



GREAT ORMOND STREET  
INSTITUTE OF CHILD HEALTH



Administrative Data  
Research Centre  
England



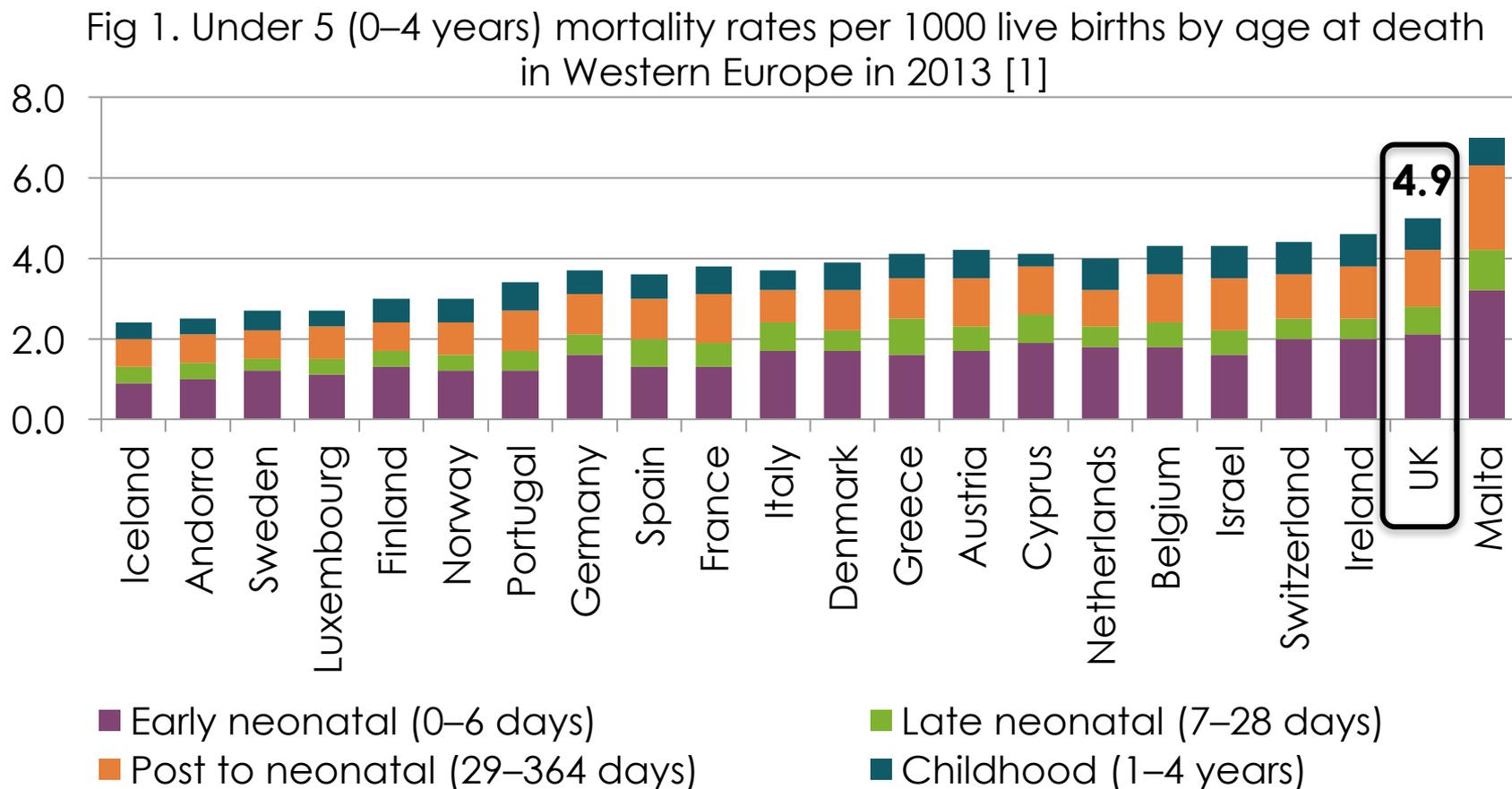
# Comparison of under-5 mortality in England and in Sweden using electronic birth cohorts from administrative linked data

