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Why do young children die in the UK? A comparison with Sweden

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ABSTRACT

Background The UK has a high child mortality rate, whereas Sweden's is lower (under-five mortality rates of five and three, respectively, in 2011). We therefore wished to compare causes of death in young children aged <5 years in the two countries.

Methods Under-five mortality data were obtained from the Office of National Statistics for each of the individual countries within the UK for 3 years (2006–2008). Data for Sweden for the same period were obtained from the National Board of Health and Welfare. Causes of death were compared statistically using χ^2 test.

Results There were a total of 14 104 and 1036 deaths aged <5 years in the UK and Sweden, respectively, between 2006 and 2008. The total numbers of live births during the same period were 2 295 964 and 315 884, respectively. The overall mortality rate in the UK was 614 per 100 000 children which was significantly higher than that in Sweden (328; $p<0.001$). The mortality rates for the three main causes of death in the UK (prematurity, congenital malformations and infections) were 138.5, 112.1 and 63.9, respectively, per 100 000 children. The mortality rates for the same three conditions in Sweden were 10.1, 88.6 and 34.8, respectively. They were all significantly more frequent in the UK than in Sweden ($p<0.001$), as were the majority of the disorders. Treatable infections, such as pneumonia, meningitis and septicaemia, in both neonates and young children had significantly higher mortality rates in the UK than in Sweden ($p<0.001$).

Conclusions In order to reduce the mortality rate in the UK, we need to try and reduce the causes of prematurity. Additionally, the care of children with treatable infections should be reviewed to understand ways in which to reduce the differences in mortality seen.

INTRODUCTION

Child mortality rates (neonatal, infant and under five) in the UK are higher than in many other European countries.¹ The under-five mortality rate (U5MR) is considered by Unicef to be one of the best indicators of the health of the children within any given country.¹ It is determined from the number of deaths per annum in relation to every thousand live births. High rates of preterm births are thought to be a major contributory factor to the high mortality rates in the UK.² It is not, however, the only factor.

We decided to compare mortality rates in the UK with another European country to identify differences in mortality rates for different diseases. We chose Sweden, as it has one of the lowest child mortality rates in Europe (U5MR of three in 2011).¹ Both the UK and Sweden have free public healthcare

What is already known

- The UK has a high child mortality rate, whereas Sweden has a low child mortality rate.
- Prematurity is the major cause of death in children aged <5 years.
- Socioeconomic inequalities contribute to child mortality and prematurity.

What this study adds

- The mortality rates for infections in children aged <5 years were significantly higher in the UK than in Sweden.
- The majority of these infections are treatable.
- Research should focus on service delivery and access rather than new medicines.

systems and similar levels of economic and social development. They both spend about 8% of their GDP on healthcare.¹ Neonatal intensive care and interventions in Sweden are similar to the UK.³ In Sweden and the UK, all neonatal deaths are recorded, irrespective of weight or gestation.³

In order to reduce the high child mortality rate in the UK, we need to understand the reasons why children die. We therefore decided to look at the causes of deaths in both countries. We were particularly interested in causes where treatments are available and especially those diseases where we currently have effective medicines.

METHODS

Under-five mortality cause-specific data were obtained for England and Wales,⁴ Scotland⁵ and Northern Ireland^{4–6} (UK) and Sweden⁷ for the available years 2006–2008.

Data for cause-specific U5MRs according to the ICD-10 classification and annual number of live births for England and Wales were obtained from the Office of National Statistics. Data for Scotland were obtained from the General Register Office for Scotland and the data for Northern Ireland were obtained from the Northern Ireland Statistics and Research Agency. Additional information was obtained for the four countries in the UK by contacting the individual offices holding the data.

