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Longitudinal clustering of health behaviours and their association with multimorbidity in older adults in England: A latent class analysis

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Why multimorbidity matters

Prevalence

Approximately 29.5-40.5% of adults in primary care have multimorbidity in the UK [1]

Costly

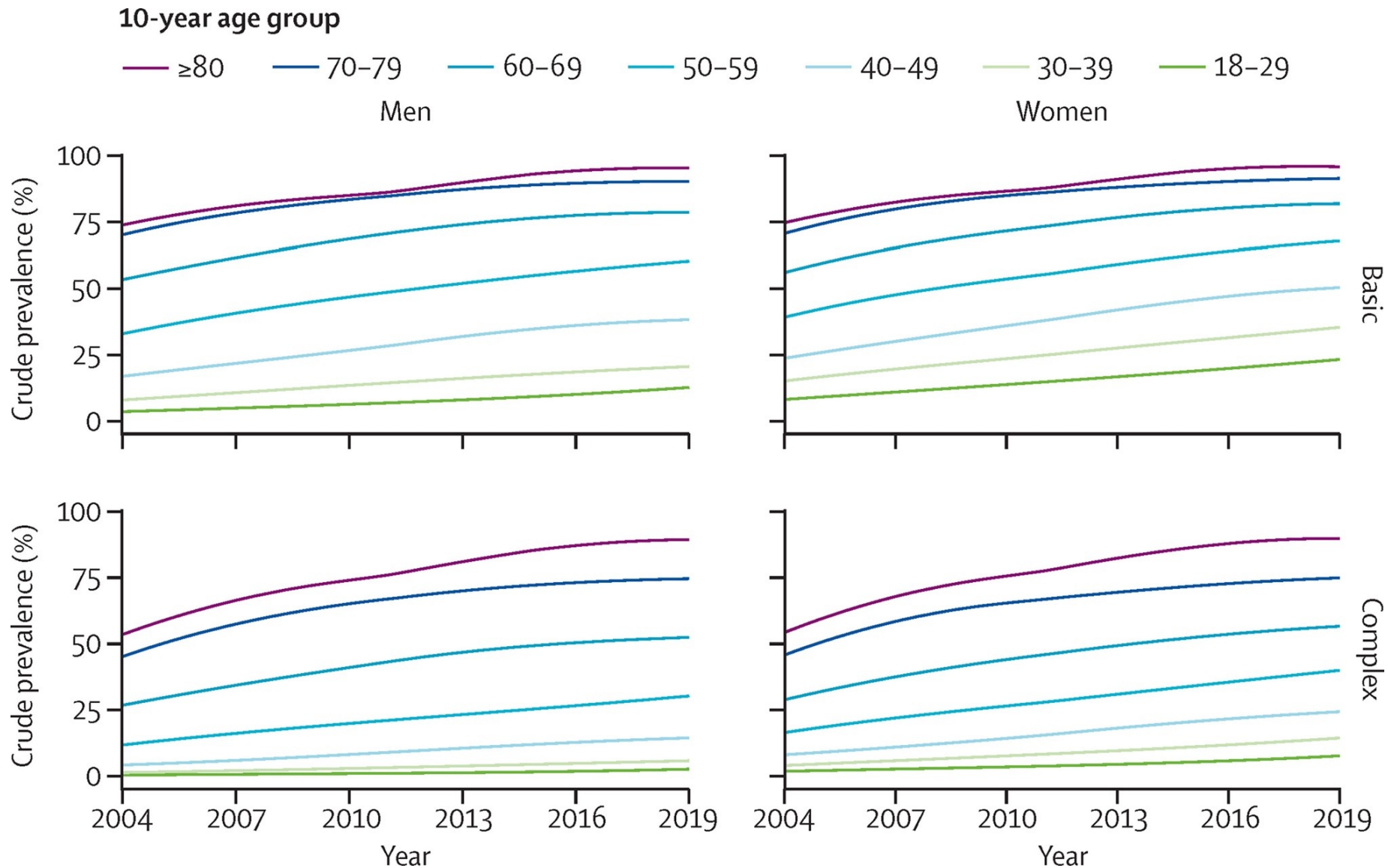
Healthcare use among individuals with multimorbidity is 2.56 times higher than people without multimorbidity [2]

Inequitable

Occurs 10–15 years earlier in people living in deprived areas compared to affluent areas [3]

Complex

Involves multiple medical specialties and tiers of care; overlaps with frailty and polypharmacy



[4] Head, A., Fleming, K., Kypridemos, C., Schofield, P., Pearson-Stuttard, J., & O'Flaherty, M. (2021). Inequalities in incident and prevalent multimorbidity in England, 2004–19: a population-based, descriptive study. *The Lancet Healthy Longevity*, *2*(8), e489-e497.

Key risk factors

Biological factors

- **Age**
- **Genetic factors**
- **Existing conditions**
- **Metabolic factors**

Sociodemographic factors

- **Relative deprivation**

Health risk behaviours

- **Smoking**
- **Poor Nutrition**
- **Alcohol consumption**
- **Physical inactivity**

