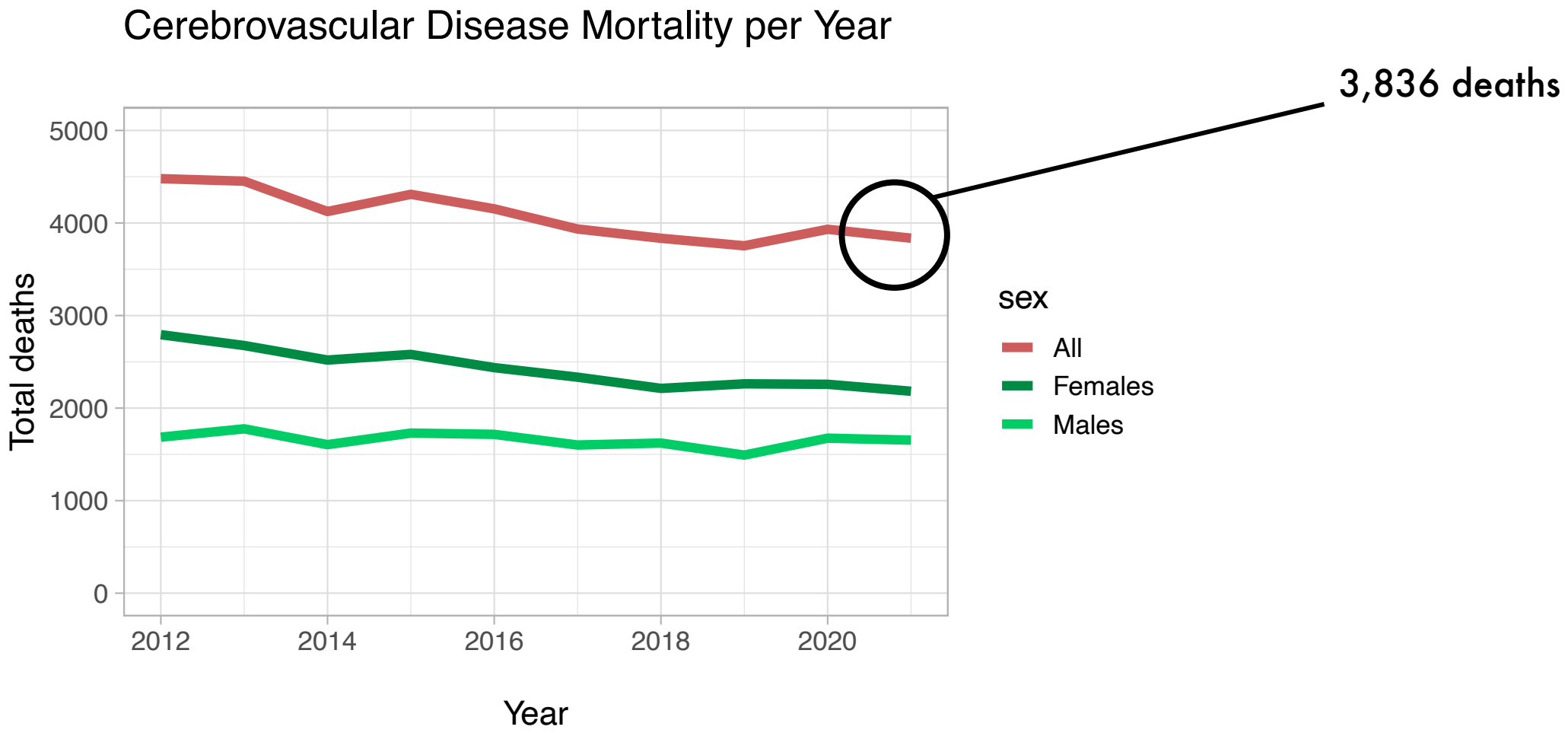
# Scottish Stroke Statistics

Public Health Scotland

Thijmen Breeschoten
CodeClan project DE21
30/08/2023

# Cerebrovascular disease -

## conditions that affect blood flow or blood vessels supplying oxygen rich blood to the brain



# Cerebrovascular disease

## National clinical priority

- Stroke Improvement Plan (2014, 2023)

# Project aims

## National clinical priority

### Stroke Improvement Plan (2014, 2023)

1 - Update key numbers/trends

*Purpose: Inform improvement plan*

2 - Predict future incidence rates

- Build predictive model using population projections 2024-2045 (NRS)

*Purpose: Help in care planning*

3 - Identify health boards of closest resemblance

- Cluster analysis to identify similarity across boards

*Purpose: Setting up collaborative teams*

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## Personal goals

- NHS data ☐
- Predictive modelling ☐
- Clustering ☐
- Leaflet spatial analysis ☐

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NHS data 

Predictive modelling 

Clustering 

Leaflet spatial analysis 

# Cerebrovascular disease

- National clinical priority
  Stroke Improvement Plan (2014, 2023)