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# Background

## The UK has one of the highest child mortality rates in Western Europe...

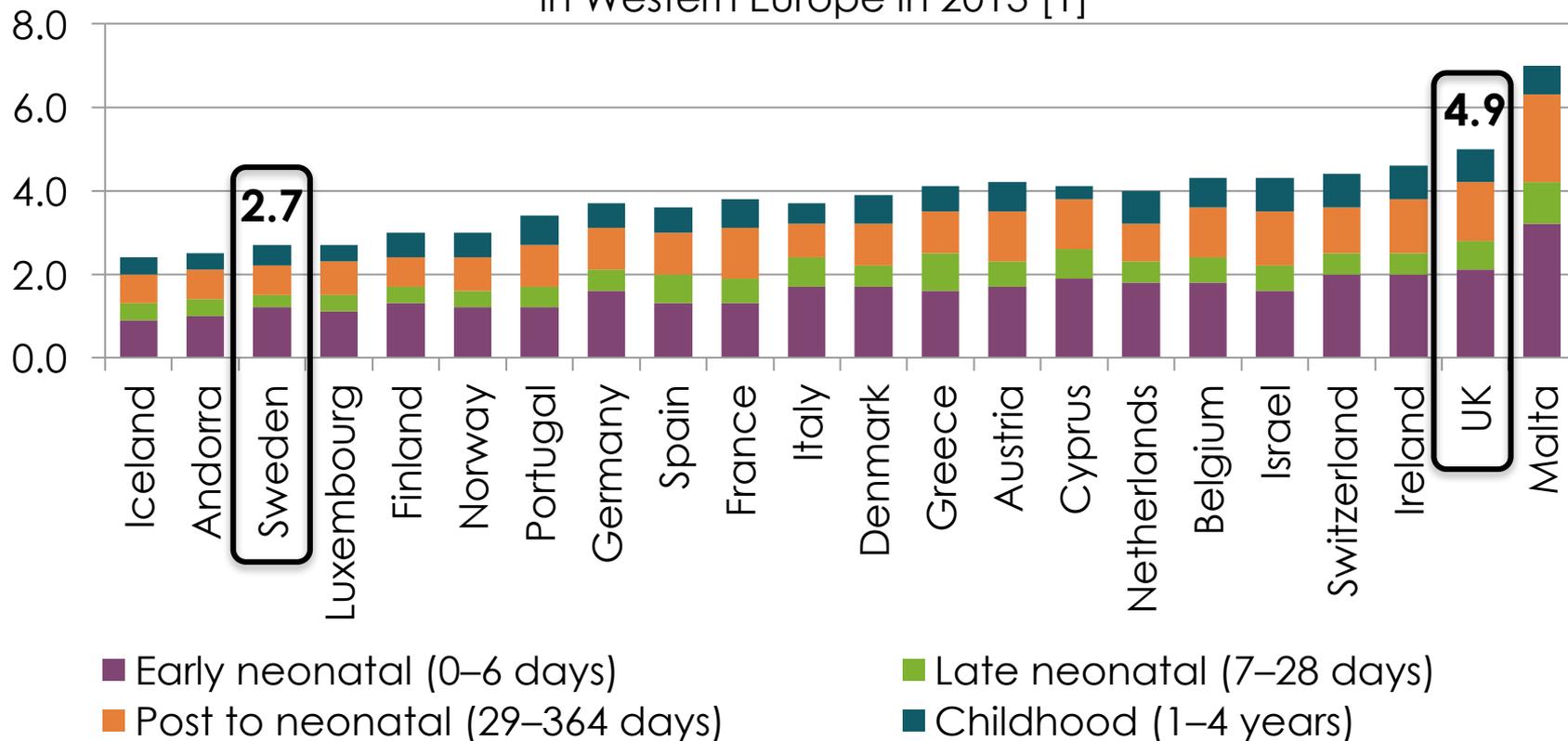


2 [1] Wang H, et al. Global, regional, and national levels of neonatal, infant, and under-5 mortality during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014 Sep 13;384(9947):957–979.

# Background

... while Sweden has one of the lowest child mortality rates in Western Europe

Fig 1. Under 5 (0–4 years) mortality rates per 1000 live births by age at death in Western Europe in 2013 [1]



3 [1] Wang H, et al. Global, regional, and national levels of neonatal, infant, and under-5 mortality during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014 Sep 13;384(9947):957–979.