SNAP risk behaviours

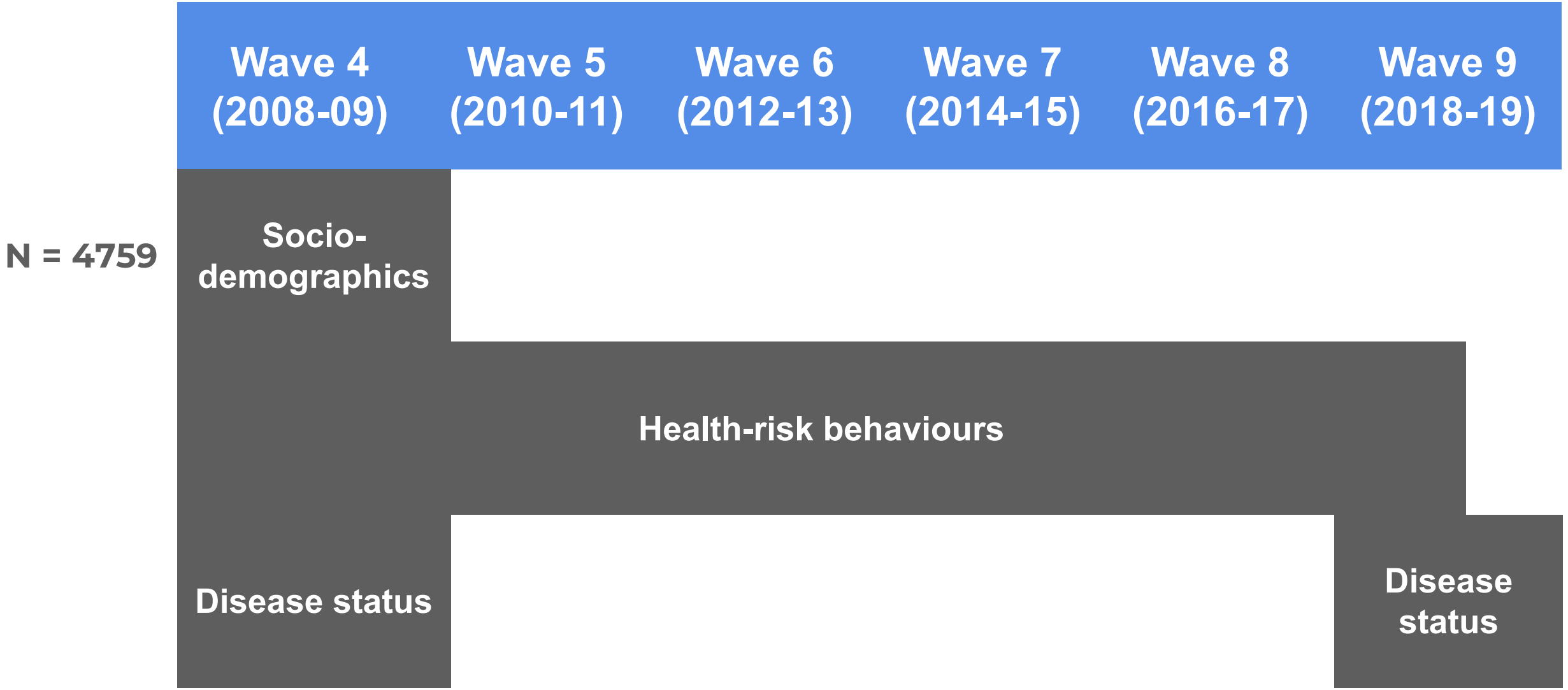
- Risk behaviours evolve over time
- Risk behaviours tend to cluster
- Their health effects tend to compound

But...

- Epidemiological studies use lifestyle indices to measure risk behaviours or examine specific combinations.
- Clusters have mostly been studied in younger age groups and using cross-sectional data
- Limited research between risk behaviour clusters and multimorbidity

How do health-risk behaviours cluster over time in older adults and how are these clusters associated with multimorbidity?

English Longitudinal Study of Ageing (ELSA)

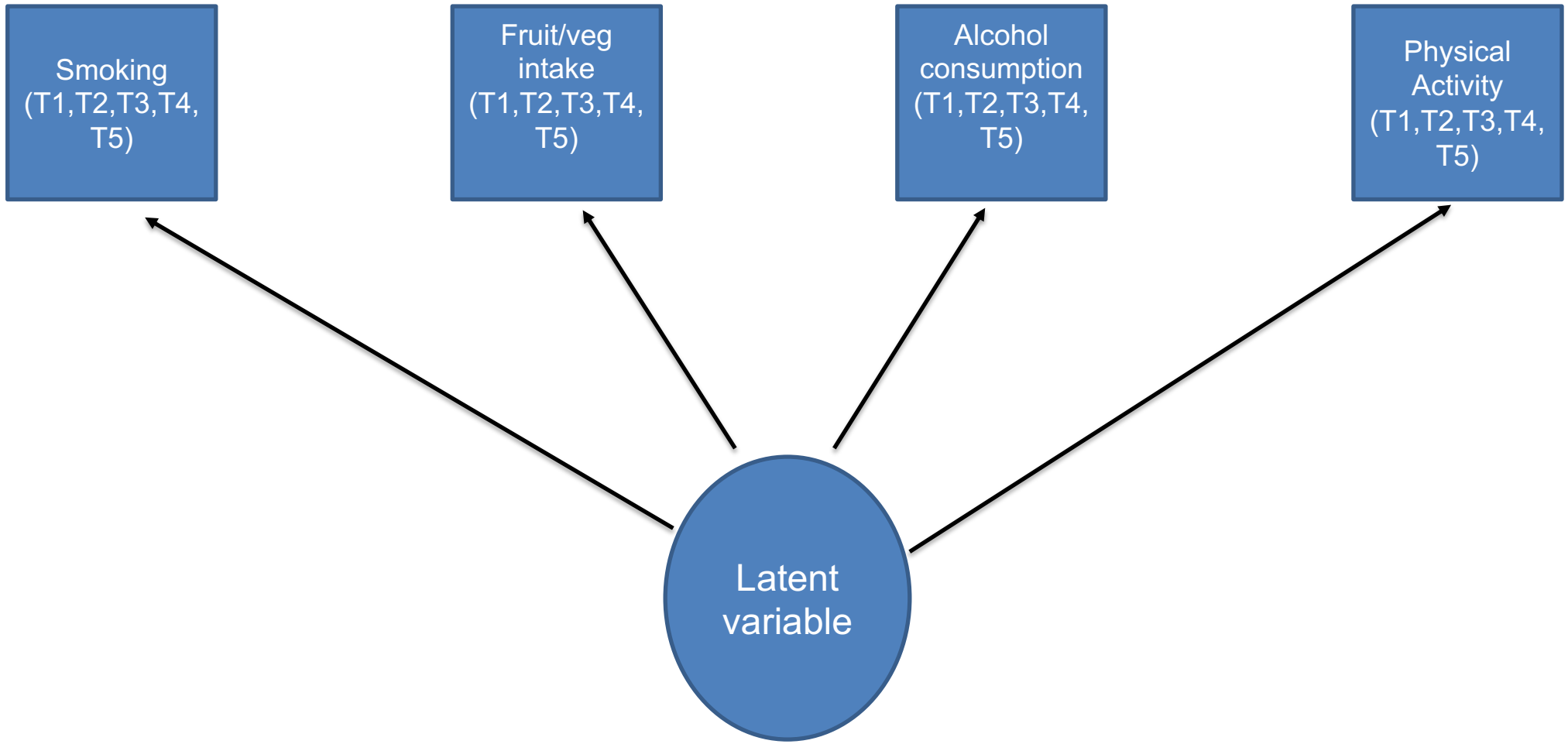


Objective 1 How do **SNAP behaviours (i.e. smoking, poor nutrition, alcohol consumption and physical inactivity)** cluster over time in older adults?

Objective 2 How does membership in different behavioural clusters vary by **socio-demographic characteristics**?