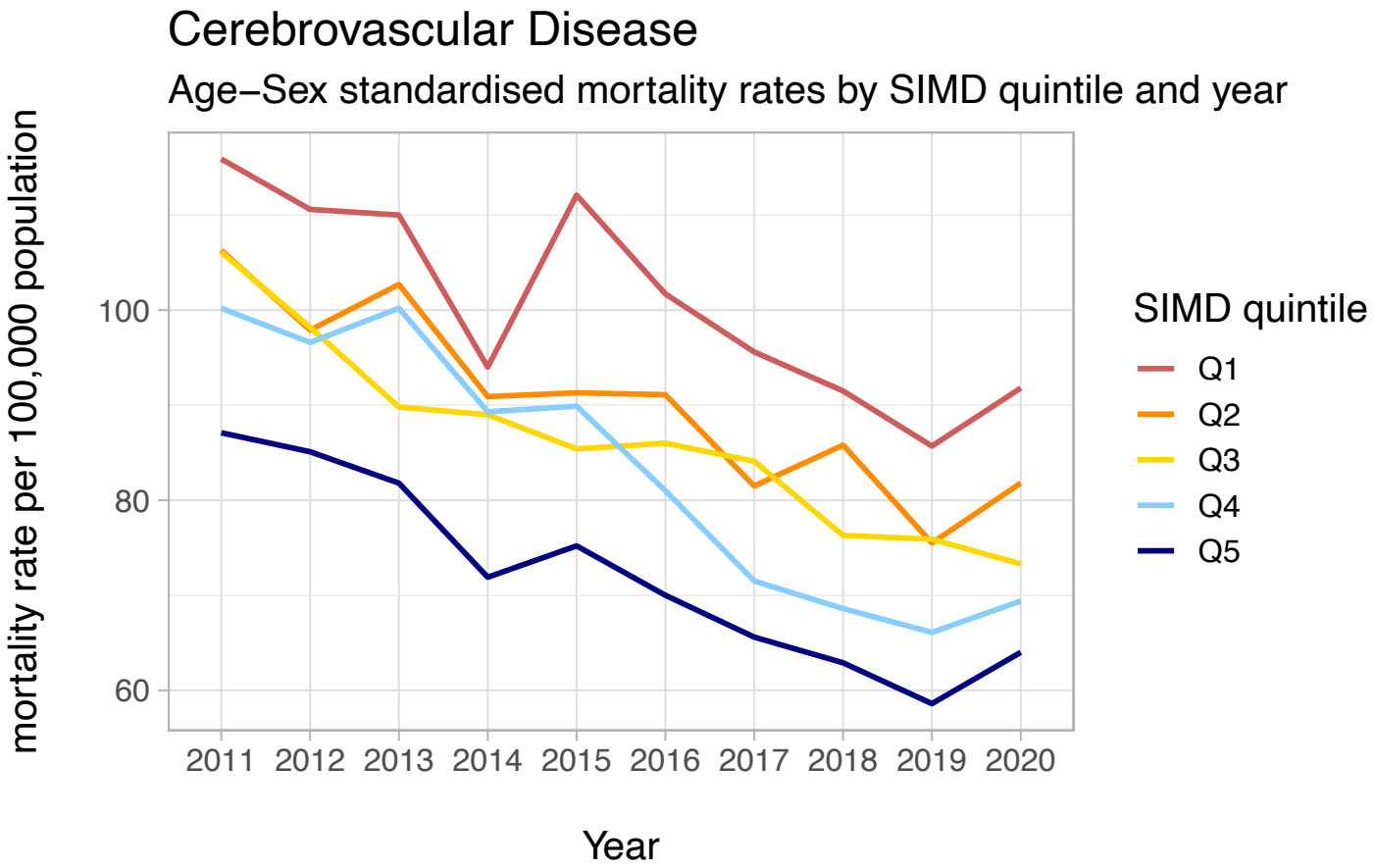
- Preventable risk factors:
  - Smoking
  - Alcohol (mis)use
  - Lack of exercise
  - High blood pressure
  - Poor diet
  - Diabetes

- Major differences across levels of deprivation:
  Social inequality of health

# Cerebrovascular disease by SIMD

## Scottish Index of Multiple Deprivation

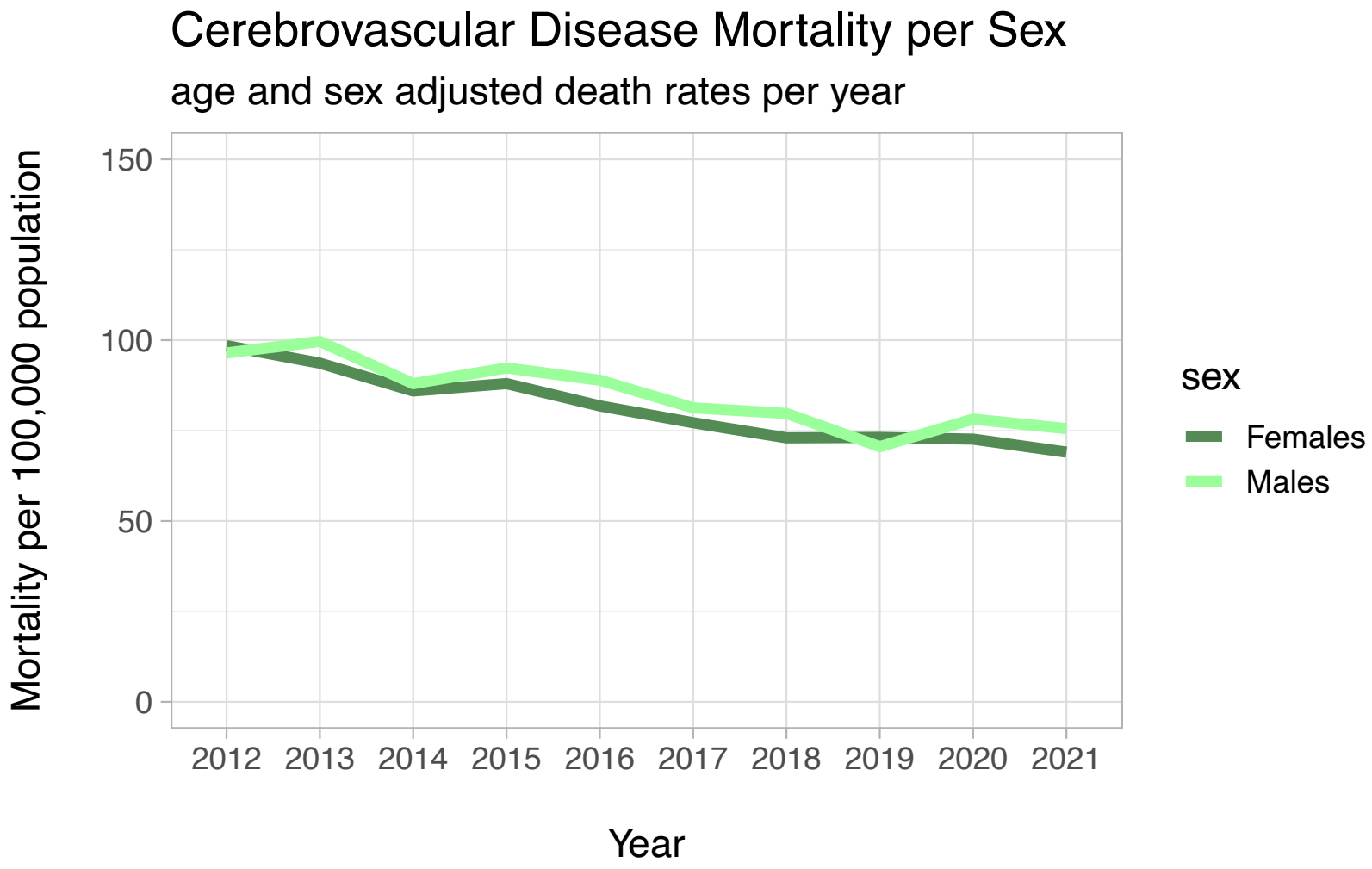
- Income
- Employment
- Education
- Health
- Access to services
- Crime
- Housing