# Risk factors affecting early life mortality



## **Maternal characteristics:**

- Maternal Age
- Parity
- Socio-economic status (SES)
- BMI
- Ethnicity/ Religion

## **Characteristics of baby at birth:**

- Preterm birth
- Low birthweight
- Congenital malformations
- Multiplicity of pregnancy
- Sex

## **Maternal health during pregnancy:**

- Smoking
- Alcohol consumption
- Drug consumption
- Nutrition  
e.g. folic acid intake

# Risk factors affecting early life mortality



## **Family-level, e.g.**

- Housing conditions
- Income

## **Community-level, e.g.**

- Physical environment, road safety
- Healthcare access

## **National-level**

- Quality of healthcare
- Welfare support

# Study aims

**To determine where the differences in child mortality between England and Sweden originate:**

- Health at birth
- Risk factors after birth

**To inform policy**

Which preventive strategies to invest in with limited resources?

- Maternal health before & during pregnancy?
- Improve care after birth?
- Both?

# Administrative linked datasets

## Birth and maternal details:

- Birth weight
- Gestational age
- Gender
- Maternal Age

## Hospitalisation history:

- Presence of congenital anomalies

## Death registration:

- Causes and timing of death

### Socio-economic status at birth:

England: IMD score (area-level)

Sweden: quintile of income (individual-level)

