Lynda’s Short Report

# Preamble/notes

Lynda noticed an important finding in NRS data on Age-Standardised Mortality Rates in Scotland by deprivation quintile. This is that, after the ‘breakpoint’, inequalities in ASMR by deprivation quintile increased as overall ASMR improvements stalled, especially for women.

The aim of this document is to produce a first draft of these findings within the 1500 word limit of a JECH short report.

## JECH Short Report Spec

### Short report

Manuscripts reporting initial results of innovative research that deserve immediate dissemination before finalisation. The section must not be used to present a poorly elaborated research report. Short Reports should follow the IMRaD style (Introduction, Methods, Results and Discussion) and should have a structured abstract (Background, Methods, Results and Conclusion).

All research on human subjects must have been approved by the appropriate ethics committee and must have conformed to the principles embodied in the Declaration of Helsinki (see Ethics Approval for more guidelines). A statement to this effect must be included in the methods section of the paper.

Manuscripts should include a box offering a thumbnail sketch of what is already known and what your paper adds to the literature (see Research Reports).

* *Word count*: up to 1500 words
* *Structured Abstract*: up to 200 words
* *Tables/Illustrations* : up to 2
* *References*: up to 20

# Structured Abstract

## Background

* Life expectancies have been stalling in Scotland, as well as in many other rich world nations, since around 2010. However, the relationship between stalling mortality improvements and socioeconomic inequalities in health in not yet known.

## Methods

* We calculate the percentage improvement in age-standardised mortality rates (ASMR) in Scotland overall, by gender, and by SIMD deprivation quintile and gender, for two periods: 2004-2010, and 2011-2017. We then calculate the socioeconomic gradients in improvements for both periods and each gender.

## Results

* Between 2004 to 2010, ASMRs fell by 12.8% (11.5% in females and 14.9% in males), but between 2011 to 2017 ASMRs only fell by 1.8% (0.9% in females and 3.5% in males). The socioeconomic gradient in ASMR improvement more than doubled, from 1.0% per quintile in 2004-2010 (1.3% in females, 0.3% in males) to 2.2% (2.8% in females, 1.3% in males). Within the most deprived quintile, ASMRs fell in the 2004-2010 period (10.4% overall, 8.1% in females and 13.2% in males), but rose in the 2011-2017 period (by 3.6% overall, 5.8% in females and 0.4% in males).

## Conclusion

* As trends towards falling mortality risks in Scotland stalled from 2011-2017 compared with 2004-2010, socioeconomic gradients in mortality widened, especially in females, and mortality risks increased in the most socioeconomically deprived fifth of the population.

# Report

## Introduction

* As in many other countries, life expectancy improvements have stalled in Scotland.
* The stall in Scotland may be more severe than in most comparable nations, with an absolute fall (rather than slowing down) in life expectancy from 2015 to 2016. (?)
* The association between stalling improvements in life expectancy, and health inequalities by socioeconomic gradient, is unclear.
* Longevity in Scotland is lower than comparator nations for both genders, but more so in relative terms for females than males.
* European age-standardised mortality rates (ASMRs) are a way of comparing mortality risks between populations between and within countries in a way that controls for population structure. The NRS have published ASMRs by population quintile, as measured by SIMD, for Scottish populations from 2001 to 2017.
* We use this recently published data to explore how health inequalities in longevity by socioeconomic gradient and gender have changed in Scotland in a recent six year period of stalling life expectancies (from 2011 to 2017) compared with the previous six year period (2004 to 2010).