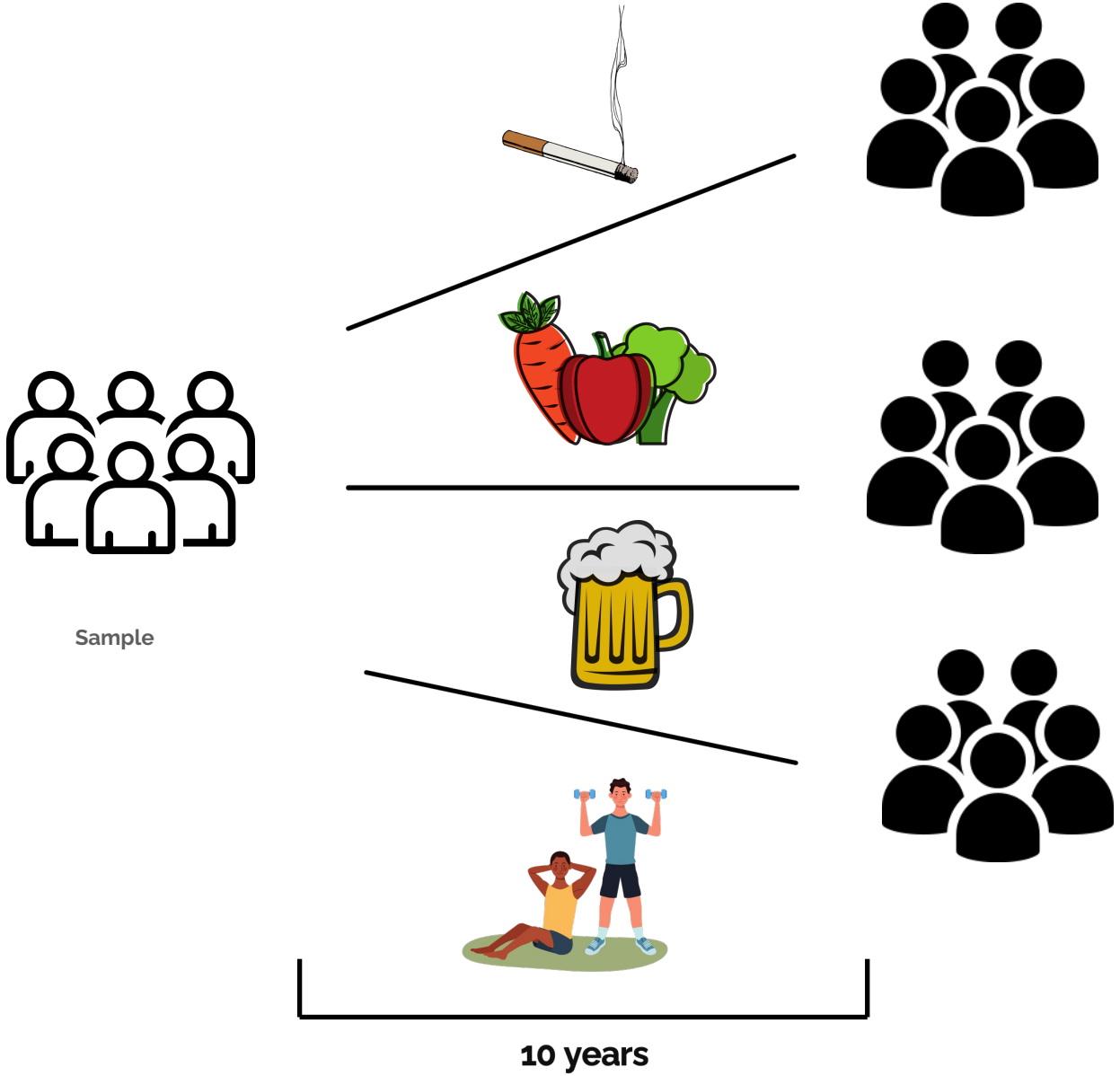
Objective 3 Which, if any, behavioural clusters are prospectively associated with **multimorbidity**