SIMD Q1 ↓ 21.2%

SIMD Q5 ↓ 28.3%

# Mortality 2012 - 2021




## Trend:

♀ ⬇ 30%

♂ ⬇ 23%

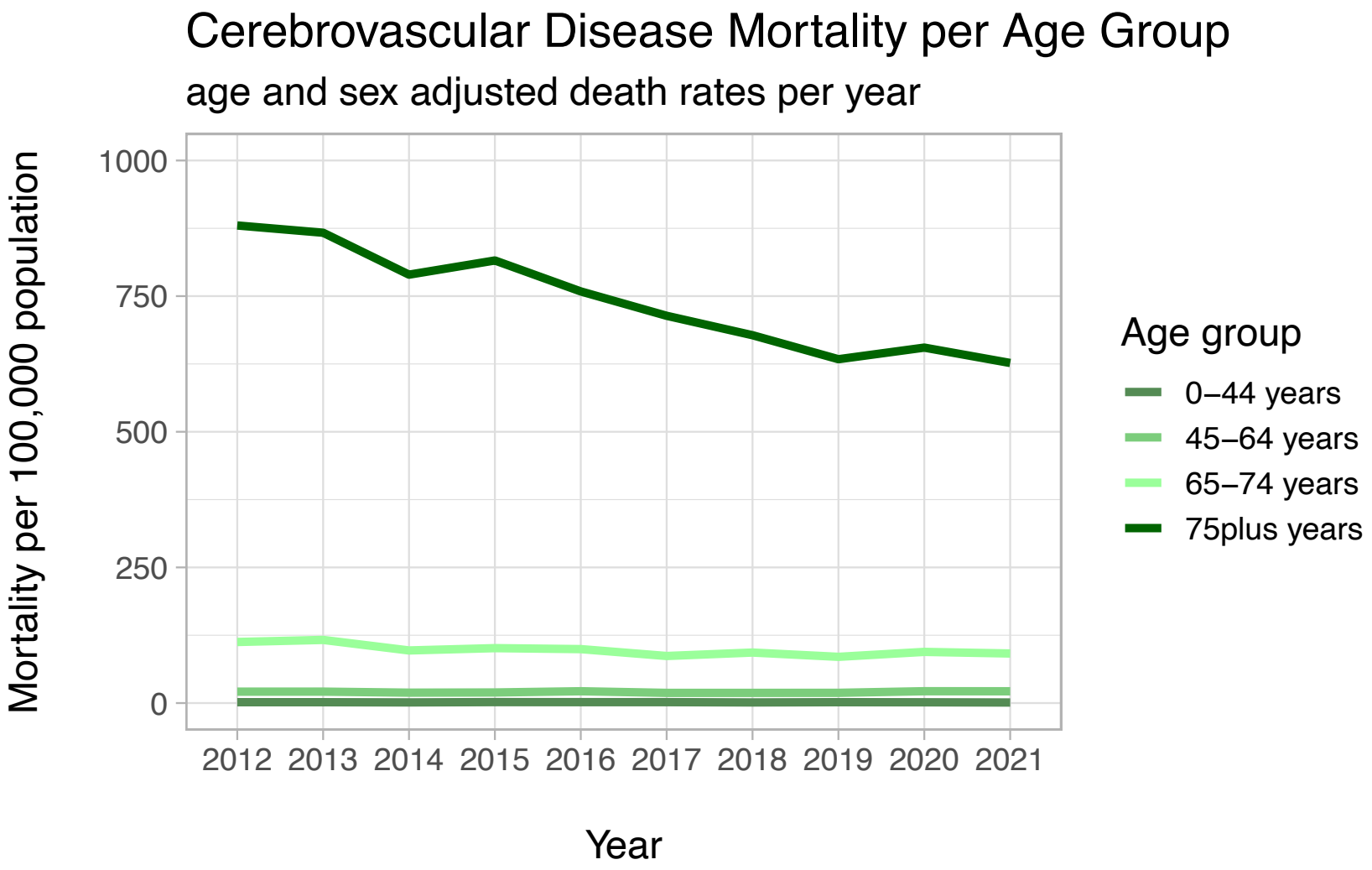
0-44

45-64

65-74

75+

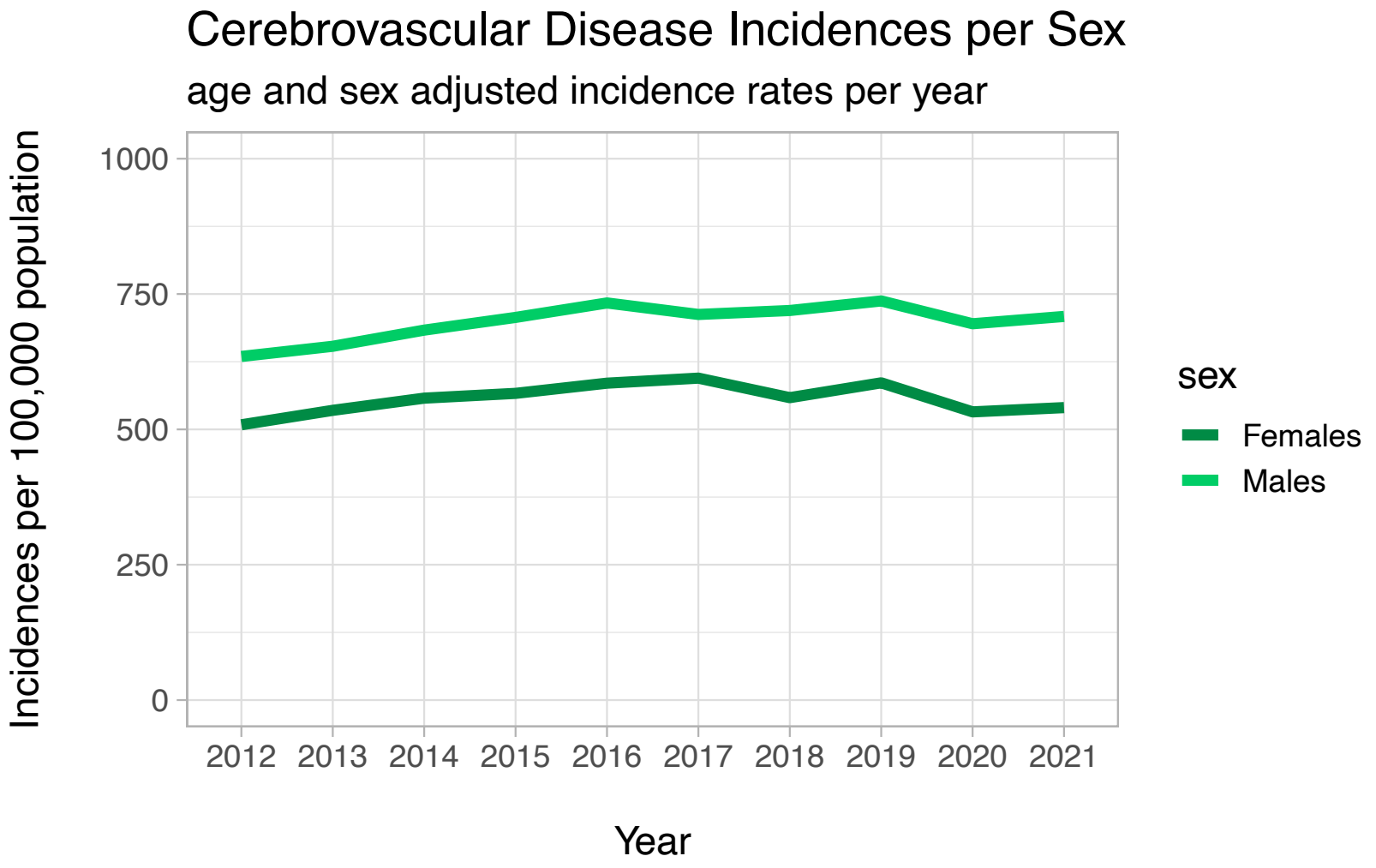
# Mortality 2012 - 2021




## Trend:

| | | |
|---|---|---|
| ♀ | ↓ | 30% |
| ♂ | ↓ | 23% |
| 0-44 | ↓ | 36% |
| 45-64 | ↑ | 3% |
