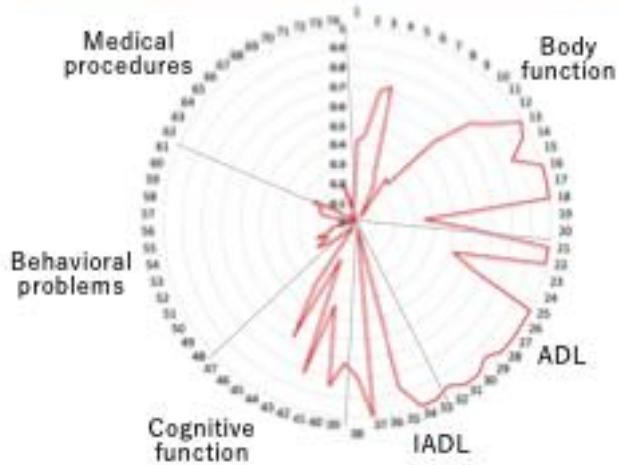
Subtype 3: (n=597; 15.5%)



Subtype 4: (n=1037; 23.2%)

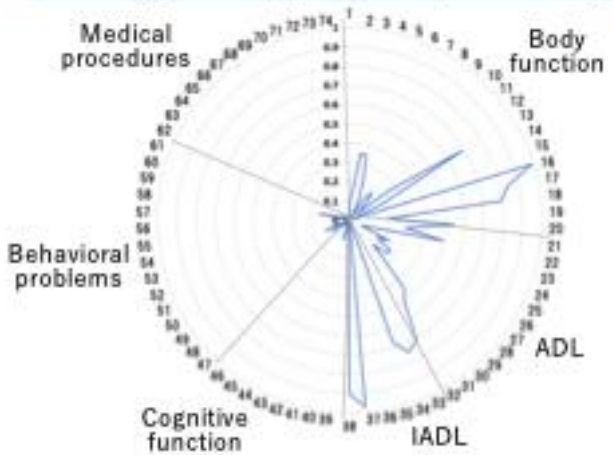


Subtype 5: (n=934; 20.9%)

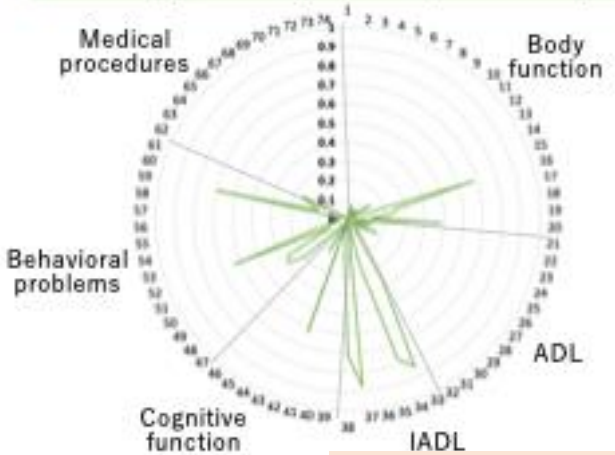


Results: Subgroups of participants

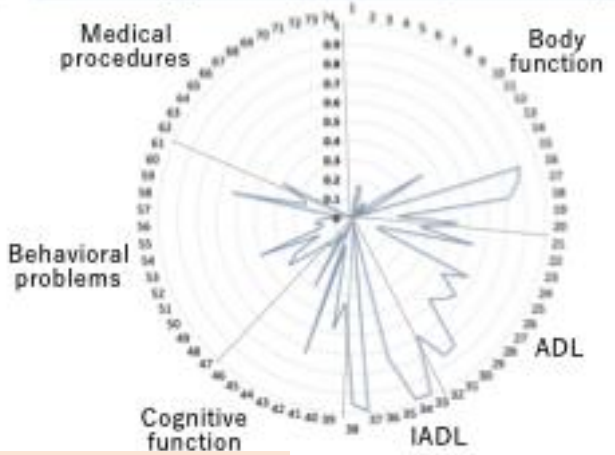
mild physical
Subtype 1: (n=1258; 32.8%)



