Online Technical Appendix for Fenton, Wyper, McCartney, Minton, 'Socioeconomic inequality in recent mortality trends in Scotland

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Introduction

This document describes all data, methods and code used to generate the results within the above-listed article.

All data are publically available, and you are free to interrogate and use the code in your own analyses.

All data preparation, analyses, figures and tables were generated using the R programming language, with the exception of some initial data preparation done within Microsoft Excel. This data preparation only involved changing the structure of existing data within an Excel sheet, rather than the contents of such data.

Reviewer comment responses

Many of the results presented here are produced in response to specific reviewer comments. Where an analysis addresses a specific comment, a comment/reviewer code (such as C7R1 for the seventh comment, by reviewer 1), is included in the text to make this clearer.

Data

The data used are from this National Records of Scotland (NRS)) webpage. The dataset 'Latest tables based on 2013 ESP' (European Standardized Population) was downloaded in Excel format.

All analyses presented in the paper were based on table 7 of this Excel Workbook.

The contents of table 7 of the Workbook were rearranged so as to conform with data structure recommended by (Wickham, (2014) 'Tidy Data')[https://www.jstatsoft.org/article/view/v059i10/v59i10.pdf], producing a new datasheet, called `flat_data`, which was imported directly into R. All further processing and analyses were conducted within R.

Workflow and results

The following code chunks perform the analyses which are presented in the paper.

Where additional information are required as to the methods, they are described adjacent to the code chunks.

Loading the required packages

```
pacman::p_load(tidyverse, readxl, cowplot, kableExtra)
```

Note: `pacman` is an R package for managing R packages. It has to be installed once using `install.packages("pacman")`, but once installed will either install or load other packages as required.

Load data

```
dta <- read_excel("data/ASMR_SIMD_2001_2017_indexed trends.xlsx", sheet = "flat_data")
```

Tidying the data

```
names(dta) <- c("year", "overall", "q1", "q2", "q3", "q4", "q5", "gender")

dta_tidy <- dta %>%
  gather(key = "simd", value = "asmr", -year, -gender) %>%
  mutate(SIMD = factor(simd,
                       levels = c("q1", "q2", "q3", "q4", "q5","overall"),
                       labels = c("Q.1 (Most deprived)",
                                  "Q.2", "Q.3", "Q.4", "Q.5 (Least deprived)", "Overall")
                       )
         )
```

Visualising

This is one part of the first figure. The R package `ggplot2` is used to produce this visualisation.

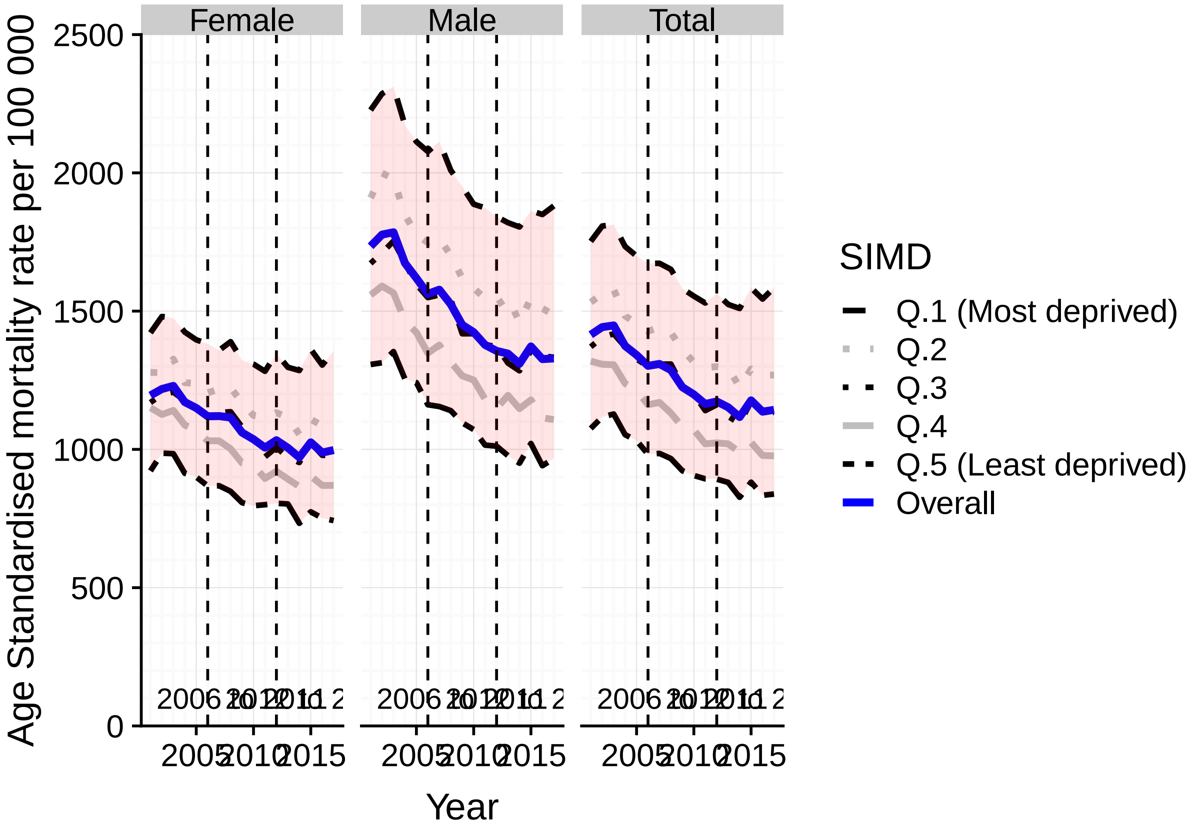
```
p1 <- dta_tidy %>%
  ggplot(aes(x = year )) +

  facet_wrap(~gender) +
  geom_line(aes(y = asmr, group = SIMD, linetype = SIMD, size = SIMD, color = SIMD)) +
  scale_size_manual(values = c(1, 1.2, 1, 1.2, 1, 1.4)) +
  scale_linetype_manual(values = c(2,3,4,5, 6, 1)) +
  scale_color_manual(values = c("black", "grey", "black", "grey", "black", "blue")) +
  labs(x = "Year", y = "Age Standardised mortality rate per 100 000") +
  scale_y_continuous(expand = c(0, 0), limits = c(0, 2500), minor_breaks = seq(0, 2500, by = 100)) +
  scale_x_continuous(minor_breaks = 2001:2017) +
  geom_vline(xintercept = 2012, linetype = "dashed") +
  geom_vline(xintercept = 2006, linetype = "dashed") +
  annotate("text", y = 100, x = 2006 + (2012 - 2006) / 2, label = "2006 to 2011") +
  annotate("text", y = 100, x = 2012 + (2018 - 2012) / 2, label = "2012 to 2017") +
  geom_ribbon(
    aes(x = year, ymin = q5, ymax =q1),
    alpha = 0.1, fill ="red",
    data = dta_tidy %>% filter(simd %in% c("q1", "q5")) %>% select(-SIMD) %>% spread(simd, asmr)

  ) +
  background_grid(major = "xy", minor = "xy")



p1
```