| 65-74 | ↓ | 18% |
| 75+ | ↓ | 28% |

# Incidences 2012 - 2021




## Trend:

♀ ⬆ 6%

♂ ⬆ 11%

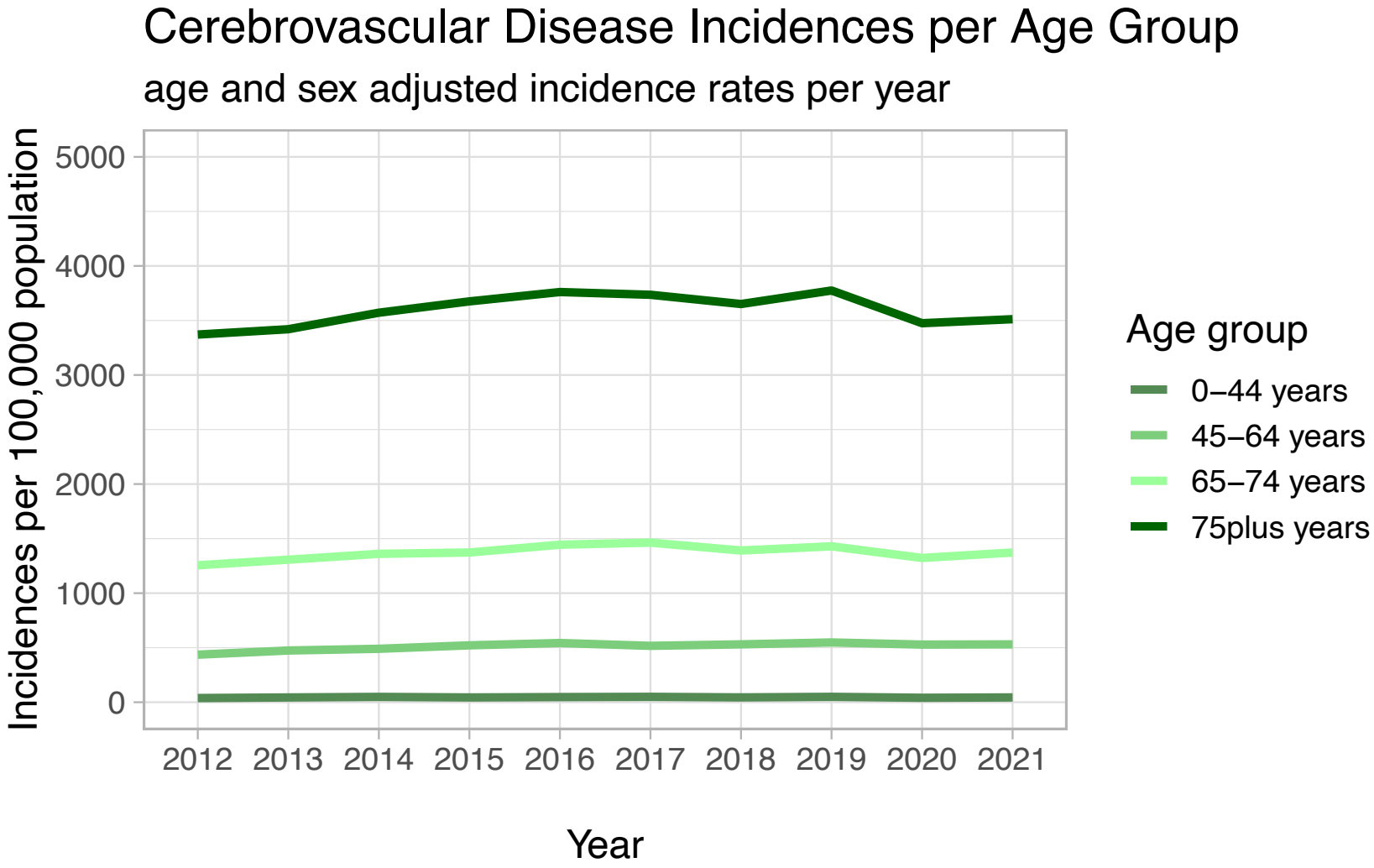
0-44

45-64

65-74

75+

# Incidences 2012 - 2021




**Trend:**

| | | |
|---|---|---|
| ♀ | ↑ | 5% |
| ♂ | ↑ | 7% |
| 0-44 | ↑ | 13% |
| 45-64 | ↑ | 21% |
| 65-74 | ↑ | 9% |
| 75+ | ↑ | 4% |