Sweden

Medical Birth Register

National Discharge Register

Cause of Death Register

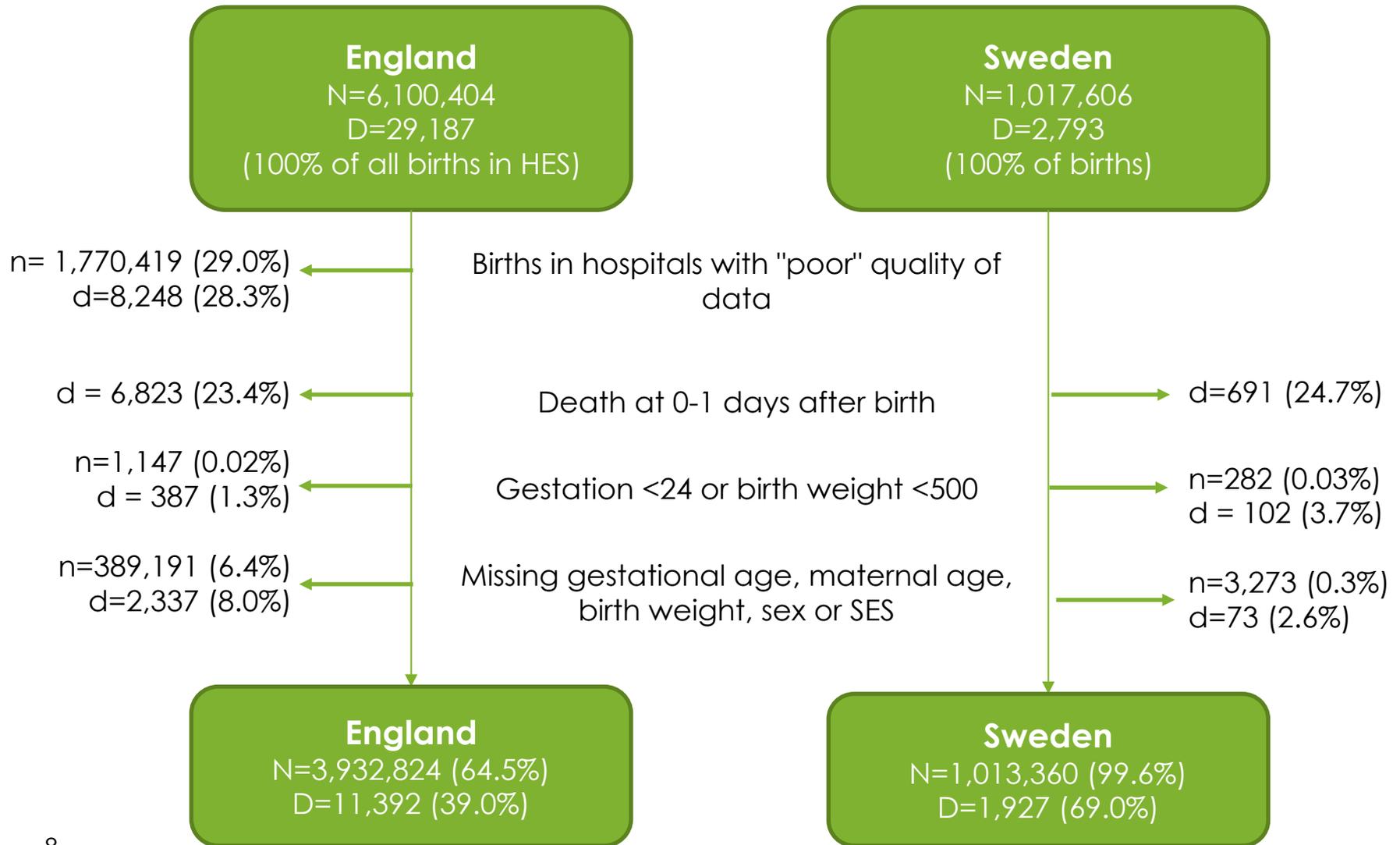
England

### Hospital Episode Statistics (HES)

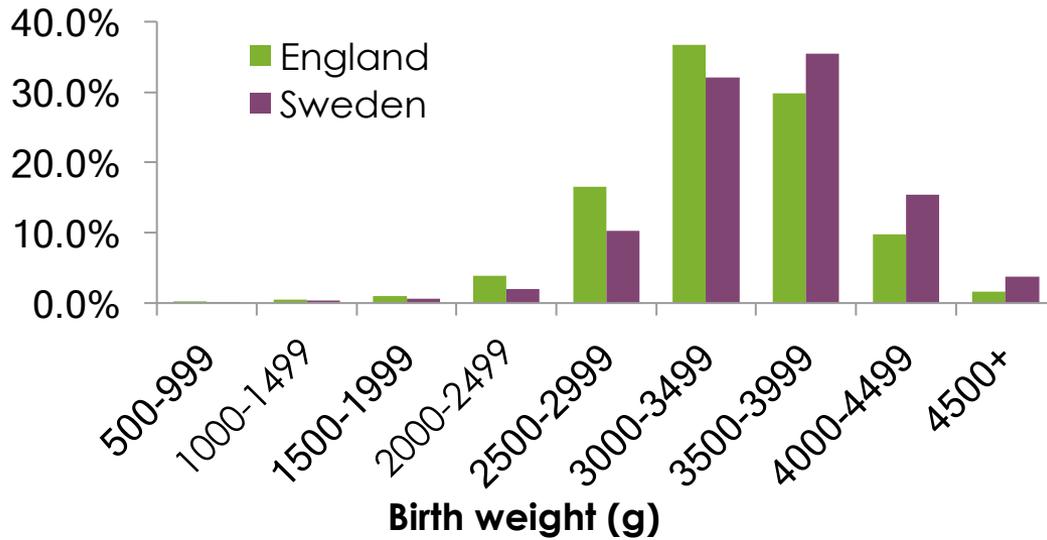
All National Health System (NHS) admitted patient care