C10R2: How was the percentage change calculated?

The following chunk calculates the percentage change, from the earlier to latter period, in ASMR by gender and SIMD quintile.

Algebraically this can be expressed as follows

$$C_T = -100[1 - \frac{y_T^{last}}{y_T^{first}}]$$

Where C_T refers to the percentage change over a time period T, y_T^{last} to the observed age-standardised mortality rate (ASMR) in the last year within the period T, and y_T^{first} to the ASMR in the first year in the period T. Within the analyses, two distinct periods are considered: 2006 to 2011 inclusive, and 2012 to 2017 inclusive.

```
percent_changes <- dta_tidy %>%
  mutate(period = case_when(
    between(year, 2012, 2017) ~ "2012-2017",
    between(year, 2006, 2011) ~ "2006-2011",
    TRUE ~ NA_character_) %>% factor(levels = c("2012-2017", "2006-2011"))) %>%
  group_by(gender, simd, period) %>%
  filter(year == min(year) | year == max(year) ) %>% # This finds the first and last year in each perio
  filter(!is.na(period)) %>%
  group_by(gender, SIMD, period) %>%
  summarise(percent_change = - 100 * (1 - asmr[year == max(year)] / asmr[year == min(year)])) %>%
  ungroup()
```

```
## Warning: Factor `period` contains implicit NA, consider using
## `forcats::fct_explicit_na`
```

For the alternative method, presented in the appendix, the model predicted ASMR values $\hat{Y}$ are used in place of the observed ASMR values y in the above. These predicted values are produced for each SIMD, period, and gender category regressed on year within period. This is shown in the section 'approach discussed in sensitivity analysis'.

Note: The contents of `percent_changes` look as follows:

```
percent_changes
```

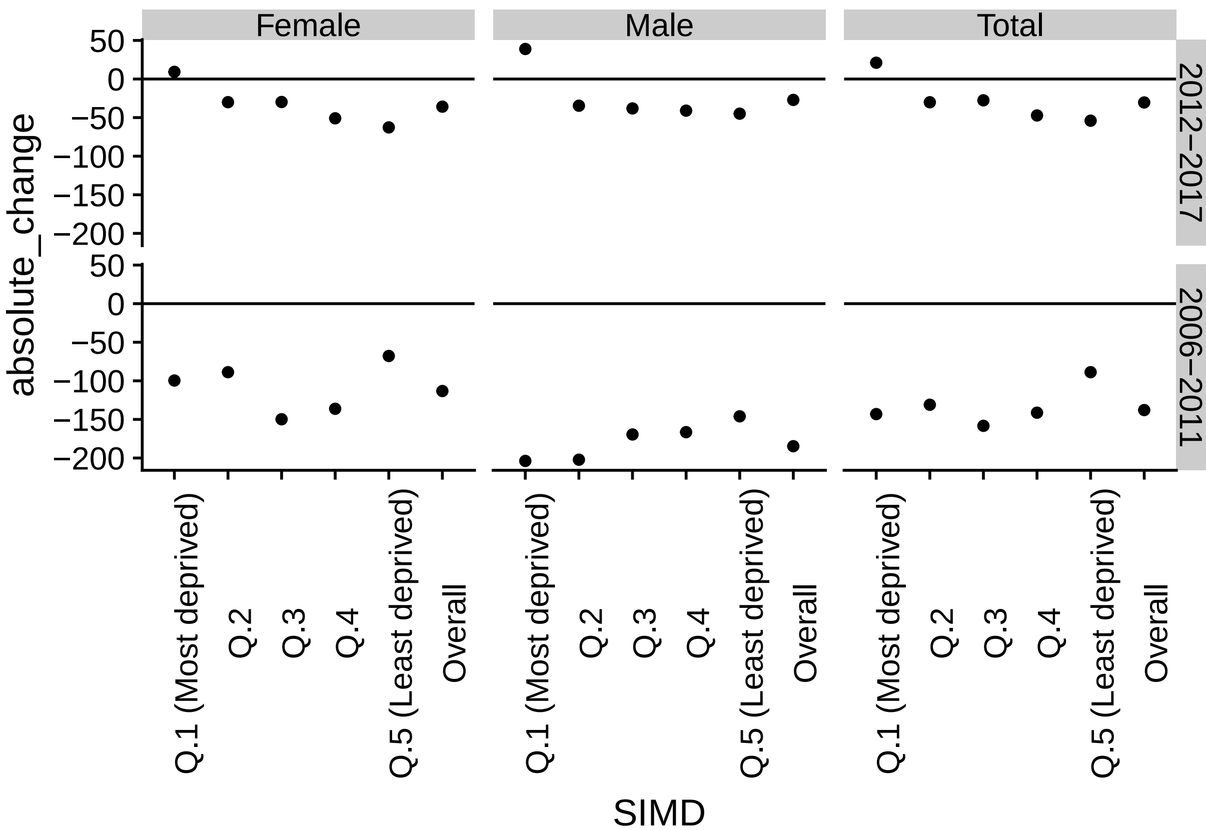
```
## # A tibble: 36 x 4
##    gender SIMD                 period    percent_change
##    <chr>  <fct>                <fct>              <dbl>
##  1 Female Q.1 (Most deprived)  2012-2017          0.690
##  2 Female Q.1 (Most deprived)  2006-2011         -7.21
##  3 Female Q.2                  2012-2017         -2.65
##  4 Female Q.2                  2006-2011         -7.37
##  5 Female Q.3                  2012-2017         -2.96
##  6 Female Q.3                  2006-2011        -13.3
##  7 Female Q.4                  2012-2017         -5.53
##  8 Female Q.4                  2006-2011        -13.2
##  9 Female Q.5 (Least deprived) 2012-2017         -7.79
## 10 Female Q.5 (Least deprived) 2006-2011         -7.81
## # ... with 26 more rows
```