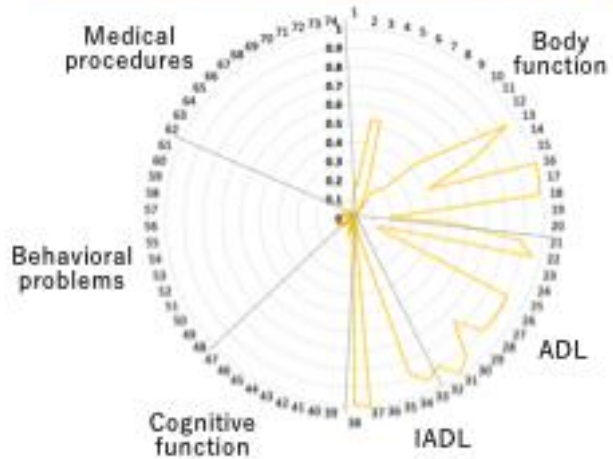
behavioral
Subtype 2: (n=946; 24.6%)



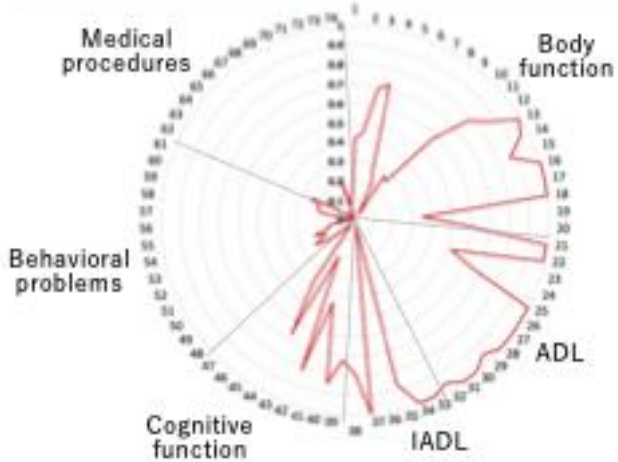
cognitive
Subtype 3: (n=597; 15.5%)



moderate physical
Subtype 4: (n=1037; 23.2%)



multicomponent
Subtype 5: (n=934; 20.9%)



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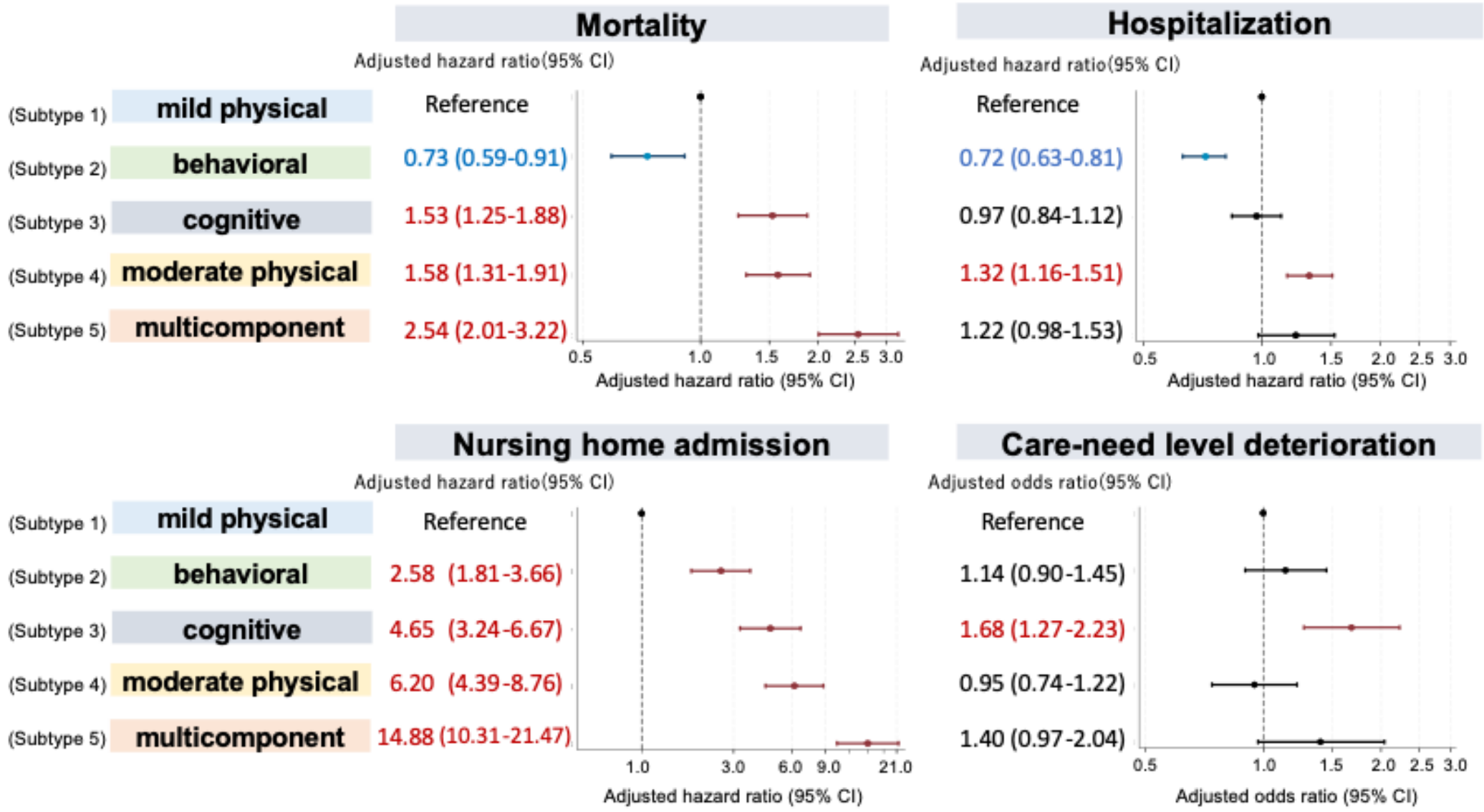
Results: Baseline characteristics