## Methods

* ASMRs from the NRS by SIMD quintile were extracted from the NRS website. ASMRs were used because life expectancy estimates for the latter period have not yet been released.
* The trends in ASMRs for each year from 2001 to 2017 inclusive by gender, overall and by SIMD quintile, were plotted.
* The percentage changes in ASMRs from 2004 to 2010 (period 1), and from 2011 to 2017 (period 2), were calculated by gender, for the whole of Scotland, and by SIMD quintile were calculated. These periods were selected because they cover the same number of years, and because the latter period includes years where life expectancy in Scotland has either fallen or improved very slowly.
* The socioeconomic gradient in percentage improvement was calculated for both periods, and by gender, by regressing percentage improvement aginst SIMD quintile using standard linear regression. Model fits were assessed with the R-squared statistic, and the intercept (predicted percentage improvements in most deprived quintile) and gradients (average increase in percentage improvement associated with move up one quintile category) were calculated and presented in tabular format.

## Results

* Figure 1A shows the change in ASMR per 100 000 population from 2001 to 2017. The thick black line shows the ASMR for Scotland overall, and thinner dashed lines indicate ASMRs for SIMD quintile groups. The two six year periods (2004-2010 and 2011-2017) are labelled and separated with vertical dashed lines. This figure shows that ASMRs improved throughout the period 2004-2010, but not in the period 2011-2017, for both genders. The falls in ASMR by deprivation quintile in the 2004-2010 period largely appear to run in parallel, suggesting that absolute (though not necessarily relative) inequalities in longevity did not increase during this period, except perhaps for females in the most deprived quintile.
* Figure 1B shows how the percentage improvement in ASMR from the start to the end of the two periods changed by SIMD quintile. Circles are used to indicate values in the 2004-2010 period, and triangles used to indicate the 2011-2017 period. The horizontal dashed lines indicate the overall percent improvement within the period, and the diagonal lines show the socioeconomic gradients. Table 1 provides the same information in tabular form.
* In the 2004-2010 period (circles in Figure 1B), ASMRs improved by 12.76% overall (11.49% for females and 14.93% for males). By constrast, in the 2011-2017 period (triangles in Figure 1B), ASMRs improved by only 1.83% overall (0.90% for females and 3.53% for males). A clear socioeconomic gradient was observed in these improvements for both periods, with larger improvements in higher SIMD groups. The linearity of the socioeconomic gradient appeared to fall somewhat from the earlier to the latter period, as suggested by a near-perfect R-Squared value (0.98) in the 2004-2010 period, and a slightly lower fit (0.84) in the 2011-2017 period. This declining fit is largely driven by the gradient in females (R-Squared 0.90 to 0.85), with the fit in males increasing slightly (0.42 to 0.67). However, while the linearity of the fit has declined, the gradient of the fit, which can be considered a measure of the importance of socioeconomic gradient to health inequalities, has increased markedly, from 0.96% per quintile in the 2004-2010 period to 2.17% per quintile in the 2011-2017 period; a ratio of gradients of 2.3, and difference in gradients of 1.2%. The change in ratio of gradients was steeper for males (4.1 compared with 2.08 for females), though the difference in gradients was greater for females (2.1%) than for males (1.0%).
* The column marked ‘intercept’ is the percentage improvement in quintile 1 (the most deprived quintile) predicted by the linear models. This can be compared with the actual percentages for quintile 1 in the third column of table 1 (as well as the corresponding points in Figure 1B). In the 2004-2010 period, the predicted values for the lowest quintile were close to the observed values, whereas for the 2011-2017 values the model predictions substantially underestimated the observed values, being 1.2% lower than predicted overall (3.62% compared with 2.45%). As Figure 1B also shows, the linear fits also under-predict improvements in quintile 2, as well as over-predicting improvements in quintile 1.