Identify clusters - using RMLCA*

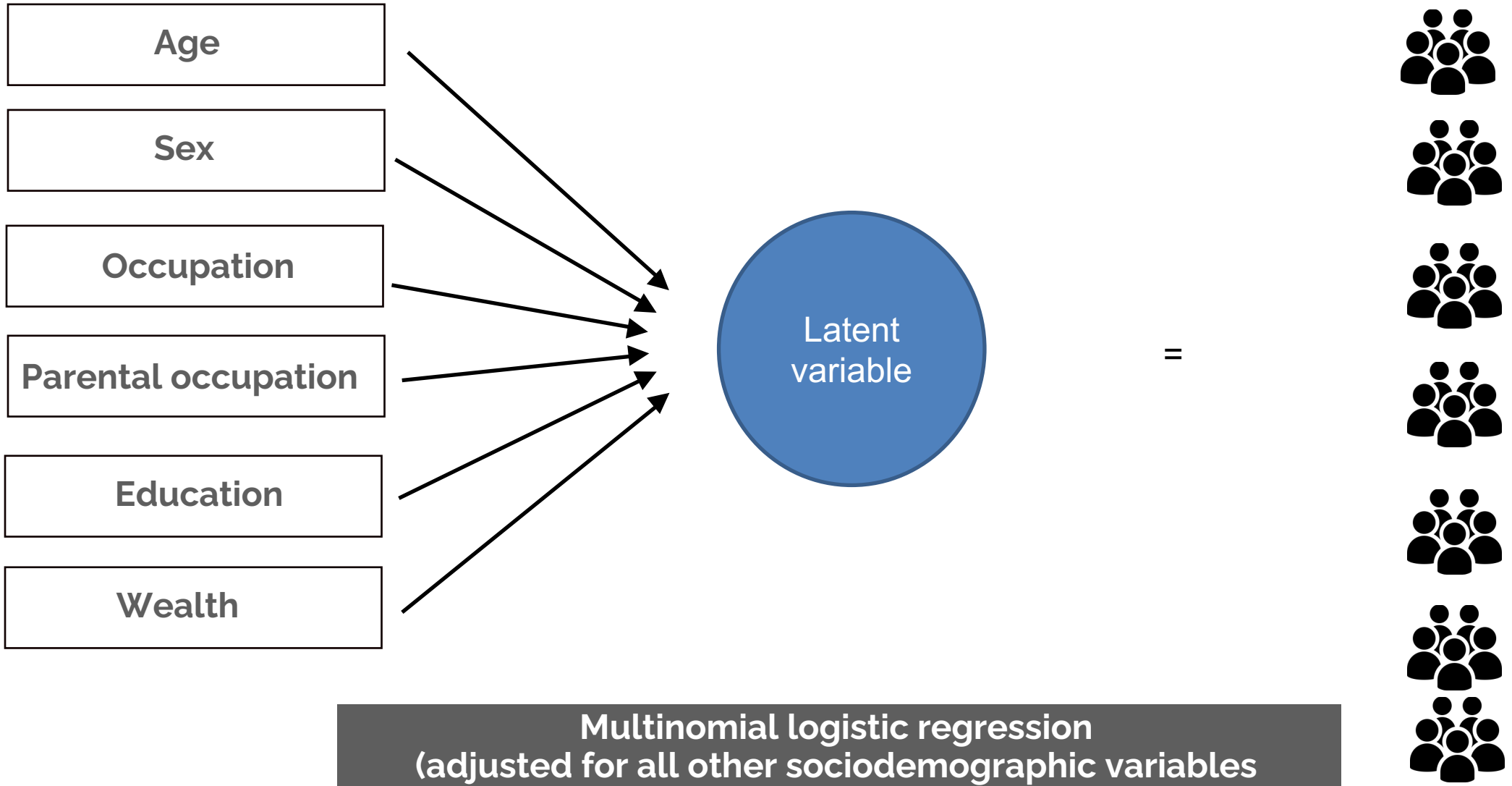


***Repeated Measures Latent Class Analysis**

Identify clusters - using latent class analysis

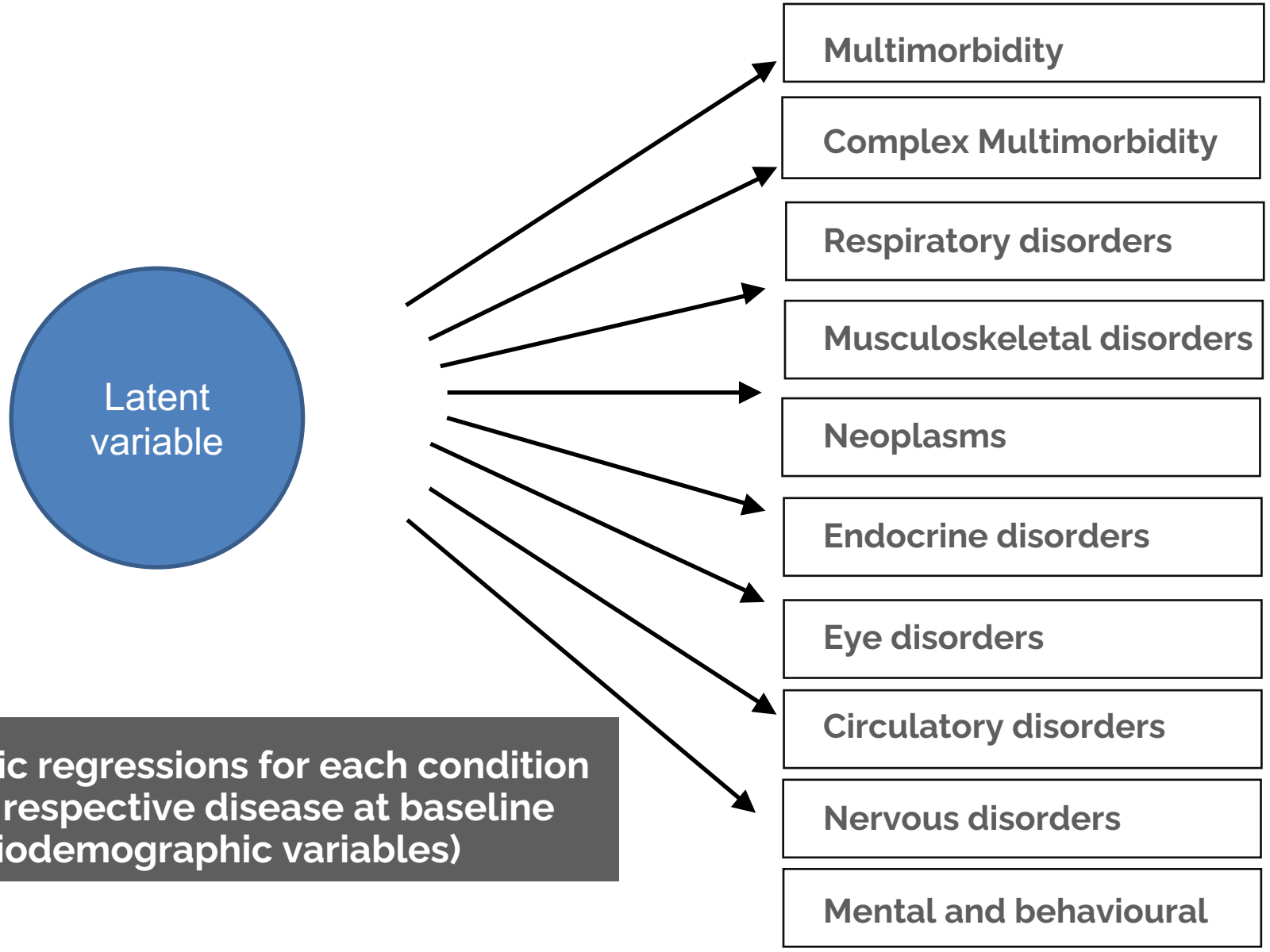


Socio-demographics



Multinomial logistic regression (adjusted for all other sociodemographic variables in the model)

Associations with multimorbidity



Binomial logistic regressions for each condition (adjusted for respective disease at baseline and sociodemographic variables)