Absolute rates (C6R1)

The following shows how the code chunk above can be adapted to show the absolute changes as a figure.

```
dta_tidy %>%
  mutate(period = case_when(
    between(year, 2012, 2017) ~ "2012-2017",
    between(year, 2006, 2011) ~ "2006-2011",
    TRUE ~ NA_character_) %>% factor(levels = c("2012-2017", "2006-2011"))) %>%
  group_by(gender, simd, period) %>%
  filter(year == min(year) | year == max(year) ) %>%
  filter(!is.na(period)) %>%
  group_by(gender, SIMD, period) %>%
  summarise(
    percent_change = - 100 * (1 - asmr[year == max(year)] / asmr[year == min(year)]),
    absolute_change = asmr[year==max(year)] - asmr[year == min(year)] # additional line
    ) %>%
  ungroup() %>% # indicative visualisation
  ggplot(aes(x = SIMD, y = absolute_change)) +
  geom_point() +
  facet_grid(period~gender) +
  geom_hline(yintercept = 0) +
  theme(axis.text.x = element_text(angle = 90))
```

```
## Warning: Factor `period` contains implicit NA, consider using
## `forcats::fct_explicit_na`
```



We can see from this that the absolute changes slowed in the latter period, and became positive (worse in absolute terms) in the most deprived fifth of the population.

The following shows the above as a table

```
dta_tidy %>%
  mutate(period = case_when(
    between(year, 2012, 2017) ~ "2012-2017",
    between(year, 2006, 2011) ~ "2006-2011",
    TRUE ~ NA_character_) %>% factor(levels = c("2012-2017", "2006-2011"))) %>%
  group_by(gender, simd, period) %>%
  filter(year == min(year) | year == max(year) ) %>%
  filter(!is.na(period)) %>%
  group_by(gender, SIMD, period) %>%
  summarise(
    percent_change = - 100 * (1 - asmr[year == max(year)] / asmr[year == min(year)]),
    absolute_change = asmr[year==max(year)] - asmr[year == min(year)] # additional line
    ) %>%
  ungroup() %>%
  select(-percent_change) %>%
  spread(SIMD, absolute_change)
```

```
## Warning: Factor `period` contains implicit NA, consider using
## `forcats::fct_explicit_na`
```

```
## # A tibble: 6 x 8
##   gender period `Q.1 (Most depr~   Q.2   Q.3   Q.4 `Q.5 (Least dep~
##   <chr>  <fct>             <dbl> <dbl> <dbl> <dbl>            <dbl>
```

```
## 1 Female 2012-~             9.30  -30    -29.8  -50.9            -62.7
## 2 Female 2006-~           -99.6   -88.8 -150.  -136.             -67.8
## 3 Male   2012-~            38.9   -34.6  -38.1  -41              -44.9
## 4 Male   2006-~          -204.   -202.  -170.  -166.            -146
## 5 Total  2012-~            21.1   -30.1  -27.6  -47.2            -54
## 6 Total  2006-~          -143.   -131   -158.  -141.             -88.8
## # ... with 1 more variable: Overall <dbl>
```

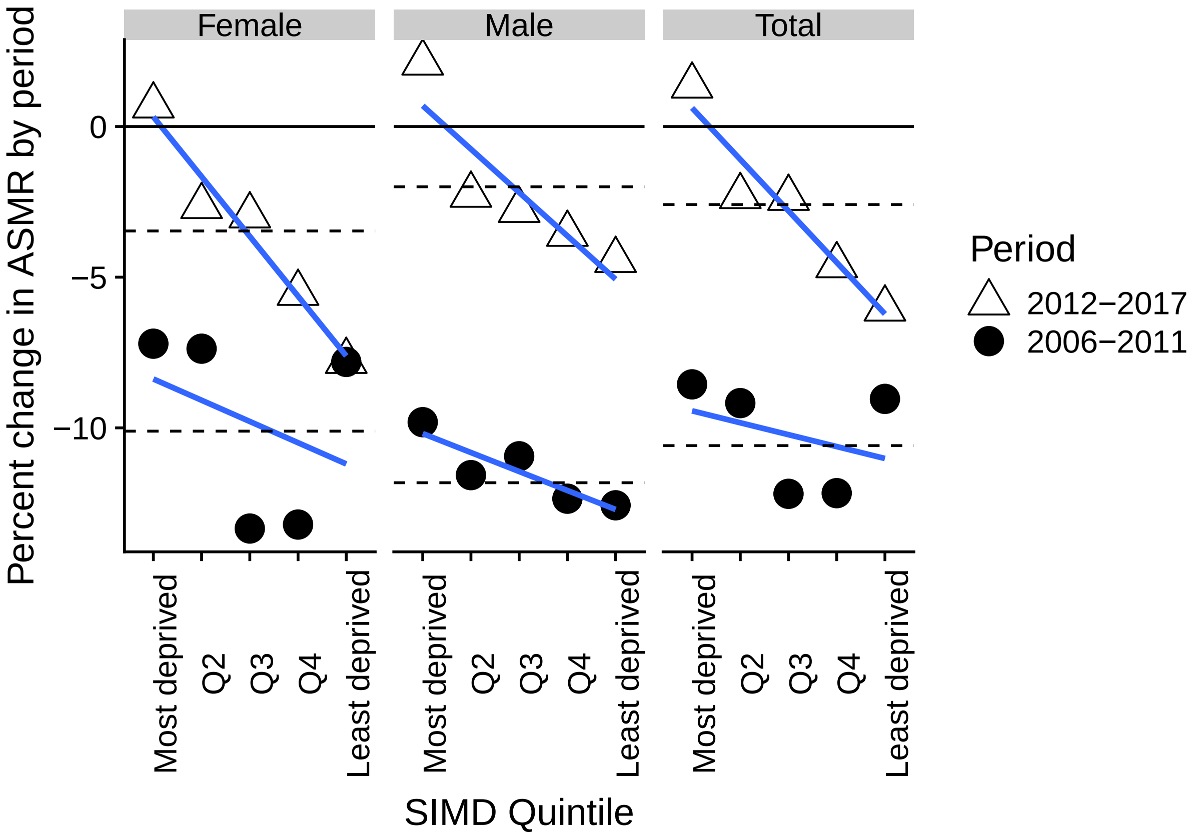
Amended figure (C12R2, C20R3)