## Discussion

* *Summary*: This paper has shown that, as improvements in mortality have stalled in Scotland, socioeconomic gradients in mortality have increased, especially for women. In the most socioeconomically deprived fifth of areas in Scotland, improvements have gone into reverse, with ASMRs increasing by 3.6% from 2011 to 2017.
* *Limitations*: This paper has not looked at life expectancies, as these have not been published for 2017. However ASMR and life expectancy trends are closely linked. The paper has also not looked at age-specific mortality rates, rather than age-standardised rates, and there may be important differences in gradients by age group.
* *Implications for Practice*: To do
* *Implications for Research*: To do

Background

1. Life expectancy improvements have stalled in Scotland; most recent NRS data showed a fall for men and women; the scale of this trend is marked historically and in comparison with other countries.
2. Age-standardised mortality rates (all age, all cause) changed trend from steady decline to a rate of slower or no improvement in the year ending 2012 Q4 for men and the year ending 2014 Q2 for women (paper 1, segmented regression, 2 break model, best estimates).
3. Mortality inequalities are increasing in Scotland:
4. Long-term monitoring report (HLE, premature mortality SII&RII)
5. NRS life expectancy by SIMD
6. Several published analyses explore the contribution of deaths by age and cause to overall mortality inequality, and some have repeated this at different time points to explore how the constituents of inequality have changed.
7. Analyses of overall mortality trends have tended to explore the age, cause and geographical variation in this (by decomposition or age/cause specific trends).
8. Bringing together analyses on overall population mortality and mortality inequality is an important step in understanding to what extent
9. Change in fundamentals –> widening health inequalities in longevity Questions
10. Are increasing inequalities having a marked impact on overall population mortality trends? Method

Data source NRS published: \* Life expectancy by SIMD 2012 (2001/03-2011/13) <https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/life-expectancy/life-expectancy-in-scottish-areas/time-series-data> \* Life expectancy by SIMD 2016 (2014/15-2-15/17) – expected shortly \* Age-standardised mortality rate by SIMD 2016 quintile 2001-2017 <https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/vital-events/deaths/age-standardised-death-rates-calculated-using-the-esp> ASMR – NRS 2001-2017 SIMD 2016 Quintile

1. Trend
2. Before & after breakpoint (2011)
3. Overall measures of inequality before and after (SII/RII)
4. Gender differences

Results 1. Trend 2. Before & after breakpoint (2011) 3. Overall measures of inequality before and after (SII/RII) 4. Gender differences

Discussion

Limitations

Implications for practice

Implications for research

# Analysis itself

Only two tables/figures are permitted.

One figure and one table

The figure should comprise:

* Trends and before after

The Table should comprise

* Numbers, gradient, and stat sig

# Load packages

pacman::p\_load(tidyverse, readxl, cowplot)

# Load data

dta <- read\_excel("ASMR\_SIMD\_2001\_2017\_indexed trends.xlsx", sheet = "flat\_data")

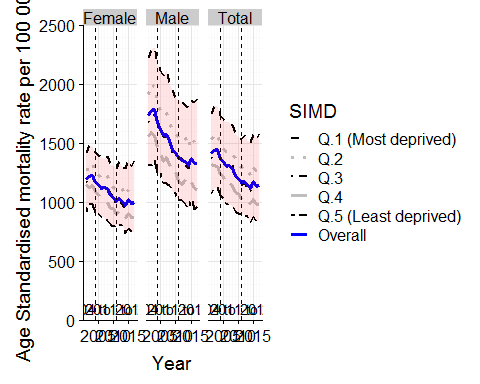
# Tidy data

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")  
 )  
 )

# Visualise

Trends

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 = 2011, linetype = "dashed") +   
 geom\_vline(xintercept = 2004, linetype = "dashed") +   
 annotate("text", y = 100, x = 2004 + (2011 - 2004) / 2, label = "2004 to 2010") +   
 annotate("text", y = 100, x = 2011 + (2018 - 2011) / 2, label = "2011 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