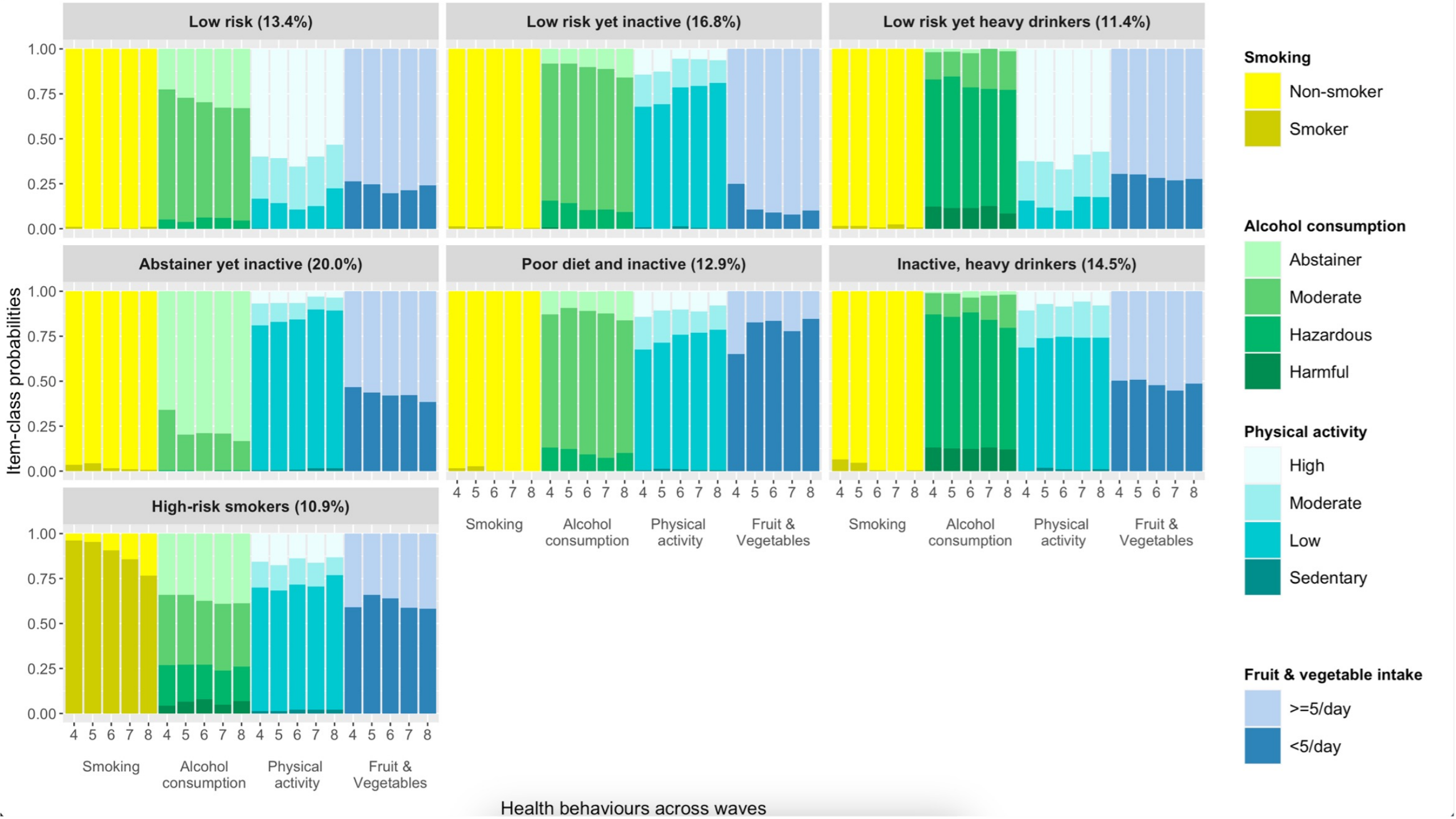

Low risk (13.4%)
Low risk yet inactive (16.8%)
Low risk yet heavy drinkers (11.4%)
Abstainer yet inactive (20.0%)
Poor diet and inactive (12.9%)
Inactive, heavy drinkers (14.5%)
High-risk smokers (10.9%)
Item-class probabilities
1.00
0.75
0.50
0.25
0.00
4 5 6 7 8
Smoking
Alcohol consumption
Physical activity
Fruit & Vegetables
Health behaviours across waves
Smoking
Non-smoker
Smoker
Alcohol consumption
Abstainer
Moderate
Hazardous
Harmful
Physical activity
High
Moderate
Low
Sedentary
Fruit & vegetable intake
>=5/day
<5/day

Table 1. Demographics and odds ratios from multinomial logistic regressions examining the association between socio-demographic predictors and cluster membership