# 1 - Update key numbers

*Purpose: Inform improvement plan*

| Mortality trend: | | | Incidences trend: | | |
|---|---|---|---|---|---|
| ♀ | ↓ | 30% | ♀ | ↑ | 5% |
| ♂ | ↓ | 23% | ♂ | ↑ | 7% |
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# National clinical priority

## Stroke Improvement Plan (2014, 2023)

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*Purpose: Setting up collaborative teams*

# 2 Build predictive model using population projections

*Purpose: Help in care planning*

- Join population estimates (NRS):
  *per year, age_group, sex, health board*
- Wrangling:
  *calculate proportions (discharges/population)*
- Variable correlations/selection:
  *age_group, sex, hbr, population*
- Logistic regression model

# Logistic regression model

Stroke% ~ age_group

| term <chr> | estimate <dbl> | std_error <dbl> | statistic <dbl> | p_value <dbl> |
|---|---|---|---|---|
| (Intercept) | -7.875934 | 2.924786 | -2.6928241 | 0.007084965 |
| age_group45-64 years | 2.535882 | 3.050616 | 0.8312687 | 0.405821841 |
| age_group65-74 years | 3.522803 | 2.972899 | 1.1849725 | 0.236028327 |
| age_group75plus years | 4.564557 | 2.942161 | 1.5514301 | 0.120798636 |
| age_groupAll | 2.705686 | 3.008338 | 0.8993956 | 0.368441994 |

Stroke% ~ sex

| term <chr> | estimate <dbl> | std_error <dbl> | statistic <dbl> | p_value <dbl> |
|---|---|---|---|---|
| (Intercept) | -4.45287456 | 0.4188297 | -10.6317066 | 2.121936e-26 |
| sexFemales | -0.14955520 | 0.6158691 | -0.2428360 | 8.081324e-01 |
| sexMales | 0.08903673 | 0.5755526 | 0.1546978 | 8.770596e-01 |

Stroke% ~ hbr

| term <chr> | estimate <dbl> | std_error <dbl> | statistic <dbl> | p_value <dbl> |
|---|---|---|---|---|
| (Intercept) | -4.48538000 | 0.8451899 | -5.30694967 | 1.114749e-07 |
| hbrS08000016 | -0.03063811 | 1.2220307 | -0.02507147 | 9.799980e-01 |
| hbrS08000017 | -0.03290705 | 1.2149271 | -0.02708561 | 9.783914e-01 |

Stroke% ~ population

| term <chr> | estimate <dbl> | std_error <dbl> | statistic <dbl> | p_value <dbl> |
|---|---|---|---|---|
| (Intercept) | -4.309825e+00 | 2.843980e-01 | -15.1542047 | 7.107049e-52 |
| population_size | -1.053916e-06 | 1.292531e-06 | -0.8153897 | 4.148493e-01 |

2 rows

# 2 Build predictive model using population projections

*Purpose: Help in care planning*

Problem:

- Data (too) aggregated
  -> row represented: demographics, location, admission, diagnosis

Solution:

- Augment data
- De-aggregate data (back to individuals)
- Time series forecasting

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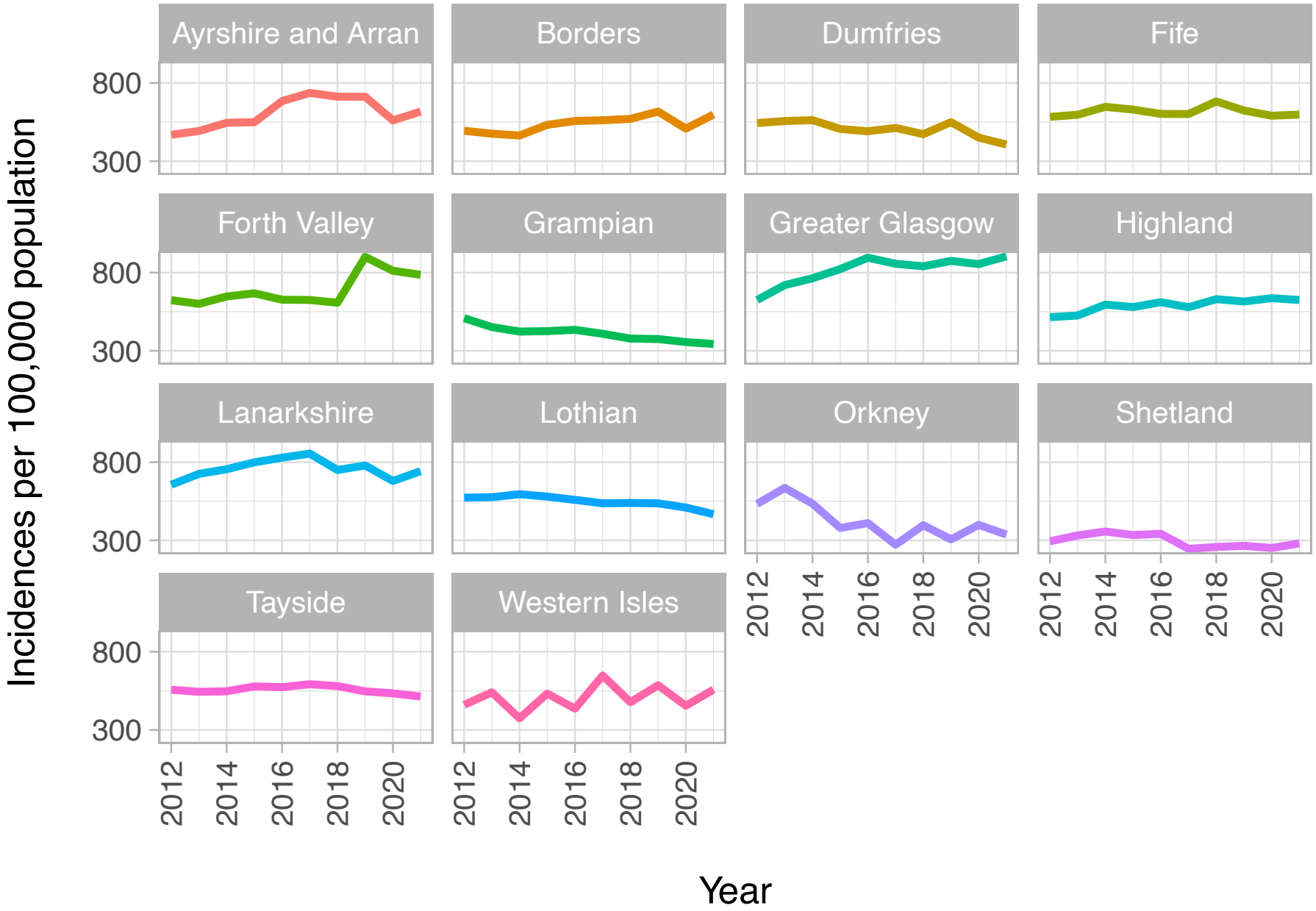
# Cerebrovascular Disease Incidences per Health Board