Before/after

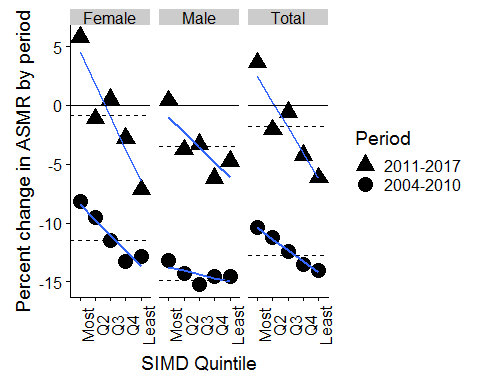
Data prep

percent\_changes <- dta\_tidy %>%   
 mutate(period = case\_when(  
 between(year, 2011, 2017) ~ "2011-2017",   
 between(year, 2004, 2010) ~ "2004-2010",  
 TRUE ~ NA\_character\_) %>% factor(levels = c("2011-2017", "2004-2010"))) %>%   
 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)])) %>%   
 ungroup()

## Warning: Factor `period` contains implicit NA, consider using  
## `forcats::fct\_explicit\_na`

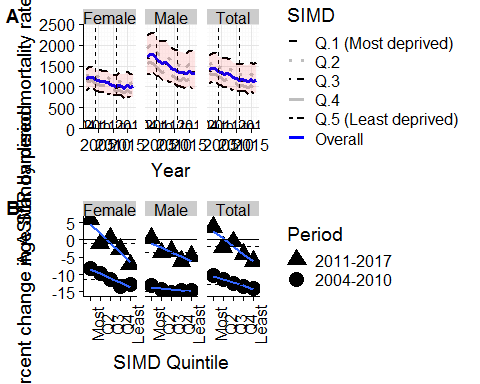
Graph

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", "Q2", "Q3", "Q4", "Least", "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) +   
 geom\_hline(yintercept = 0) +   
 geom\_hline(  
 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(17, 16))   
   
p2



# Combined figure

p\_both <- plot\_grid(p1, p2, labels = c("A", "B"), ncol = 1, align = "v")  
  
p\_both



ggsave("combined\_figure.png", dpi = 300, units = "cm", height = 30, width = 30)

And a table

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\_1 <- percent\_changes %>%   
 filter(SIMD != "Overall") %>%   
 mutate(qnt = unclass(SIMD) - 1) %>% # This is so the intercept refers to the 1st quintile (not the 'zeroth' quintile)  
 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 2011-2017 0.848 -2.75 (-4.07, -1.43) " 4.53 ( 1.30, 7.76)"  
## 2 Female 2004-2010 0.902 -1.32 (-1.81, -0.82) " -8.43 ( -9.63, -7.23)"  
## 3 Male 2011-2017 0.673 -1.28 (-2.29, -0.27) " -0.99 ( -3.47, 1.48)"  
## 4 Male 2004-2010 0.420 -0.31 (-0.73, 0.10) -13.75 (-14.76, -12.73)   
## 5 Total 2011-2017 0.843 -2.17 (-3.23, -1.11) " 2.45 ( -0.15, 5.05)"  
## 6 Total 2004-2010 0.983 -0.96 (-1.10, -0.82) -10.41 (-10.75, -10.06)

tbl\_2 <- percent\_changes %>% spread(SIMD, percent\_change)  
  
tbl\_both <- inner\_join(tbl\_2, tbl\_1)

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

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 2011-~ 5.75 -1.15 0.504 -2.80 -7.19  
## 2 Female 2004-~ -8.14 -9.55 -11.5 -13.3 -12.8   
## 3 Male 2011-~ 0.384 -3.79 -3.34 -6.24 -4.79  
## 4 Male 2004-~ -13.2 -14.3 -15.2 -14.6 -14.6   
## 5 Total 2011-~ 3.62 -2.10 -0.579 -4.27 -6.17  
## 6 Total 2004-~ -10.3 -11.3 -12.5 -13.5 -14.0   
## # ... with 4 more variables: Overall <dbl>, `R. sq.` <dbl>,  
## # gradient <chr>, intercept <chr>

Now to present this table in a neat way.

tbl\_both %>%   
 mutate(period = factor(period, levels = c("2004-2010", "2011-2017"))) %>%  
 arrange(gender, period) %>%   
 knitr::kable("html",  
 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 % change per unit increase in quintile. Intercept: Predicted % change in most deprived quintile. For gradient and intercept, values in parentheses show lower and upper 95% confidence intervals of coefficients respectively.")