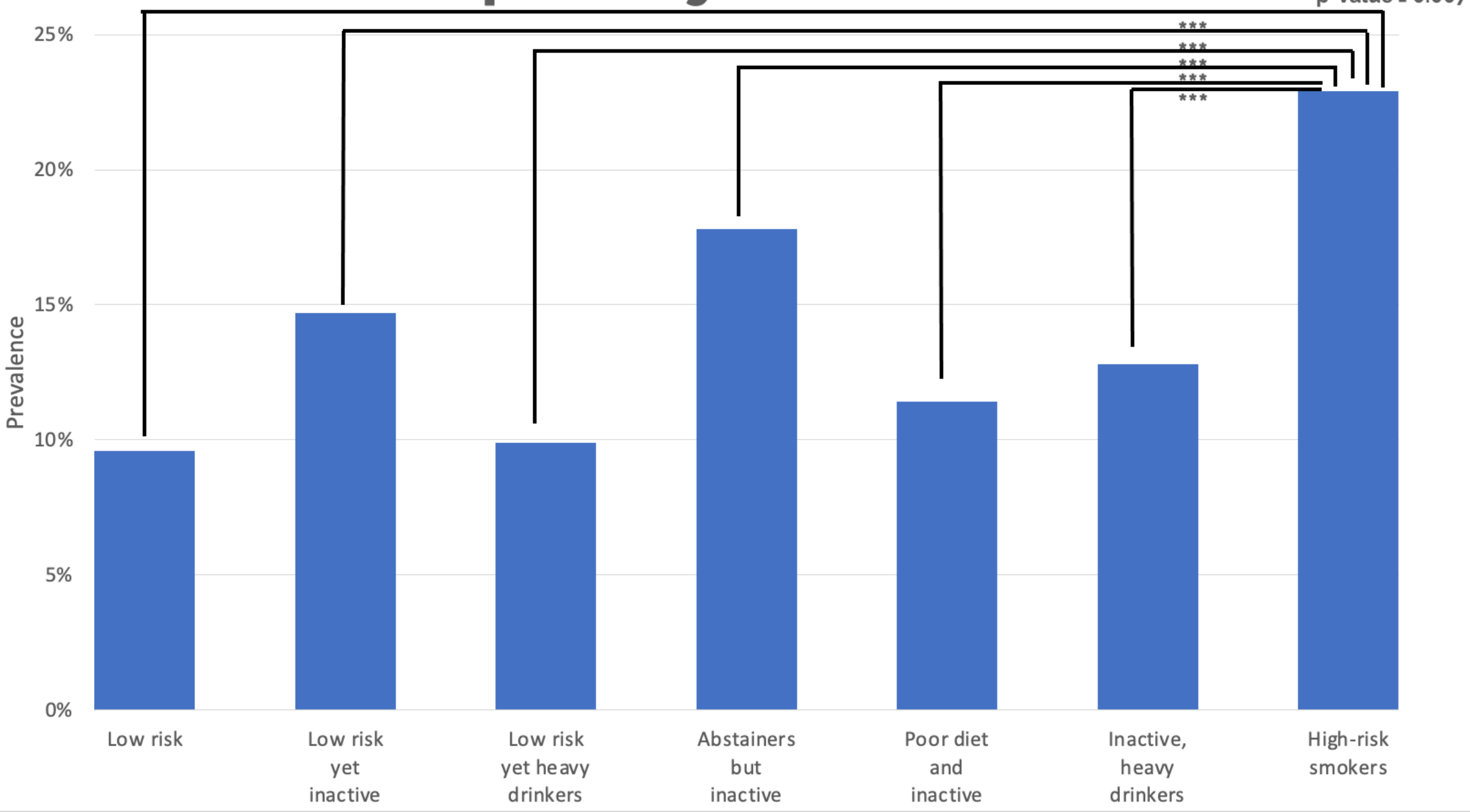
Socio-demographic characteristics	Low risk (n = 13.4%)		Low risk yet inactive (n = 16.8%)		Low risk yet heavy drinkers (n = 11.4%)		Abstainers but inactive (n = 20%)		Poor diet and inactive (n = 12.9%)		Inactive, heavy drinkers (n = 14.5%)		High-risk smokers (n = 10.9%)	
	(Ref. class)													
				OR [95% C.I.]		OR [95% C.I.]		OR [95% C.I.]		OR [95% C.I.]		OR [95% C.I.]		OR [95% C.I.]
Age (s.d.)	61.42 (8.4)	Ref.	65.30 (12)	**1.06 [1.04, 1.08]**	60.31 (7.7)	0.97 [0.96, 1.00]	66.70 (13.2)	**1.07 [1.05, 1.09]**	65.00 (13.5)	**1.06 [1.03, 1.08]**	62.97 (11.3)	**1.03 [1.01, 1.05]**	60.52 (8.7)	**0.97 [0.95, 0.99]**
Sex														
Male	45.6%	Ref	35.5%	Ref	67.5%	Ref	25.4%	Ref	51.6%	Ref	69.1%	Ref	45.2%	Ref
Female	54.4%	Ref	64.5%	**1.49 [1.10, 2.02]**	32.5%	**0.40 [0.29, 0.55]**	74.6%	**2.31 [1.68, 3.17]**	48.4%	0.77 [0.55, 1.06]	30.9%	**0.37 [0.27, 0.49]**	54.8%	1.02 [0.75, 1.40]
Education Level														
No qualifications	15.5%	Ref	23.4%	Ref	11.3%	Ref	43.9%	Ref	30.1%	Ref	13.4%	Ref	40.5%	Ref
Intermediate	58.1%	Ref	61.4%	0.89 [0.57, 1.39]	52.9%	0.90 [0.53, 1.53]	50.6%	**0.56 [0.38, 0.83]**	60.9%	0.76 [0.49, 1.18]	62.7%	1.24 [0.78, 1.96]	51.2%	**0.44 [0.29, 0.66]**
Degree or higher	26.4%	Ref	15.2%	**0.52 [0.30, 0.88]**	35.8%	0.91 [0.51, 1.63]	5.5%	**0.23 [0.13, 0.40]**	9.0%	**0.32 [0.18, 0.60]**	23.9%	0.84 [0.50, 1.42]	8.3%	**0.21 [0.12, 0.36]**
Wealth														
First tertile	15.8%	Ref	25.0%	Ref	9.5%	Ref	47.8%	Ref	37.2%	Ref	20.6%	Ref	50.9%	Ref
Second tertile	35.5%	Ref	37.2%	0.67 [0.43, 1.03]	27.9%	1.17 [0.67, 2.06]	33.9%	**0.38 [0.26, 0.57]**	41.2%	**0.53 [0.34, 0.81]**	30.3%	**0.63 [0.40, 0.97]**	30.5%	**0.33 [0.22, 0.49]**
Third tertile	48.7%	Ref	37.8%	**0.48 [0.31, 0.75]**	62.6%	1.71 [0.99, 2.94]	18.3%	**0.18 [0.12, 0.28]**	21.6%	**0.22 [0.14, 0.36]**	49.1%	0.71 [0.47, 1.09]	18.6%	**0.18 [0.11, 0.28]**
Occupation—Self														
Routine/manual	33.3%	Ref	36.8%	Ref	18.5%	Ref	55.8%	Ref	45.8%	Ref	31.4%	Ref	54.1%	Ref
Intermediate	27.0%	Ref	27.7%	1.11 [0.75, 1.64]	26.3%	**1.70 [1.07, 2.71]**	22.6%	0.84 [0.57, 1.22]	28.2%	1.17 [0.77, 1.76]	22.5%	1.03 [0.69, 1.52]	21.9%	0.87 [0.58, 1.30]
Professional/ managerial	39.7%	Ref	35.5%	1.32 [0.90, 1.94]	55.2%	**1.95 [1.26, 3.04]**	21.6%	1.02 [0.70, 1.49]	26.0%	1.06 [0.70, 1.62]	46.1%	1.33 [0.93, 1.91]	24.0%	0.96 [0.65, 1.43]
Parental Occupation														
Routine/manual	24.2%	Ref	27.3%	Ref	20.8%	Ref	37.5%	Ref	29.5%	Ref	25.1%	Ref	35.9%	Ref
Intermediate	35.0%	Ref	28.8%	0. 78 [0.53, 1.15]	29.7%	0.82 [0.53, 1.25]	34.1%	0.79 [0.54, 1.14]	38.5%	1.06 [0.71, 1.60]	28.9%	0.77 [0.52, 1.13]	40.2%	0.96 [0.66, 1.40]
Professional/ managerial	40.8%	Ref	43.9%	1.14 [0.78, 1.67]	49.5%	1.11 [0.73, 1.67]	28.4%	0.85 [0.58, 1.23]	32.0%	1.10 [0.71, 1.71]	46.0%	1.18 [0.81, 1.71]	23.9%	0.76 [0.51, 1.14]

Note. Odds Ratios [95% Confidence interval] are from BCH multinomial logistic regression analysis; Ref = Reference cluster. **Bold values** are statistically significant at the significance level (p = 0.05). All clusters are compared to the Reference cluster—*Low-risk*. Each odds ratio is adjusted for the remaining socio-demographic variables in the model.