Two cosmetic amendments to Figure1b have been requested. The first is to avoid overlapping points between periods; the second is to relabel the xaxis so the labels read 'most deprived' and 'least deprived' rather than 'most' and 'least'.

The following code chunk produces these figures with these amendments made.

```
p2 <- percent_changes %>%
    mutate(SIMD = factor(SIMD,
                       levels = c("Q.1 (Most deprived)",
                                  "Q.2", "Q.3", "Q.4", "Q.5 (Least deprived)", "Overall"),
                       labels = c("Most deprived", "Q2", "Q3", "Q4", "Least deprived", "Overall")
                       )
         ) %>%
  filter(SIMD != "Overall") %>%
  ggplot(aes(x = SIMD, y = percent_change, group = period, shape = period)) +
  facet_wrap( ~ gender) +
  geom_point(size = 5) +
  stat_smooth(method = "lm", se = F) + # This produces the blue line with the regression slopes
  geom_hline(yintercept = 0) +
  geom_hline( # This adds the overall percent change
    aes(yintercept = percent_change, group = period),
    data = percent_changes %>% filter(SIMD == "Overall"),
    linetype = "dashed"
  ) +
  theme(axis.text.x = element_text(angle = 90)) +
  labs(y = "Percent change in ASMR by period", x = "SIMD Quintile") +
  scale_shape_manual("Period", values = c(2, 16))  # This has been changed to make one of the points ho

p2
```



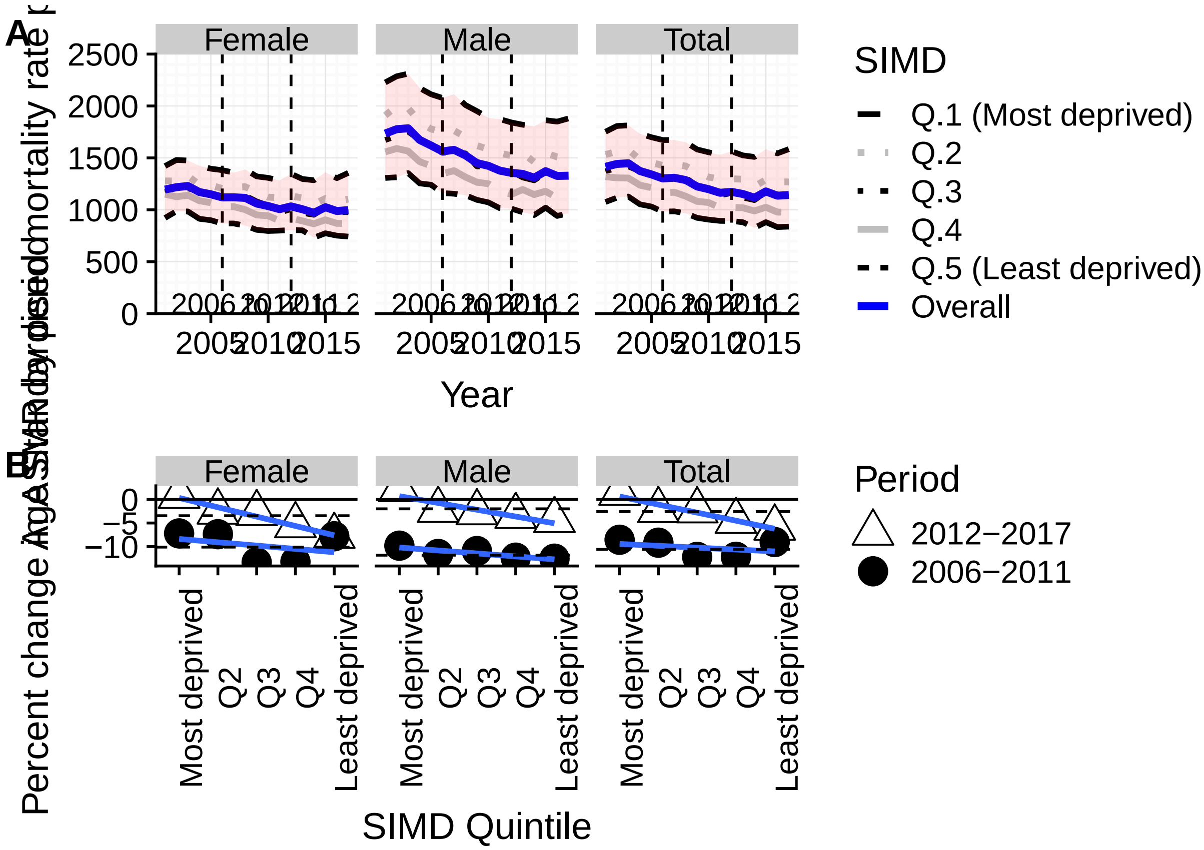
It is now clear that the points overlap in the least deprived quitile.

Combined figure

The following produces the combined figure comprising the two parts shown previously. The figure is rendered as a png format image at 300dpi, and placed in the directory 'figures'.

```
p_both <- plot_grid(p1, p2, labels = c("A", "B"), ncol = 1, align = "v")

p_both
```




```r
ggsave("figures/combined_figure_2012.png", dpi = 300, units = "cm", height = 30, width = 30)
```

Table

The following shows how the contents of the table were produced.

These summarise a series of univariate linear regressions of SIMD quintile against precentage change in ASMR within distinct periods.