Office for National Statistics (ONS) Death Registration

# Comparable birth cohorts: 2003-2012

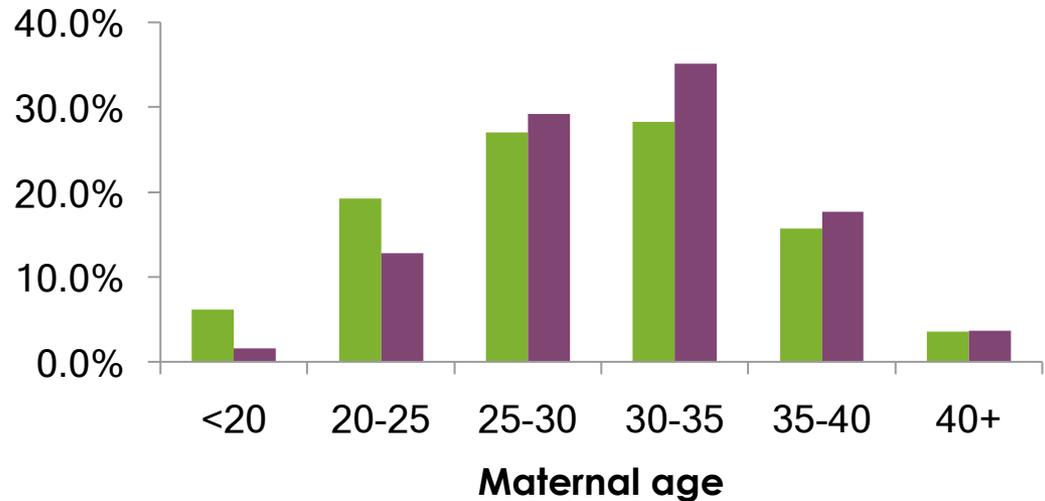


# Characteristics at birth

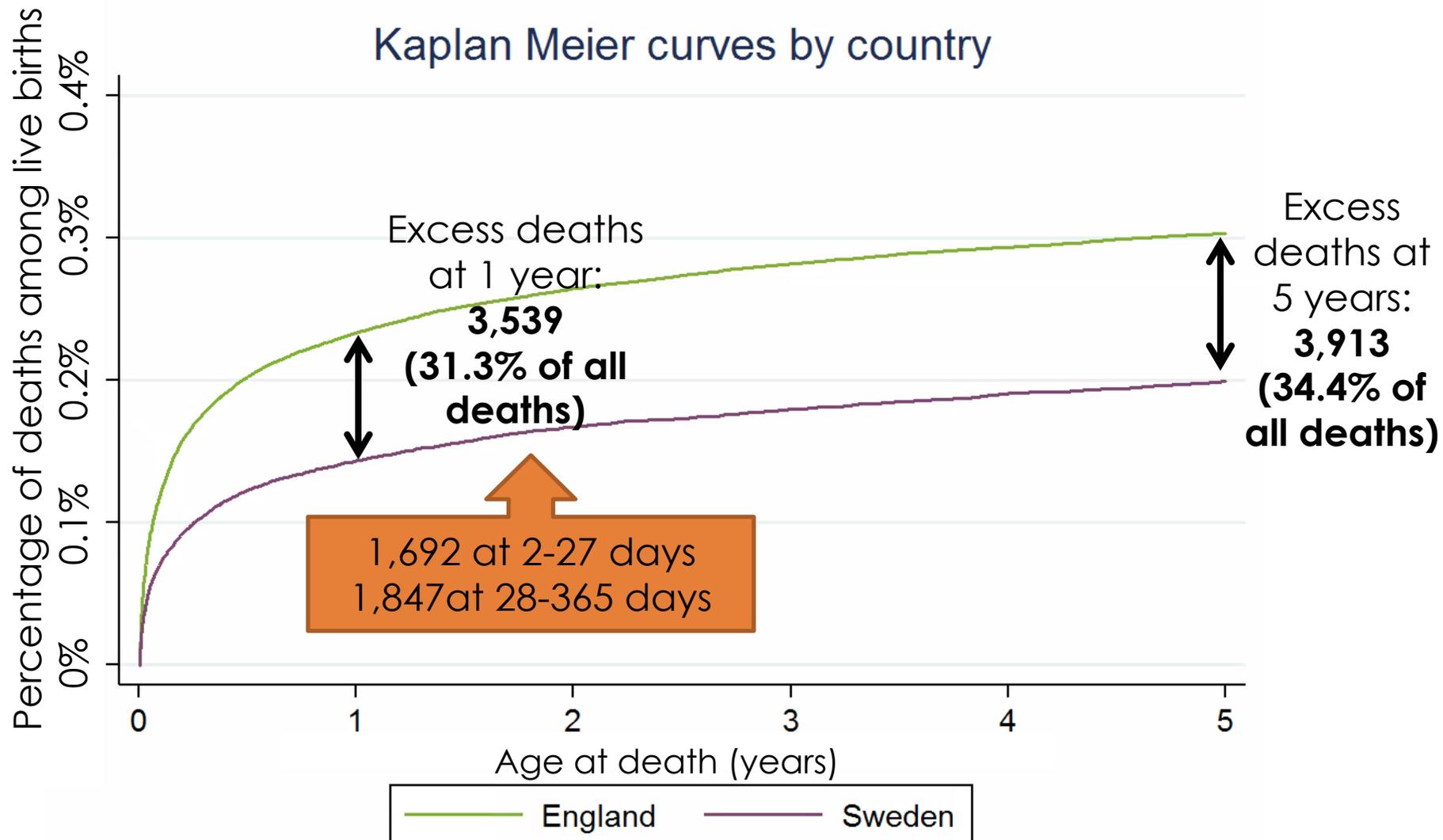


Gestation	England	Sweden
<37 weeks	5.7%	4.8%
>41 weeks	4.7%	6.9%

	England	Sweden
Congenital Anomaly	3.2%	2.4%



# Deaths by age at death (2 days – 4 years)



# Mortality at 2-27 days – Cox PH model

Country	England	Sweden
# of deaths (% of all deaths at 2 days – 4 years)	4,207 (36.9%)	648 (33.6%)

# Mortality at 2-27 days – Cox PH model

Model 1

**England**  
(baseline: Sweden)

**1.67 (1.53, 1.81)**

English children  
have **67%** higher  
risk of death at  
2-27 days than  
Swedish children

# Mortality at 2-27 days – Cox PH model

		Model 1	Model 2
<b>England</b> (baseline: Sweden)		<b>1.67 (1.53, 1.81)</b>	<b>1.37 (1.26, 1.48)</b>
<b>Birth weight</b> (baseline: 3.5+ kg)	0.5-1kg		31.30 (24.83, 39.46)
	1-1.5kg		11.89 (9.61, 14.70)
	1.5-2.5kg		6.03 (5.27, 6.90)
	2.5-3.5kg		1.82 (1.66, 1.99)
<b>Gestation</b> (baseline: 39+ weeks)	24-27		15.44 (12.36, 19.29)
	28-31		5.57 (4.58, 6.76)