age and sex adjusted incidence rates per year



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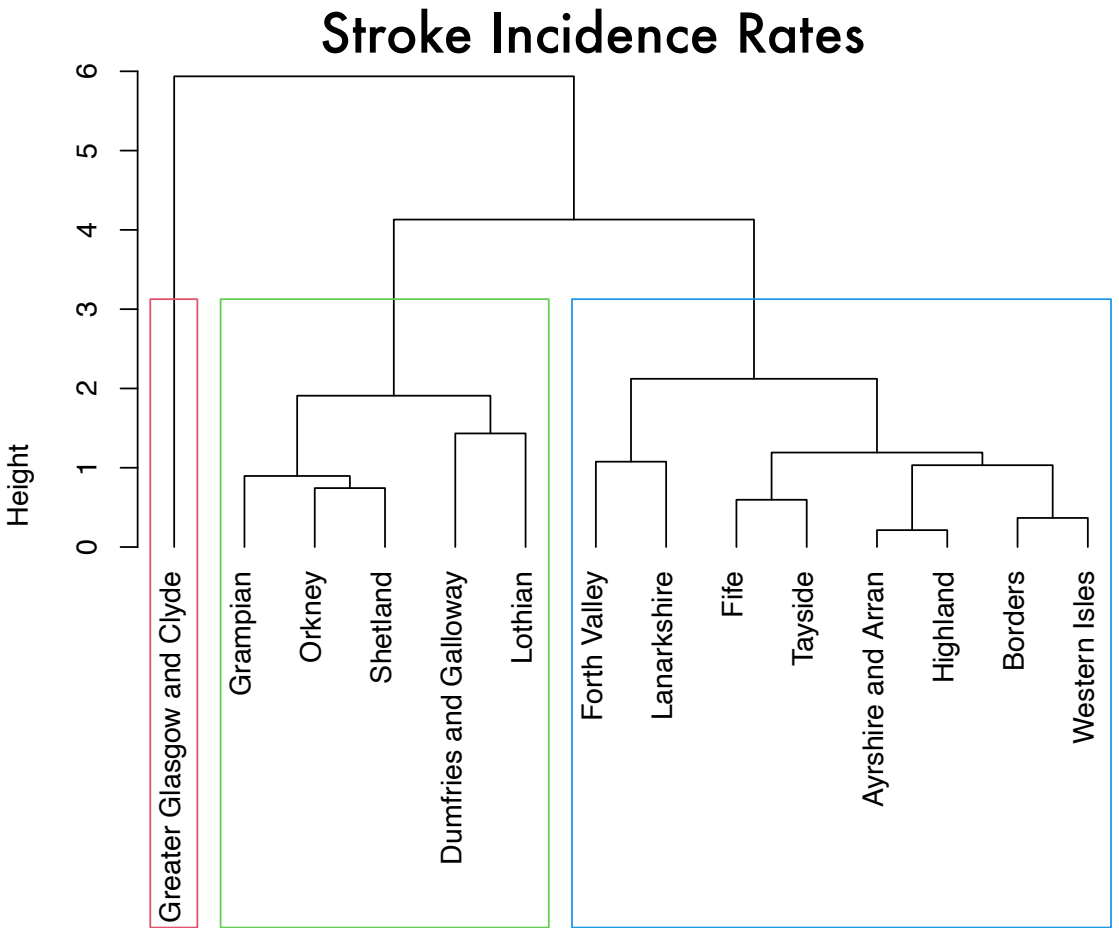
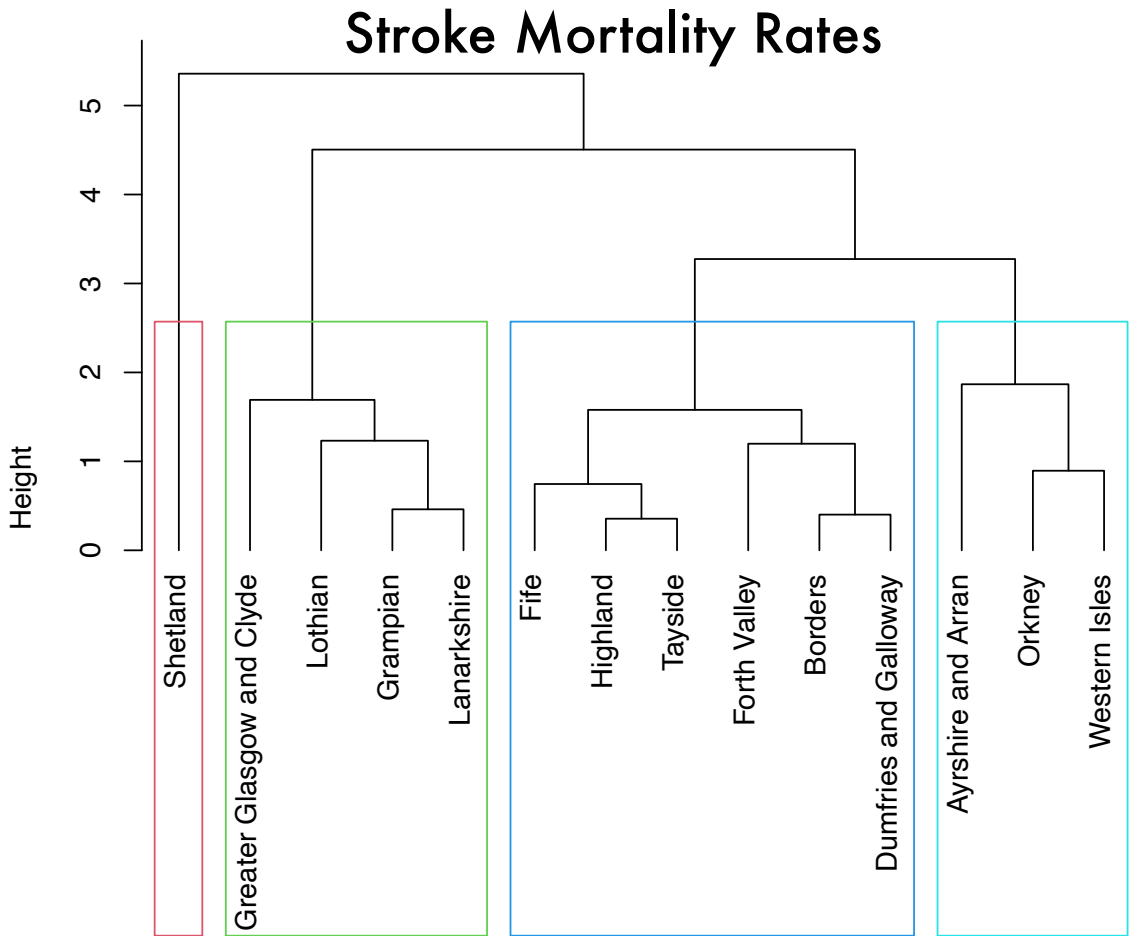
Cluster analysis to identify similarity across boards
- Hierarchical clustering: complete linkage (max distance), Euclidian distance