	mild physical (n=1258; 32.8%)	behavioral (n=946; 24.6%)	cognitive (n=597; 15.5%)	moderate physical (n=767; 20.0%)	multi-component (n=273; 7.1%)	Overall (n=3841)
Age years, median (IQR)	82 (76-87)	83 (78-87)	83 (77-88)	83 (77-88)	83 (78-88)	83 (77-87)
Sex, female	752 (59.8)	625 (66.1)	325 (54.4)	424 (55.3)	152 (55.7)	2278 (59.3)
Care need level						
1 (least disabled)	846 (67.2)	821 (86.8)	103 (17.3)	28 (3.7)	0 (0.0)	1798 (46.8)
2	383 (30.4)	123 (13.0)	298 (49.9)	185 (24.1)	41 (1.5)	993 (25.9)
3	25 (2.0)	20 (0.2)	160 (26.8)	284 (37.0)	29 (10.6)	500 (13.0)
4	40 (0.3)	0 (0.0)	34 (5.7)	235 (30.6)	131 (48.0)	404 (10.5)
5 (most disabled)	0 (0.0)	0 (0.0)	20 (0.3)	35 (4.6)	109 (39.9)	146 (3.8)

Results: Association between subtypes and outcomes



Discussion: Summary of the results

Outcomes	mild physical (n=1258; 32.8%)	behavioral (n=946; 24.6%)	cognitive (n=597; 15.5%)	moderate physical (n=767; 20.0%)	multi-component (n=273; 7.1%)
1) Death	Ref.	Low risk	High risk	High risk	High risk
2) Hospitalization	Ref.	Low risk	n.s.	High risk	n.s.
3) Nursing home admission	Ref.	High risk	High risk	High risk	High risk
4) Care-need level deterioration	Ref.	n.s.	High risk	n.s.	n.s.

Discussion

- Higher risk in deterioration of care-need levels and death in the cognitive subtype:
  - those with intermediate cognitive impairment were more likely to feel uncomfortable asking doctor questions and to avoid doctors owing to embarrassment.[3]
  - For Cognitive subtype, timely detection and appropriate management may be delayed.

3) Lovett RM et al., J Appl Gerontol. 2023

Limitations

- External validity should be critically evaluated
- Naming of each class could be subjective

Conclusion

- We identified **five subtypes** of older adults who started LTC, with varying prognoses.
- Findings may **inform individualized care decisions** and **tailored planning** of medical and long-term care services.