Results: Sociodemographic characteristics

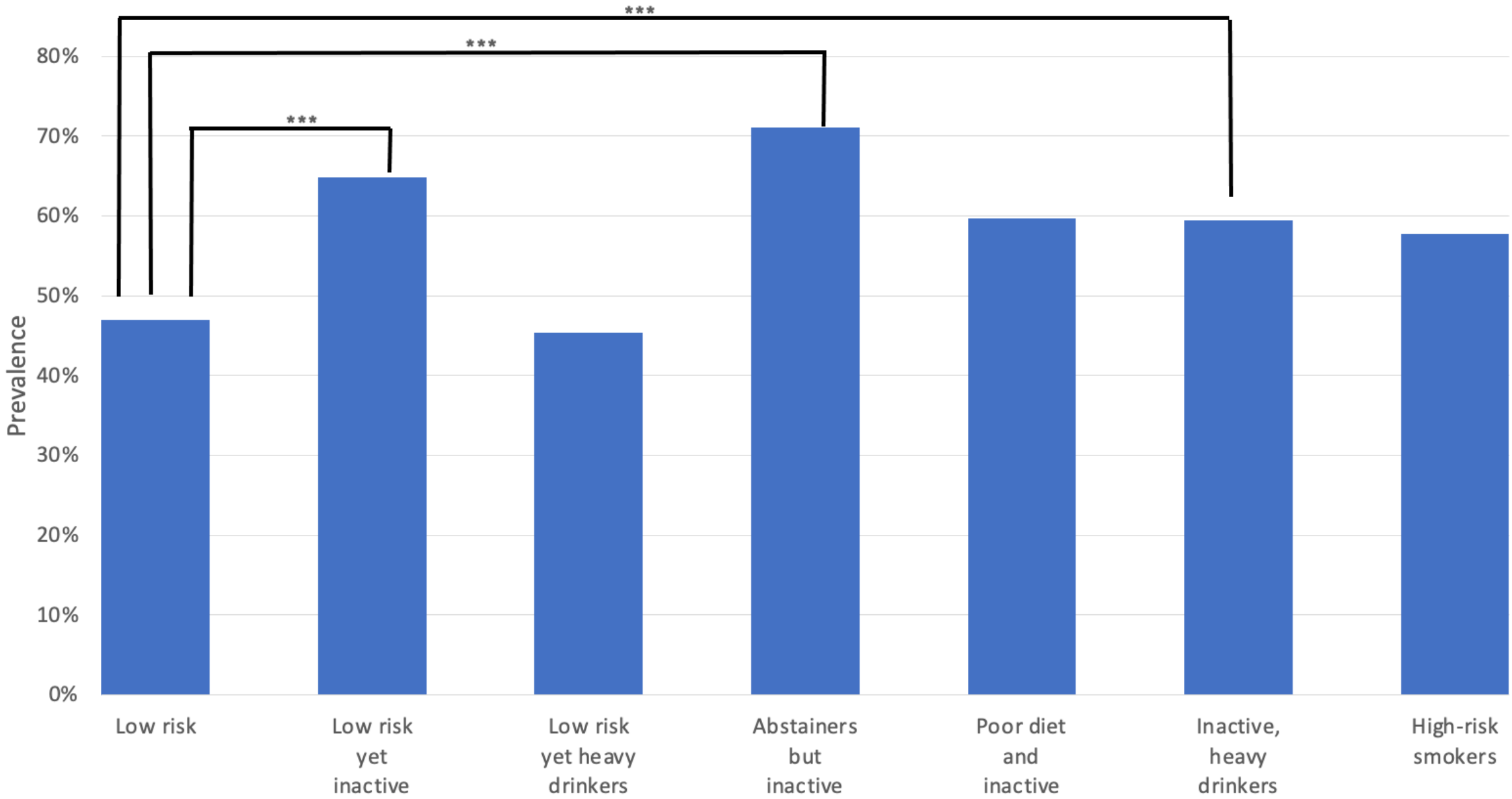
- The two clusters of heavy drinkers were predominantly male (~70%)
- The *Abstainer but inactive* cluster comprised mostly women (~70%)
- *Low-risk yet heavy drinkers* were more likely to hold intermediate and professional/managerial jobs.
- Clusters characterized by physical inactivity were less likely to be wealthy or well-educated.