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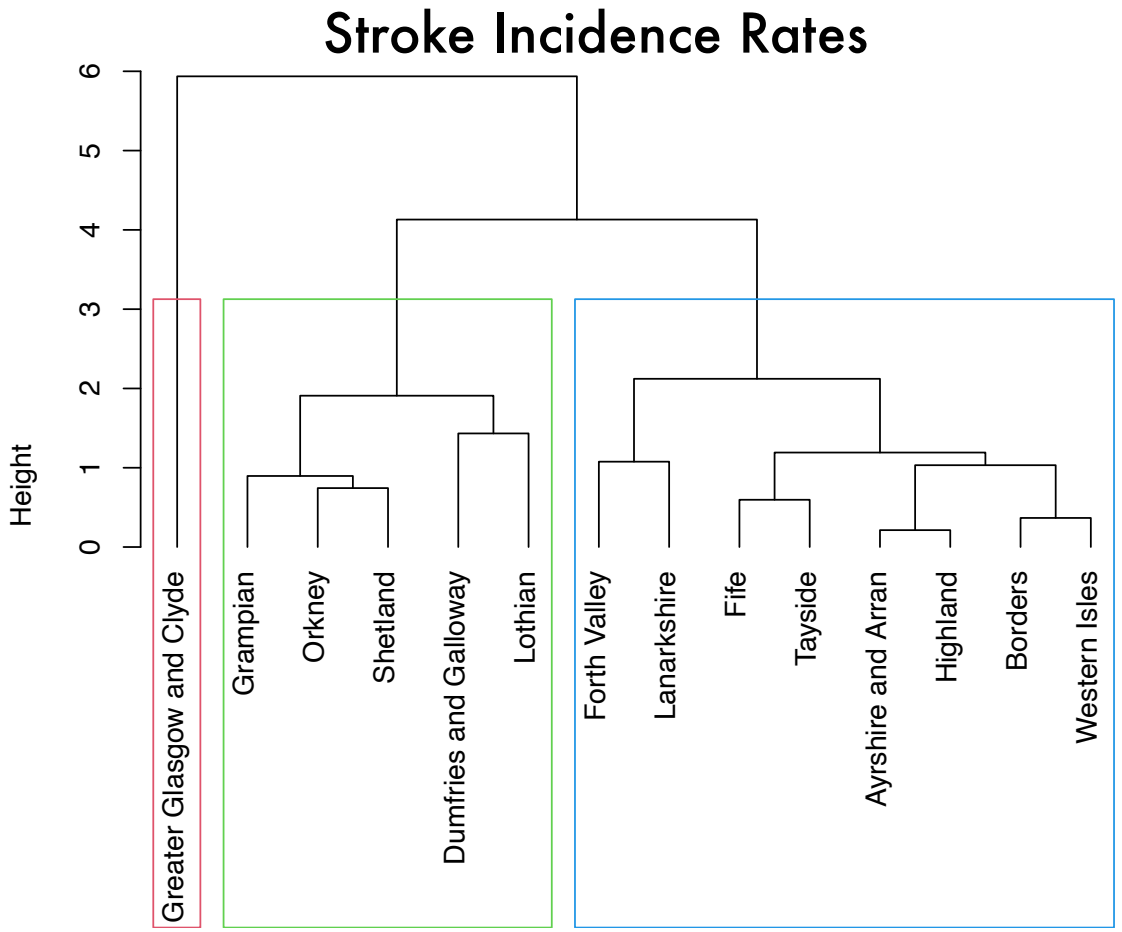