	32-34		3.42 (2.94, 3.98)
	35-36		2.69 (2.37, 3.06)
	37-38		1.61 (1.48, 1.76)
<b>Boy</b> (baseline: girl)			1.27 (1.20, 1.35)

Reduction in risk of  
death in England  
vs Sweden from  
**67% to 37%**

# Mortality at 2-27 days – Cox PH model

		Model 1	Model 2	Model 3
<b>England</b> (baseline: Sweden)		1.67 (1.53, 1.81)	1.37 (1.26, 1.48)	<b>1.14 (1.05, 1.24)</b>
<b>Birth weight</b> (baseline: 3.5+ kg)	0.5-1kg		31.30 (24.83, 39.46)	16.63 (13.21, 20.95)
	1-1.5kg		11.89 (9.61, 14.70)	7.78 (6.29, 9.61)
	1.5-2.5kg		6.03 (5.27, 6.90)	5.22 (4.56, 5.97)
	2.5-3.5kg		1.82 (1.66, 1.99)	1.81 (1.65, 1.98)
<b>Gestation</b> (baseline: 39+ weeks)	24-27		15.44 (12.36, 19.29)	7.94 (6.37, 9.91)
	28-31		5.57 (4.58, 6.76)	3.99 (3.29, 4.85)
	32-34		3.42 (2.94, 3.98)	2.97 (2.55, 3.45)
	35-36		2.69 (2.37, 3.06)	2.46 (2.17, 2.79)
	37-38		1.61 (1.48, 1.76)	1.53 (1.40, 1.68)
<b>Boy</b> (baseline: girl)			1.27 (1.20, 1.35)	1.19 (1.13, 1.26)
<b>Congenital Anomaly</b>				6.74 (6.28, 7.24)

Reduction in risk of death in England vs Sweden from **67%** to **14%** after adjusting for **all** risk factors at birth