Respiratory disorders



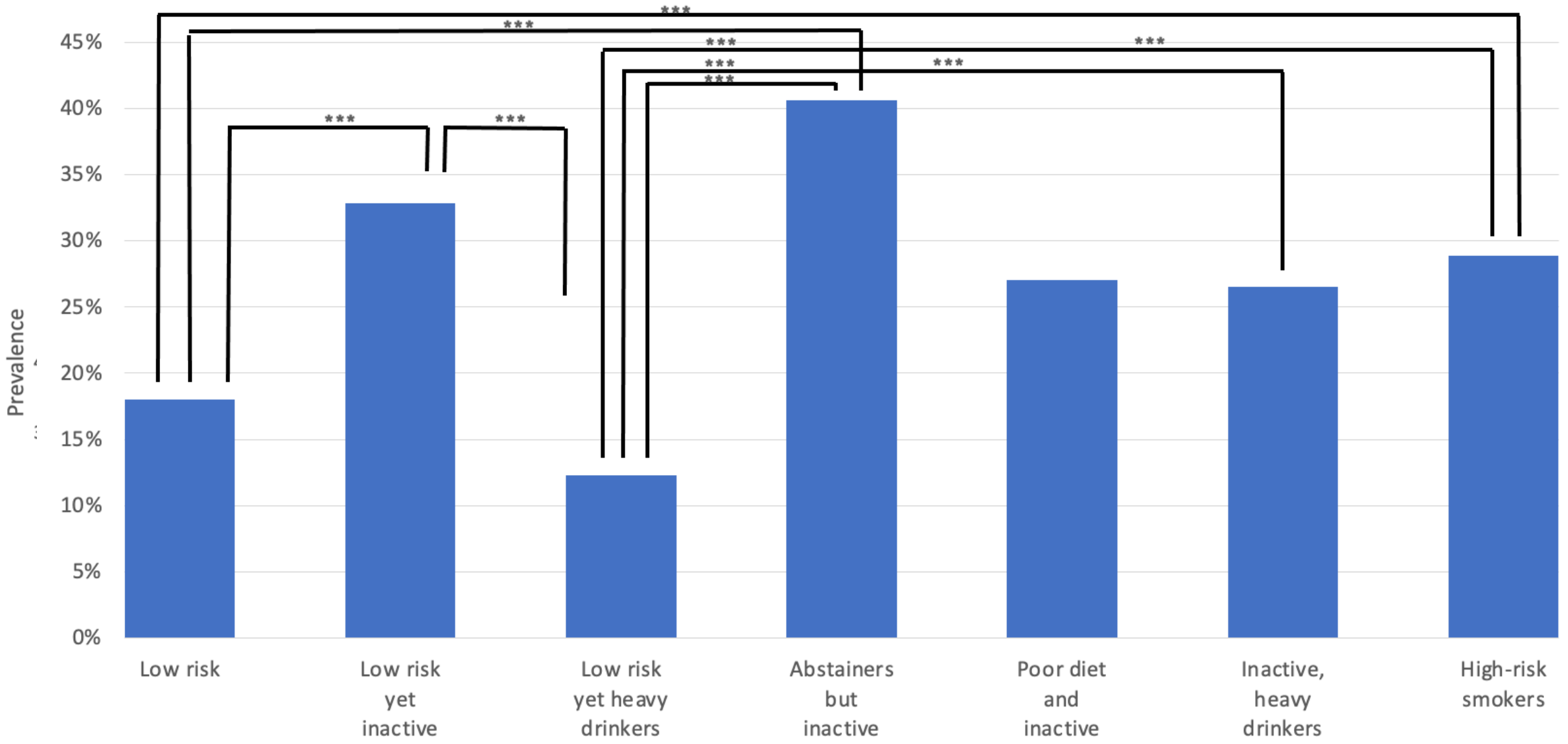
Multimorbidity

*** p-value ≤ 0.007

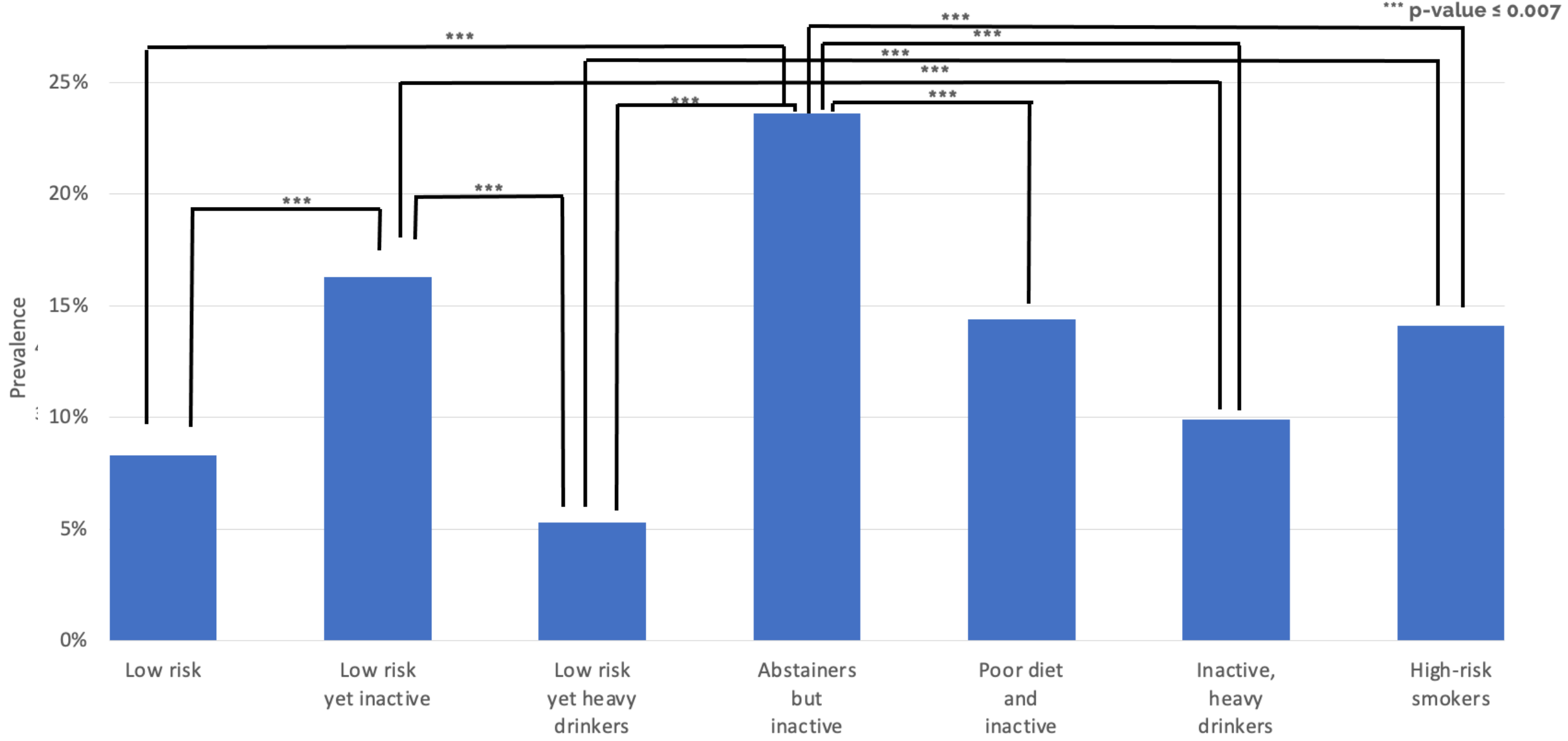


Complex multimorbidity

*** p-value ≤ 0.007



Endocrine, nutritional and metabolic disorders



Results: Health outcomes

- *High-risk smokers* were most likely to have respiratory disorders.
- *Low-risk* and *Low-risk yet heavy drinkers* had a lower prevalence of all health conditions studied.
- The *Abstainer but inactive* cluster had the highest prevalence of multimorbidity, complex multimorbidity, and endocrine disorders.

Summary of findings

- Identified seven clusters of health risk behaviours
- Patterns of behaviour within the clusters were largely stable over time, with some exceptions.
- Clusters were significantly associated with income, wealth, education, occupation, age and sex.
- Clusters differed in their prevalence of multimorbidity, complex multimorbidity, respiratory disorders, and endocrine, nutritional and metabolic disorders.

Implications

- Health-risk behaviours tend to be fairly stable as people age and so ought to be addressed early.
- Clusters can help identify high-risk subgroups
- Information on clusters can be used to tailor interventions.
- A complex (not linear dose–response) relationship between risk behaviours and disease outcomes.

Future research

- Studies are needed to understand how behavioural clusters interact with sociodemographic risk factors to affect disease outcomes

- How such behaviours might cluster together in other populations, and how this relates to the risk of chronic diseases remains unclear.

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Questions/comments?

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Suhag, A., Webb, T. L., & Holmes, J. (2024). Longitudinal clustering of health behaviours and their association with multimorbidity in older adults in England: A latent class analysis. *Plos one*, *19*(1), e0297422.

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3-step method

1. Estimate the Model Without Covariates

- Identify latent classes based solely on primary data indicators, without any exogenous variables

2. Assign Members to Classes

- Classify individuals into classes based on the highest probability of membership. (Note: class assignment is probabilistic and not absolute.)

3. Add Covariates and Outcomes

- Integrate additional variables (covariates) and outcomes to explore their relationship with class membership, while adjusting for possible misclassification.