Percent change in ASMR by gender, SIMD quintile, and period

Percentages

Model results

gender

period

Q.1 (Most deprived)

Q.2

Q.3

Q.4

Q.5 (Least deprived)

Overall

R. sq.

gradient

intercept

Female

2004-2010

-8.14

-9.55

-11.47

-13.31

-12.84

-11.49

0.90

-1.32 (-1.81, -0.82)

-8.43 ( -9.63, -7.23)

Female

2011-2017

5.75

-1.15

0.50

-2.80

-7.19

-0.90

0.85

-2.75 (-4.07, -1.43)

4.53 ( 1.30, 7.76)

Male

2004-2010

-13.16

-14.29

-15.25

-14.57

-14.59

-14.93

0.42

-0.31 (-0.73, 0.10)

-13.75 (-14.76, -12.73)

Male

2011-2017

0.38

-3.79

-3.34

-6.24

-4.79

-3.53

0.67

-1.28 (-2.29, -0.27)

-0.99 ( -3.47, 1.48)

Total

2004-2010

-10.35

-11.27

-12.46

-13.54

-14.00

-12.76

0.98

-0.96 (-1.10, -0.82)

-10.41 (-10.75, -10.06)

Total

2011-2017

3.62

-2.10

-0.58

-4.27

-6.17

-1.83

0.84

-2.17 (-3.23, -1.11)

2.45 ( -0.15, 5.05)

Note:

Overall: Whole of Scotland. R.Sq. : R-Squared for model. Gradient: Increase in % change per unit increase in quintile. Intercept: Predicted % change in most deprived quintile. For gradient and intercept, values in parentheses show lower and upper 95% confidence intervals of coefficients respectively.

# Alternative approach to producing differences

Rather than using the actual values from the start and the end of each of the periods, we could use the values for the first and last year as predicted by the trends within the 6 year periods. This would have the effect of controlling for whether the first and last year are anomalous, but might be harder to explain.

percent\_changes\_pred <- dta\_tidy %>%   
 mutate(period = case\_when(  
 between(year, 2011, 2017) ~ "2011-2017",   
 between(year, 2004, 2010) ~ "2004-2010",  
 TRUE ~ NA\_character\_) %>% factor(levels = c("2011-2017", "2004-2010"))) %>%   
 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`

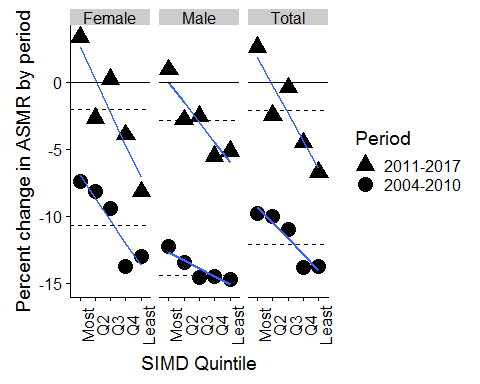
percent\_changes\_pred\_overall <- percent\_changes\_pred %>%   
 group\_by(gender, period) %>%   
 summarise(percent\_change = mean(percent\_change)) %>%   
 ungroup() %>%   
 mutate(SIMD = "Mean of quintiles") %>%   
 select(gender, SIMD, period, percent\_change)  
   
percent\_changes\_pred <- percent\_changes\_pred %>%   
 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 quintiles"),  
 labels = c("Most", "Q2", "Q3", "Q4", "Least", "Overall", "Mean of quintiles")  
 )  
 )

## 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 figure itself - in this version the dashed line is for ‘overall’, whereas the dot-dashed line is the mean of the values for quintiles. I’m not sure if this helps…