# Mortality at 2-27 days – Cox PH model

		Model 1	Model 2	Model 3	Model 4
<b>England</b> (baseline: Sweden)		1.67 (1.53, 1.81)	1.37 (1.26, 1.48)	1.14 (1.05, 1.24)	<b>1.12 (1.03, 1.22)</b>
<b>Birth weight</b> (baseline: 3.5+ kg)	0.5-1kg		31.30 (24.83, 39.46)	16.63 (13.21, 20.95)	15.80 (12.55, 19.90)
	1-1.5kg		11.89 (9.61, 14.70)	7.78 (6.29, 9.61)	7.40 (5.98, 9.14)
	1.5-2.5kg		6.03 (5.27, 6.90)	5.22 (4.56, 5.97)	5.00 (4.37, 5.72)
	2.5-3.5kg		1.82 (1.66, 1.99)	1.81 (1.65, 1.98)	1.77 (1.61, 1.94)
<b>Gestation</b> (baseline: 39+ weeks)	24-27		15.44 (12.36, 19.29)	7.94 (6.37, 9.91)	8.09 (6.48, 10.09)
	28-31		5.57 (4.58, 6.76)	3.99 (3.29, 4.85)	4.06 (3.34, 4.92)
	32-34		3.42 (2.94, 3.98)	2.97 (2.55, 3.45)	3.01 (2.59, 3.50)
	35-36		2.69 (2.37, 3.06)	2.46 (2.17, 2.79)	2.47 (2.18, 2.80)
	37-38		1.61 (1.48, 1.76)	1.53 (1.40, 1.68)	1.54 (1.40, 1.68)
<b>Boy</b> (baseline: girl)			1.27 (1.20, 1.34)	1.26 (1.19, 1.33)	1.19 (1.13, 1.26)
<b>Congenital Anomaly</b>				1.24 (1.17, 1.31)	6.72 (6.25, 7.21)
<b>Maternal Age</b> (baseline: 30-35)	<20				1.22 (1.09, 1.37)
	20-25				1.14 (1.05, 1.24)
	25-30				1.10 (1.01, 1.18)
	35-40				1.05 (0.96, 1.15)
	40+				1.32 (1.15, 1.51)
<b>SES</b> (baseline: Q5, least deprived 20%)	Q1: Most deprived 20%				1.22 (1.12, 1.34)
	Q2				1.10 (1.00, 1.21)
	Q3				0.98 (0.89, 1.08)
	Q4				0.94 (0.85, 1.04)

No significant change to parameter estimates after adjusting for socio-economic factors

# Mortality at 28-365 days – Cox PH model

Country	England	Sweden
# of deaths (% of all deaths at 2 days – 4 years)	4,963 (43.6%)	803 (41.7%)

# Mortality at 28-365 days – Cox PH model

Model 1

**England**

(baseline: Sweden)

**1.59 (1.47, 1.71)**

English children have **59%** higher risk of death at 28-365 days than Swedish children

# Mortality at 28-365 days – Cox PH model

		Model 1	Model 2
<b>England</b> (baseline: Sweden)		<b>1.59 (1.47, 1.71)</b>	<b>1.32 (1.22, 1.42)</b>
<b>Birth weight</b> (baseline: 3.5+ kg)	<1.5kg		<b>27.83 (23.22, 33.35)</b>
	1.5-2.5kg		7.07 (6.33, 7.89)
	2.5-3.5kg		2.00 (1.85, 2.15)
<b>Gestation</b> (baseline: 39+ weeks)	<32		3.04 (2.56, 3.61)
	32-34		1.61 (1.40, 1.86)
	35-36		1.89 (1.69, 2.11)
	37-38		1.53 (1.42, 1.64)
<b>Boy</b> (baseline: girl)			1.33 (1.26, 1.40)

Reduction in risk of death in England vs Sweden from **59% to 32%**

# Mortality at 28-365 days – Cox PH model

		Model 1	Model 2	Model 3
<b>England</b> (baseline: Sweden)		<b>1.59 (1.47, 1.71)</b>	<b>1.32 (1.22, 1.42)</b>	<b>1.16 (1.08, 1.25)</b>
<b>Birth weight</b> (baseline: 3.5+ kg)	<1.5kg		27.83 (23.22, 33.35)	12.12 (10.07, 14.59)
	1.5-2.5kg		7.07 (6.33, 7.89)	5.34 (4.79, 5.96)
	2.5-3.5kg		2.00 (1.85, 2.15)	1.94 (1.80, 2.09)
<b>Gestation</b> (baseline: 39+ weeks)	<32		3.04 (2.56, 3.61)	1.61 (1.35, 1.92)
	32-34		1.61 (1.40, 1.86)	1.33 (1.16, 1.53)
	35-36		1.89 (1.69, 2.11)	1.62 (1.45, 1.81)
	37-38		1.53 (1.42, 1.64)	1.40 (1.30, 1.50)
<b>Boy</b> (baseline: girl)			1.33 (1.26, 1.40)	1.18 (1.12, 1.25)
<b>Congenital Anomaly</b>				14.27 (13.46, 15.13)