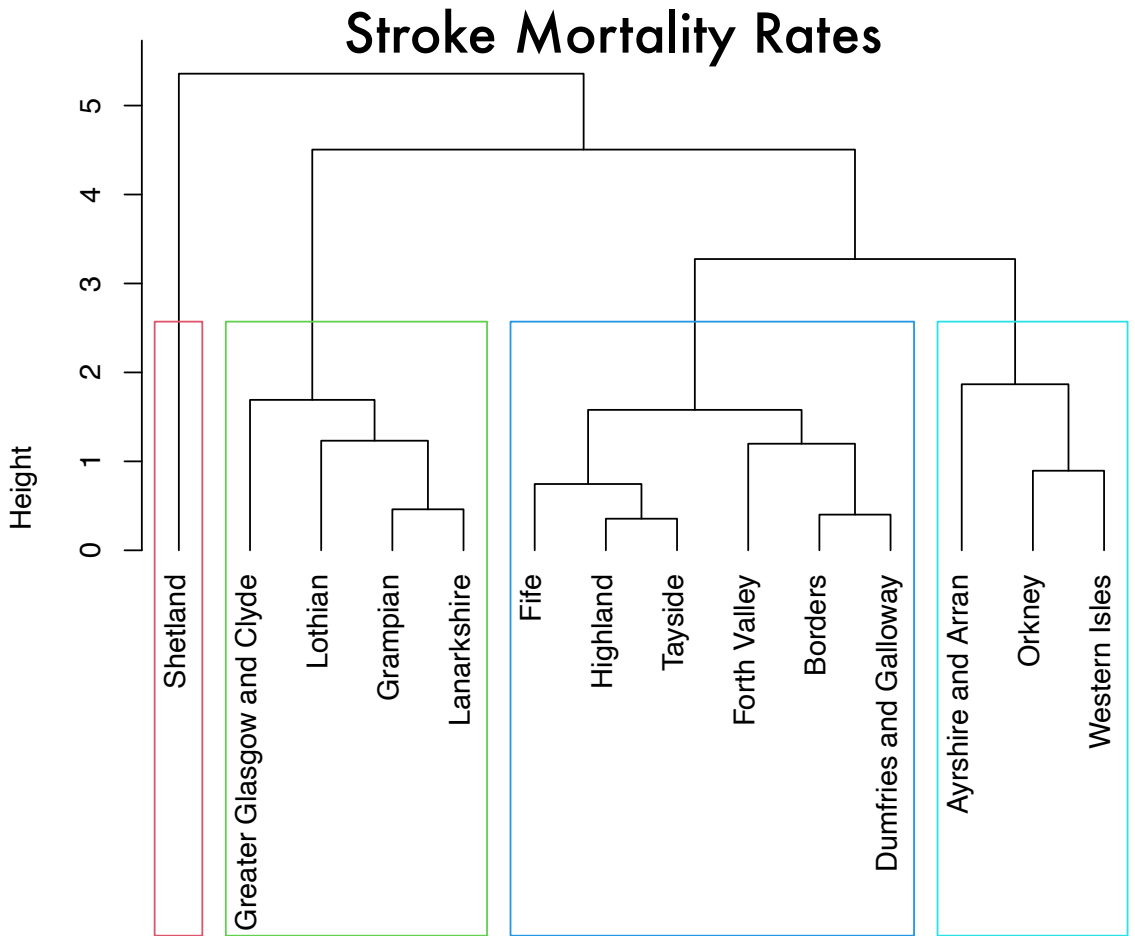

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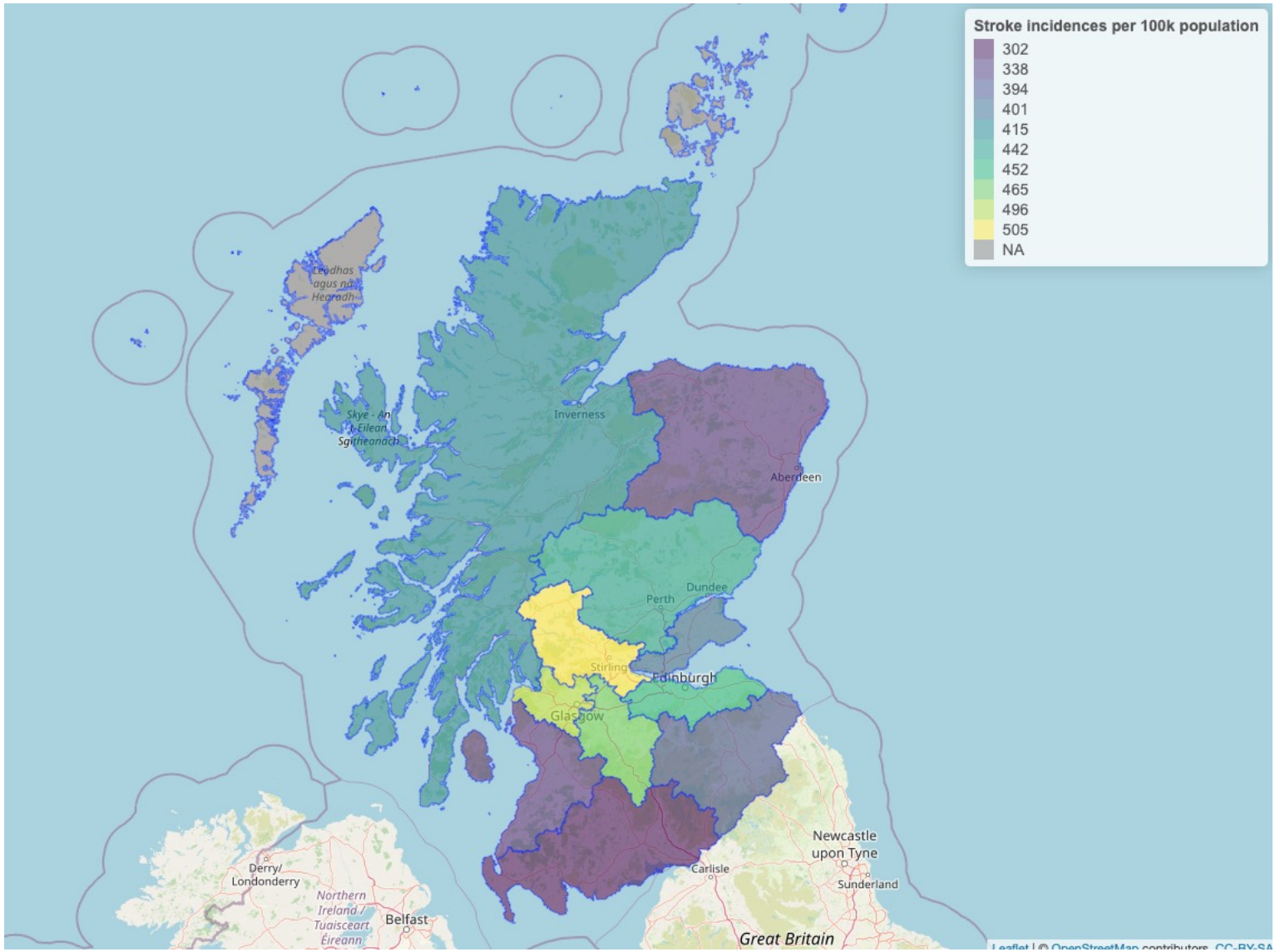

# Conclusions

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Mortality -> decreasing across demographics

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# Conclusions

1 - Update key numbers/trend

Mortality -> decreasing across demographics

Incidences -> increasing across demographics

2 - Predict future incidence rates

Aggregated data -> augment, deaggregate

3 - Identify health boards of closest resemblance

Cluster analysis -> identified healthboard clusters

# Scottish Stroke Statistics

Public Health Scotland

Data sources:

**PHS open data – Scottish Stroke Statistics**

version 1.0, SMR01, 24/01/2023
- Stroke Activity By Health Board
- Stroke Mortality By Health Board

**NRS – Mid-Year Population Estimates**

- TSD – by NHS health board, sex and single year of age
  1981-2021 – version 13/07/2022
- Sub-National Population Projections Scotland
  2018-based – version 24/03/2020

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# Cerebrovascular disease

Stroke – blood supply to part of brain is cut off

Subarachnoid haemorrhage – bleeding in space surrounding brain

TIAs and related syndromes – temporary stroke (few minutes)

# Cerebrovascular disease