The columns `intercept` and `gradient` present summary information about point estimates and 95% confidence intervals for the intercept and gradient of the the regressions, which are then presented in the formatted table.

A functional programming approach was adopted in order to produce the same analyses consistently for different gender and period combinations, using functions within the (`purrr` package)[https://purrr.tidyverse.org/.

```r
get_ci <- function(x){
  tmp <- x %>% summary() %>% coefficients()

  return(
    list(
      lower = tmp[,1] - 1.96 * tmp[,2],
      upper = tmp[,1] + 1.96 * tmp[,2]
    )
  )

}
```

```r
# Model parameters
tbl_1 <- percent_changes %>%
  filter(SIMD != "Overall") %>%
  mutate(qnt = unclass(SIMD) - 1) %>% # This is so the intercept refers to the 1st quintile (not the 'z
  select(gender, period, percent_change, qnt) %>%
  group_by(gender, period) %>%
  nest() %>%
  mutate(mdl = map(data, ~lm(percent_change ~ qnt, data = .x))) %>%
  mutate(`R. sq.` = map_dbl(mdl, ~summary(.x)["r.squared"][[1]])) %>%
  mutate(gradient = map_dbl(mdl, ~coef(.x)["qnt"])) %>%
  mutate(intercept = map_dbl(mdl, ~coef(.x)["(Intercept)"])) %>%
  mutate(cis = map(mdl, get_ci)) %>%
  mutate(
    int_lower = map_dbl(cis, ~.[["lower"]][1]),
    int_upper = map_dbl(cis, ~.[["upper"]][1]),
    grd_lower = map_dbl(cis, ~.[["lower"]][2]),
    grd_upper = map_dbl(cis, ~.[["upper"]][2])
  ) %>%
  select(gender, period, `R. sq.`,
         gradient, grd_lower, grd_upper,
         intercept, int_lower, int_upper
  ) %>%
  mutate(
    gradient = paste0(
      format(round(gradient, 2), nsmall = 2),
      " (",
      format(round(grd_lower, 2), nsmall = 2),
      ", ",
      format(round(grd_upper, 2), nsmall = 2),
      ")"
    )
  ) %>%
  mutate(
    intercept = paste0(
      format(round(intercept, 2), nsmall = 2),
      " (",
      format(round(int_lower, 2), nsmall = 2),
      ", ",
      format(round(int_upper, 2), nsmall = 2),
      ")"
    )
  ) %>%
  select(-grd_lower, -grd_upper, -int_lower, -int_upper)

tbl_1
```

```
## # A tibble: 6 x 5
##   gender period    `R. sq.` gradient              intercept
##   <chr>  <fct>        <dbl> <chr>                 <chr>
## 1 Female 2012-2017    0.960 -1.98 (-2.44, -1.53) "  0.32 ( -0.80,  1.44)"
## 2 Female 2006-2011    0.122 -0.70 (-2.84,  1.44) " -8.38 (-13.62, -3.14)"
## 3 Male   2012-2017    0.803 -1.44 (-2.25, -0.63) "  0.69 ( -1.29,  2.67)"
## 4 Male   2006-2011    0.790 -0.63 (-1.00, -0.26) -10.19 (-11.09, -9.29)
## 5 Total  2012-2017    0.928 -1.71 (-2.25, -1.17) "  0.62 ( -0.70,  1.93)"
```

Table 1: Percent change in ASMR by gender, SIMD quintile, and period

		Percentages							
gender	period	Q.1 (Most deprived)	Q.2	Q.3	Q.4	Q.5 (Least deprived)	Overall	R. sq.	gradient
Female	2006-2011	-7.21	-7.37	-13.34	-13.21	-7.81	-10.11	0.12	-0.70 (-2
Female	2012-2017	0.69	-2.65	-2.96	-5.53	-7.79	-3.46	0.96	-1.98 (-2
Male	2006-2011	-9.81	-11.57	-10.94	-12.35	-12.57	-11.82	0.79	-0.63 (-1
Male	2012-2017	2.11	-2.27	-2.78	-3.57	-4.44	-2.00	0.80	-1.44 (-2
Total	2006-2011	-8.56	-9.18	-12.19	-12.17	-9.04	-10.59	0.12	-0.40 (-1
Total	2012-2017	1.35	-2.32	-2.38	-4.61	-6.05	-2.59	0.93	-1.71 (-2

Note:
Overall: Whole of Scotland. R.Sq. : R-Squared for model. Gradient: Increase in % change per unit increase in quintile. In

```
## 6 Total  2006-2011    0.121 -0.40 (-1.60,  0.81) " -9.44 (-12.39, -6.48)"
```

```r
tbl_2 <- percent_changes %>% spread(SIMD, percent_change)

tbl_both <- inner_join(tbl_2, tbl_1)
```

```
## Joining, by = c("gender", "period")
```

```r
tbl_both
```

```
## # A tibble: 6 x 11
##   gender period `Q.1 (Most depr~    Q.2    Q.3    Q.4 `Q.5 (Least dep~
##   <chr>  <fct>             <dbl>  <dbl>  <dbl>  <dbl>            <dbl>
## 1 Female 2012-~            0.690  -2.65  -2.96  -5.53            -7.79
## 2 Female 2006-~           -7.21   -7.37 -13.3  -13.2             -7.81
## 3 Male   2012-~            2.11   -2.27  -2.78  -3.57            -4.44
## 4 Male   2006-~           -9.81  -11.6  -10.9  -12.4            -12.6
## 5 Total  2012-~            1.35   -2.32  -2.38  -4.61            -6.05
## 6 Total  2006-~           -8.56   -9.18 -12.2  -12.2             -9.04
## # ... with 4 more variables: Overall <dbl>, `R. sq.` <dbl>,
## #   gradient <chr>, intercept <chr>
```

The following converts the above table into a more neatly formatted table using the `kable` and `kableExtra` packages.

```r
tbl_both %>%
  mutate(period = factor(period, levels = c("2006-2011", "2012-2017")))  %>%
  arrange(gender, period) %>%
  knitr::kable(
    digits = 2,
    caption = "Percent change in ASMR by gender, SIMD quintile, and period"
  ) %>%
  kableExtra::kable_styling() %>%
  kableExtra::add_header_above(c(" "," ", "Percentages" = 6, "Model results" = 3)) %>%
  kableExtra::footnote("Overall: Whole of Scotland. R.Sq. : R-Squared for model. Gradient: Increase in %
```

Approach discussed in sensitivity analysis (C2R1, C10R2)

The sensitivity analysis to the paper showed the effect of using the fitted values for the first and last year in each of the periods, rather than the values themselves. This approach can address any concern that the first and last year within either period were in any way anomalous or uncharacteristic of change within the period as a whole.