Reduction in risk of death in England vs Sweden from **59%** to **16%** after adjusting for **all** risk factors at birth

# Mortality at 28-365 days – Cox PH model

		Model 1	Model 2	Model 3	Model 4
<b>England</b> (baseline: Sweden)		<b>1.59 (1.47, 1.71)</b>	<b>1.32 (1.22, 1.42)</b>	<b>1.16 (1.08, 1.25)</b>	<b>1.10 (1.02, 1.18)</b>
<b>Birth weight</b> (baseline: 3.5+ kg)	<1.5kg		27.83 (23.22, 33.35)	12.12 (10.07, 14.59)	10.85 (9.01, 13.06)
	1.5-2.5kg		7.07 (6.33, 7.89)	5.34 (4.79, 5.96)	4.82 (4.31, 5.38)
	2.5-3.5kg		2.00 (1.85, 2.15)	1.94 (1.80, 2.09)	1.84 (1.71, 1.99)
<b>Gestation</b> (baseline: 39+ weeks)	<32		3.04 (2.56, 3.61)	1.61 (1.35, 1.92)	1.68 (1.41, 2.00)
	32-34		1.61 (1.40, 1.86)	1.33 (1.16, 1.53)	1.38 (1.20, 1.59)
	35-36		1.89 (1.69, 2.11)	1.62 (1.45, 1.81)	1.65 (1.48, 1.84)
	37-38		1.53 (1.42, 1.64)	1.40 (1.30, 1.50)	1.41 (1.32, 1.52)
<b>Boy</b> (baseline: girl)			1.33 (1.26, 1.40)	1.18 (1.12, 1.25)	1.18 (1.12, 1.24)
<b>Congenital Anomaly</b>				1.5 (1.13, 1.99)	14.13 (13.33, 14.99)
<b>Maternal Age</b> (baseline: 30-35)	<20				1.72 (1.56, 1.89)
	20-25				1.32 (1.22, 1.42)
	25-30				1.10 (1.02, 1.18)
	35-40				0.98 (0.90, 1.07)
	40+				1.19 (1.04, 1.37)
<b>SES</b> (baseline: Q5, least deprived 20%)	Q1: Most deprived 20%				1.64 (1.50, 1.79)
	Q2				1.48 (1.35, 1.62)
	Q3				1.14 (1.03, 1.25)
	Q4				1.12 (1.01, 1.23)

Reduction in risk of death in England vs Sweden from **59%** to **10%** after adjusting for **all** risk factors at birth and the socio-economic factors

1.19 (1.04, 1.37)  
1.64 (1.50, 1.79)  
1.48 (1.35, 1.62)  
1.14 (1.03, 1.25)  
1.12 (1.01, 1.23)

# Mortality at 1-4 years – Cox PH model

Country	England	Sweden
# of deaths	2,222	476
(% of all deaths at 2 days – 4 years)	(19.5%)	(24.7%)

## Overall:

Children born in England had **27%** higher risk of death  
(Hazard ratio (HR) for England vs Sweden=1.27 (1.15-1.40))

## Adjusting for all characteristics at birth:

- Negligible difference in risk of death between England and Sweden  
(HR = 1.06 (0.96, 1.18))
- Congenital anomalies were the most important risk factor  
(HR=16.70 (15.38-18.13))

## Further adjustment for SES

No statistically significant differences in parameter estimates  
(HR for England vs Sweden = 1.03 (0.93, 1.14))

# Discussion

The differences in mortality at 2 days – 5 years between England and Sweden were primarily driven by variation in the prevalence of key risk factors at birth

**Policy focus: health of women and girls before and during pregnancy**

- 28-365 days mortality: some of the differences were also explained by socio-economic factors
- 2-365 days mortality: some of the differences remain unexplained:
  - higher prevalence of chronic conditions that are not congenital
  - other unmeasured factors operating after birth

## **Future work:**

- Comparison of cause-specific mortality
- Include chronic conditions in the model

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