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("fig1a\_using\_alt\_method.png", dpi = 300, units = "cm", height = 16, width = 30)

And in tabular form

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 'zeroth' quintile)  
 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 2011-2017 0.782 -2.43 (-3.89, -0.98) " 2.62 ( -0.94, 6.18)"  
## 2 Female 2004-2010 0.859 -1.69 (-2.46, -0.92) " -6.95 ( -8.84, -5.05)"  
## 3 Male 2011-2017 0.829 -1.49 (-2.26, -0.73) " -0.03 ( -1.91, 1.84)"  
## 4 Male 2004-2010 0.816 -0.60 (-0.92, -0.28) -12.73 (-13.51, -11.94)   
## 5 Total 2011-2017 0.823 -2.08 (-3.17, -0.99) " 1.85 ( -0.82, 4.52)"  
## 6 Total 2004-2010 0.875 -1.17 (-1.68, -0.67) " -9.32 (-10.55, -8.09)"

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")

tbl\_both\_a

## # A tibble: 6 x 11  
## gender period Most Q2 Q3 Q4 Least Overall `R. sq.`  
## <chr> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 Female 2011-~ 3.34 -2.67 0.225 -3.93 -8.19 -2.05 0.782  
## 2 Female 2004-~ -7.37 -8.12 -9.42 -13.7 -13.0 -10.7 0.859  
## 3 Male 2011-~ 0.938 -2.81 -2.53 -5.54 -5.17 -2.81 0.829  
## 4 Male 2004-~ -12.3 -13.5 -14.6 -14.5 -14.7 -14.5 0.816  
## 5 Total 2011-~ 2.61 -2.47 -0.407 -4.52 -6.74 -2.07 0.823  
## 6 Total 2004-~ -9.81 -10.0 -10.9 -13.8 -13.8 -12.1 0.875  
## # ... with 2 more variables: gradient <chr>, intercept <chr>

And the table using the alternative approach

tbl\_both\_a %>%   
 mutate(period = factor(period, levels = c("2004-2010", "2011-2017"))) %>%  
 arrange(gender, period) %>%   
 knitr::kable("html",  
 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 % change per unit increase in quintile. Intercept: Predicted % change in most deprived quintile. For gradient and intercept, values in parentheses show lower and upper 95% confidence intervals of coefficients respectively.")

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

Percentages

Model results

gender

period

Most

Q2

Q3

Q4

Least

Overall

R. sq.

gradient

intercept

Female

2004-2010

-7.37

-8.12

-9.42

-13.72

-13.01

-10.70

0.86

-1.69 (-2.46, -0.92)

-6.95 ( -8.84, -5.05)

Female

2011-2017

3.34

-2.67

0.22

-3.93

-8.19

-2.05

0.78

-2.43 (-3.89, -0.98)

2.62 ( -0.94, 6.18)

Male

2004-2010

-12.29

-13.45

-14.59

-14.53

-14.74

-14.45

0.82

-0.60 (-0.92, -0.28)

-12.73 (-13.51, -11.94)

Male

2011-2017

0.94

-2.81

-2.53

-5.54

-5.17

-2.81

0.83

-1.49 (-2.26, -0.73)

-0.03 ( -1.91, 1.84)

Total

2004-2010

-9.81

-10.01

-10.95

-13.80

-13.78

-12.08

0.88

-1.17 (-1.68, -0.67)

-9.32 (-10.55, -8.09)

Total

2011-2017

2.61

-2.47

-0.41

-4.52

-6.74

-2.07

0.82

-2.08 (-3.17, -0.99)

1.85 ( -0.82, 4.52)

Note:

Overall: Whole of Scotland. R.Sq. : R-Squared for model. Gradient: Increase in % change per unit increase in quintile. Intercept: Predicted % change in most deprived quintile. For gradient and intercept, values in parentheses show lower and upper 95% confidence intervals of coefficients respectively.