The function `broom::augment` was used to extract fitted values for each year within each period, gender and SIMD combination. The fitted values, `.fitted`, were then used in place of the observed values, `asmr`, as in the main analyses.

```
percent_changes_pred <- dta_tidy %>%
    mutate(period = case_when(
        between(year, 2012, 2017) ~ "2012-2017",
        between(year, 2006, 2011) ~ "2006-2011",
        TRUE ~ NA_character_) %>% factor(levels = c("2012-2017", "2006-2011"))) %>%
    group_by(gender, SIMD, simd, period) %>%
  nest() %>%
  mutate(mdl = map(data, ~lm(asmr ~ year, data = .x))) %>%
  mutate(aug = map(mdl, broom::augment)) %>%
  select(-data, -mdl) %>%
  unnest() %>%
  filter(!is.na(period)) %>%
  group_by(gender, SIMD, period) %>%
  filter(year == min(year) | year == max(year) ) %>%
  summarise(percent_change = - 100 * (1 - .fitted[year == max(year)] / .fitted[year == min(year)])) %>%
  ungroup()
```

```
## Warning: Factor `period` contains implicit NA, consider using
## `forcats::fct_explicit_na`

## Warning: Factor `period` contains implicit NA, consider using
## `forcats::fct_explicit_na`
```

```
percent_changes_pred_overall <- percent_changes_pred %>%
  group_by(gender, period) %>%
  summarise(percent_change = mean(percent_change)) %>%
  ungroup() %>%
  mutate(SIMD = "Mean of quintiles") %>%
  select(gender, SIMD, period, percent_change)

percent_changes_pred <- percent_changes_pred %>%
  bind_rows(percent_changes_pred_overall) %>%
  mutate(SIMD = factor(SIMD,
                       levels = c("Q.1 (Most deprived)",
                                  "Q.2", "Q.3", "Q.4", "Q.5 (Least deprived)", "Overall", "Mean of quin
                       labels = c("Most deprived", "Q2", "Q3", "Q4", "Least deprived", "Overall", "Mean
                       )
  )
```

```
## Warning in bind_rows_(x, .id): binding factor and character vector,
## coercing into character vector

## Warning in bind_rows_(x, .id): binding character and factor vector,
## coercing into character vector
```

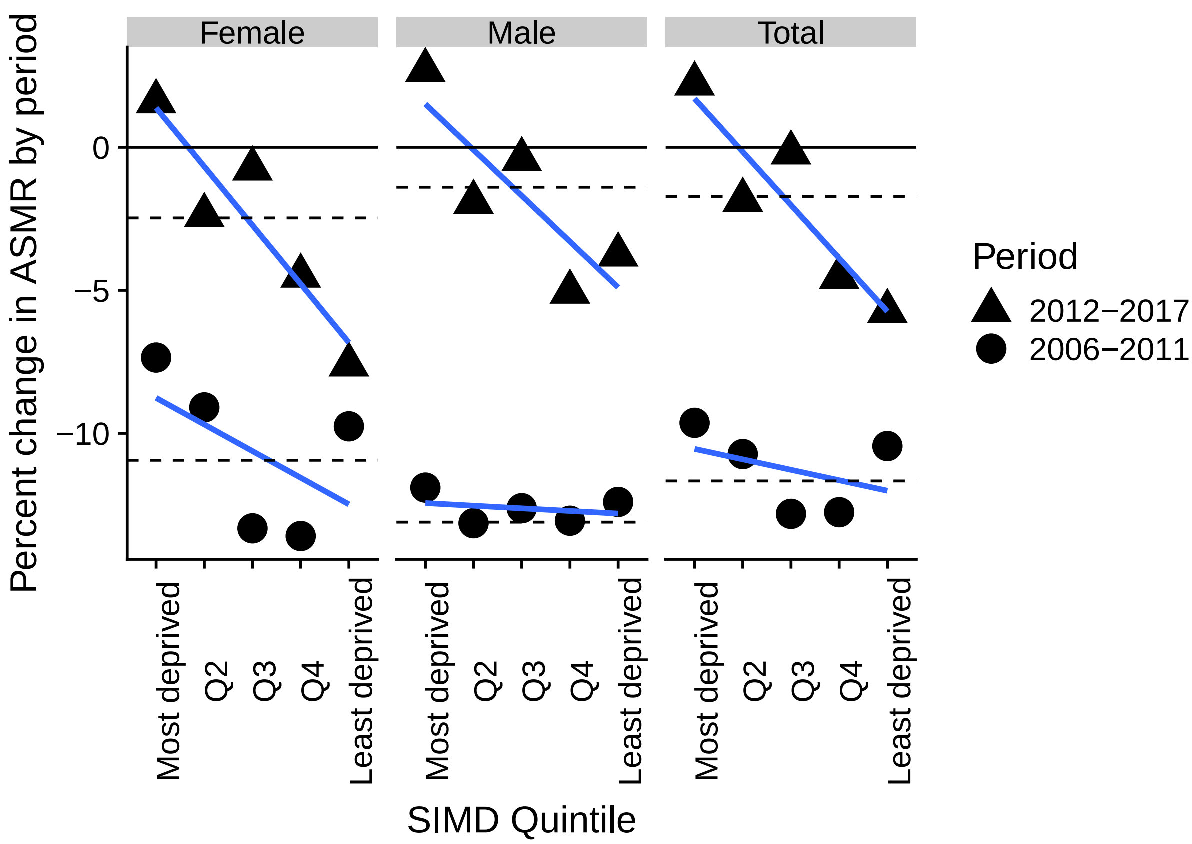
The subfigure using this alternative stratgy is therefore produced as follows:

```
p2a <- percent_changes_pred %>%
  filter(!(SIMD %in% c("Overall", "Mean of quintiles"))) %>%
  ggplot(aes(x = SIMD, y = percent_change, group = period, shape = period)) +
  facet_wrap( ~ gender) +
  geom_point(size = 5) +
  stat_smooth(method = "lm", se = F) +
```

```
  geom_hline(yintercept = 0) +
  geom_hline(
    aes(yintercept = percent_change, group = period),
    data = percent_changes_pred %>% filter(SIMD == "Overall"),
    linetype = "dashed"
  ) +

  theme(axis.text.x = element_text(angle = 90)) +
  labs(y = "Percent change in ASMR by period", x = "SIMD Quintile") +
  scale_shape_manual("Period", values = c(17, 16))

p2a
```




```
ggsave("figures/fig1a_using_alt_method_2012.png", dpi = 300, units = "cm", height = 16, width = 30)
```

The table of the above, using this alternative modelling strategy, is produced using the code chunks below

```
get_ci <- function(x){
  tmp <- x %>% summary() %>% coefficients()

  return(
    list(
      lower = tmp[,1] - 1.96 * tmp[,2],
      upper = tmp[,1] + 1.96 * tmp[,2]
    )
  )
```

```
}

# Model parameters
tbl_1a <- percent_changes_pred %>%
  filter(!(SIMD %in% c("Overall", "Mean of quintiles"))) %>%
  mutate(qnt = unclass(SIMD) - 1) %>% # This is so the intercept refers to the 1st quintile (not the 'z
  select(gender, period, percent_change, qnt) %>%
  group_by(gender, period) %>%
  nest() %>%
  mutate(mdl = map(data, ~lm(percent_change ~ qnt, data = .x))) %>%
  mutate(`R. sq.` = map_dbl(mdl, ~summary(.x)["r.squared"][[1]])) %>%
  mutate(gradient = map_dbl(mdl, ~coef(.x)["qnt"])) %>%
  mutate(intercept = map_dbl(mdl, ~coef(.x)["(Intercept)"])) %>%
  mutate(cis = map(mdl, get_ci)) %>%
  mutate(
    int_lower = map_dbl(cis, ~.[["lower"]][1]),
    int_upper = map_dbl(cis, ~.[["upper"]][1]),
    grd_lower = map_dbl(cis, ~.[["lower"]][2]),
    grd_upper = map_dbl(cis, ~.[["upper"]][2])
  ) %>%
  select(gender, period, `R. sq.`,
         gradient, grd_lower, grd_upper,
         intercept, int_lower, int_upper
  ) %>%
  mutate(
    gradient = paste0(
      format(round(gradient, 2), nsmall = 2),
      " (",
      format(round(grd_lower, 2), nsmall = 2),
      ", ",
      format(round(grd_upper, 2), nsmall = 2),
      ")"
    )
  ) %>%
  mutate(
    intercept = paste0(
      format(round(intercept, 2), nsmall = 2),
      " (",
      format(round(int_lower, 2), nsmall = 2),
      ", ",
      format(round(int_upper, 2), nsmall = 2),
      ")"
    )
  ) %>%
  select(-grd_lower, -grd_upper, -int_lower, -int_upper)

tbl_1a
```

```
## # A tibble: 6 x 5
##   gender period    `R. sq.` gradient              intercept
##   <chr>  <fct>        <dbl> <chr>                 <chr>
## 1 Female 2012-2017    0.848 -2.05 (-3.03, -1.07) "  1.38 ( -1.03,   3.78)"
## 2 Female 2006-2011    0.290 -0.93 (-2.58,  0.72) " -8.76 (-12.80,  -4.72)"
## 3 Male   2012-2017    0.705 -1.60 (-2.78, -0.43) "  1.51 ( -1.36,   4.39)"
```

Table 2: Percent change in ASMR by gender, SIMD quintile, and period. (Alternative method)

		Percentages							
gender	period	Most deprived	Q2	Q3	Q4	Least deprived	Overall	R. sq.	gradient
Female	2006-2011	-7.35	-9.09	-13.32	-13.59	-9.76	-10.94	0.29	-0.93 (-2.58, 0.72)
Female	2012-2017	1.60	-2.38	-0.75	-4.50	-7.60	-2.47	0.85	-2.05 (-3.03, -1.07)
Male	2006-2011	-11.90	-13.14	-12.62	-13.06	-12.40	-13.11	0.08	-0.09 (-0.44, 0.26)
Male	2012-2017	2.69	-1.92	-0.42	-5.06	-3.76	-1.40	0.71	-1.60 (-2.78, -0.43)
Total	2006-2011	-9.63	-10.73	-12.82	-12.76	-10.45	-11.67	0.16	-0.37 (-1.31, 0.58)
Total	2012-2017	2.22	-1.85	-0.19	-4.54	-5.73	-1.72	0.83	-1.86 (-2.80, -0.92)

Note:

Overall: Whole of Scotland. R.Sq. : R-Squared for model. Gradient: Increase in % change per unit increase in quintile. In

```
## 4 Male   2006-2011   0.0813 -0.09 (-0.44,  0.26) -12.44 (-13.29, -11.59)
## 5 Total  2012-2017   0.834  -1.86 (-2.80, -0.92) "  1.70 ( -0.60,   4.01)"
## 6 Total  2006-2011   0.162  -0.37 (-1.31,  0.58) -10.55 (-12.85,  -8.24)
```

```r
tbl_2a <- percent_changes_pred %>% filter(SIMD != "Mean of quintiles") %>% spread(SIMD, percent_change)

tbl_both_a <- inner_join(tbl_2a, tbl_1a)
```

```
## Joining, by = c("gender", "period")
```

```r
tbl_both_a
```

```
## # A tibble: 6 x 11
##   gender period `Most deprived`     Q2      Q3     Q4 `Least deprived`
##   <chr>  <fct>            <dbl>  <dbl>   <dbl>  <dbl>            <dbl>
## 1 Female 2012-~            1.60  -2.38  -0.751  -4.50            -7.60
## 2 Female 2006-~           -7.35  -9.09 -13.3   -13.6             -9.76
## 3 Male   2012-~            2.69  -1.92  -0.424  -5.06            -3.76
## 4 Male   2006-~          -11.9  -13.1  -12.6   -13.1            -12.4
## 5 Total  2012-~            2.22  -1.85  -0.190  -4.54            -5.73
## 6 Total  2006-~           -9.63 -10.7  -12.8   -12.8            -10.4
## # ... with 4 more variables: Overall <dbl>, `R. sq.` <dbl>,
## #   gradient <chr>, intercept <chr>
```

And the table using the alternative approach

```r
tbl_both_a %>%
  mutate(period = factor(period, levels = c("2006-2011", "2012-2017")))  %>%
  arrange(gender, period) %>%
  knitr::kable(
    digits = 2,
    caption = "Percent change in ASMR by gender, SIMD quintile, and period. (Alternative method)"
  ) %>%
  kableExtra::kable_styling() %>%
  kableExtra::add_header_above(c(" "," ", "Percentages" = 6, "Model results" = 3)) %>%
  kableExtra::footnote("Overall: Whole of Scotland. R.Sq. : R-Squared for model. Gradient: Increase in %
```

Discussion

This document has provided descriptions of the data used, the processing performed on the data, and the code used to perform all analyses, visualisations, and tabulations. Our hope is this addresses any methodological concerns from viewers and reviewers, and will make it much more straightforward for anyone who wants to replicate and advance on our analyses to do so.

Requests from reviewers

This section will include additional analyses performed as a result of reviewer comments.

C7 R1 - Observed vs predicted values

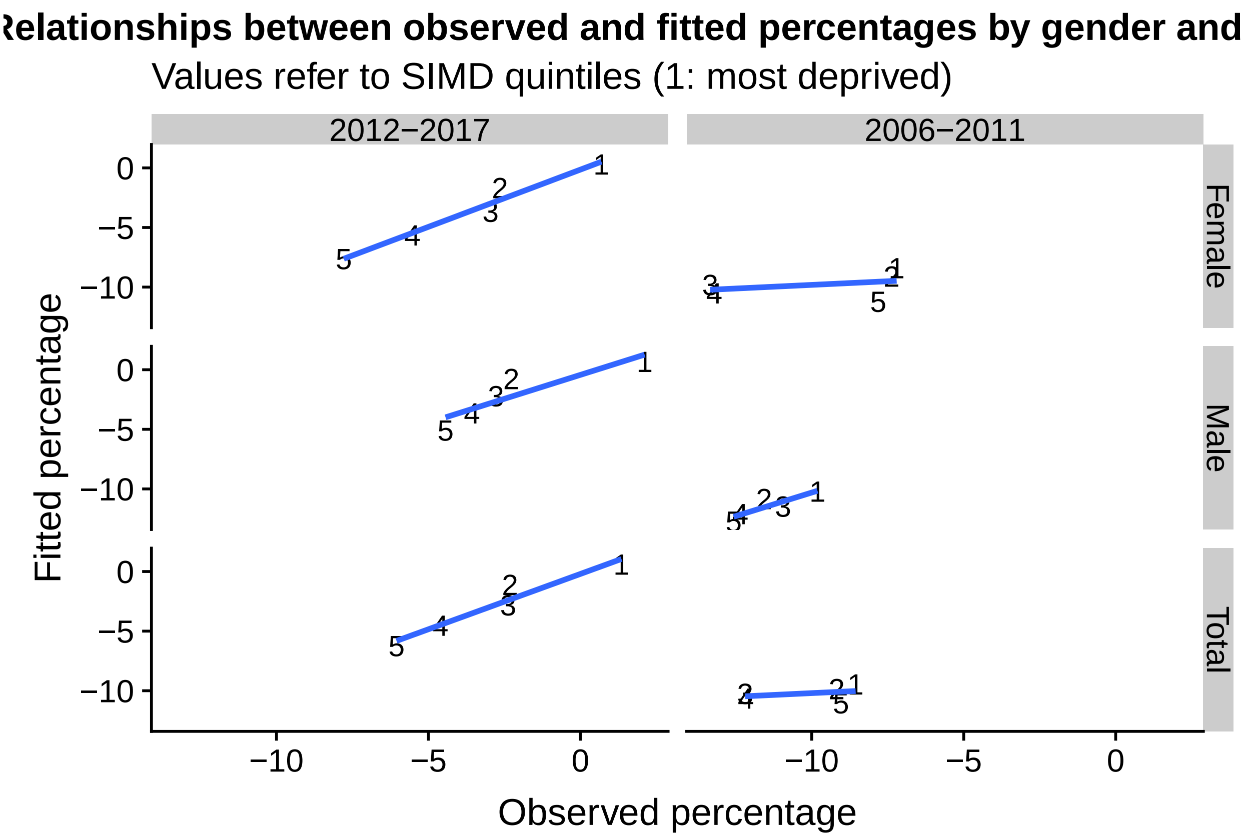
The reviewer comment was:

```
R-squared is a poor measure in and of itself of model fit - particularly given the small number of obse
```

The predicted vs observed values are shown as follows:

```
percent_changes %>%
  filter(SIMD != "Overall") %>%
  mutate(qnt = unclass(SIMD) - 1) %>% # This is so the intercept refers to the 1st quintile (not the 'z
  select(gender, period, percent_change, qnt) %>%
  group_by(gender, period) %>%
  nest() %>%
  mutate(mdl = map(data, ~lm(percent_change ~ qnt, data = .x))) %>%
  mutate(dta_augmented = map2(mdl, data, broom::augment)) %>%
  select(-data, -mdl) %>%
  unnest() %>%
  ggplot(aes(x = percent_change, y = .fitted, label = qnt + 1)) +
  geom_text() +
  facet_grid(gender ~ period) +
  stat_smooth(method = "lm", se = F) +
  labs(
    x = "Observed percentage",
    y = "Fitted percentage",
    title = "Relationships between observed and fitted percentages by gender and period",
    subtitle = "Values refer to SIMD quintiles (1: most deprived)"

  )
```



This supports the observation that the relationship has become more linear over time, as also illustrated by the changing R^2 values between the two periods.