Data for Sweden were obtained from The National Board of Health and Welfare.⁷

There are two major limitations to the use of the ICD classification. First, a large proportion of child

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Table 1 Mortality rates in UK and Sweden: 2006-2008, ICD classification

ICD code	Disease	Mortality rates per 100 000 population					
		0-27 days		28 days-4 years		Total under 5	
		UK	Sweden	UK	Sweden	UK	Sweden
P0-96	Certain conditions originating in the perinatal period	296.9	97.2	27.8	10.4	324.6	107.6
Q0-99	Congenital malformations and chromosomal anomalies	68.6	50.0	43.7	38.7	112.1	88.6
R0-99	Symptoms, signs, abnormal clinical and laboratory findings not elsewhere classified	7.8	21.0	33.8	23.4	41.5	44.3
G0-99	Diseases of the nervous system	4.0	2.5	21.2	11.7	25.1	14.2
V0-Y89	External causes of morbidity and mortality	3.7	1.3	15.5	12.1	19.2	13.3
A0-B99	Certain infectious and parasitic diseases	0.4	3.5	18.1	7.9	18.4	11.4
J0-J99	Diseases of the respiratory system	0.1	0.3	17.9	8.2	17.9	8.5
C0-D48	Neoplasms	0.8	1.6	13.8	15.5	14.5	17.1
I0-99	Diseases of the circulatory system	2.7	1.3	11.7	2.8	14.4	4.1
E0-90	Endocrine, nutritional and metabolic diseases	4.1	1.9	9.2	10.4	13.3	12.3
K0-93	Diseases of the digestive system	0.7	0.9	7.1	2.5	7.8	3.5
D50-89	Diseases of the blood and blood forming organs and immune system	0.4	0.3	2.9	0.3	3.3	0.6
N0-90	Diseases of the genitourinary system	0	0	1.1	0.3	1.1	0.3
M0-99	Diseases of the musculoskeletal system and connective tissue disorders	0	0	0.7	0.9	0.7	0.9
L0-99	Diseases of the skin and subcutaneous tissue	0.1	0	0.1	0.3	0.2	0.3
H0-95	Diseases of the eye, ear and adnexa	0	0	0.2	0.3	0.2	0.3
F0-99	Mental and behavioural disorders	0	0	0.1	0.3	0.1	0.3
	Total	390.2	181.7	224.9	146.5	614.3	328.0

deaths are classified under codes R0-99 (symptoms, signs, abnormal clinical and laboratory findings not elsewhere classified). This is not clinically helpful. Second, the majority of infections are classified under systems, for example, respiratory infections are classified under respiratory disorders and osteomyelitis is classified under disorders of the musculoskeletal system.

From the ICD classification a more clinically useful underlying cause of death was therefore allocated. Such an approach has been used by others.⁸ In the cases of congenital malformations and chromosomal anomalies (Q0-99), neoplasms (C0-D48), diseases of the blood and blood-forming organs and immune system (D50-89), this was identical to the ICD classification. All infections were identified and grouped together (see online supplementary table S1). Conditions originating in the perinatal period (P0-96) were divided into (i) disorders related to prematurity, (ii) complications during labour and delivery, (iii) respiratory distress syndrome, (iv) other neonatal respiratory conditions, (v) neonatal haemorrhage and (vi) necrotising enterocolitis. Symptoms, signs, abnormal clinical and laboratory findings not elsewhere classified (R0-99) were evaluated and reassigned to the most appropriate clinical cause of death. Within external causes of morbidity and mortality (V0-Y89), trauma was separated. Conditions with a low mortality rate: genitourinary (N0-90), musculoskeletal (M0-99), skin (L0-99), eye and ear (H0-95) and mental and behavioural (F0-99) were combined into the miscellaneous group along with any conditions that were not classified.

The cause-specific mortality deaths were grouped similarly for UK and Sweden. Data were combined for 3 years for analysis. χ^2 test was used to compare the number of deaths between the two countries. Mortality rates (per 100 000 population) were calculated to allow comparison between the two countries.

RESULTS

There were a total of 14 104 and 1036 deaths aged <5 years in the UK and Sweden, respectively, between 2006 and 2008. The

total numbers of live births in UK and Sweden during the same period were 2 295 964 and 315 884. The majority of the deaths occurred in the neonatal period, both in the UK (8960 (63%)) and Sweden (574 (55%)). There were 5144 deaths in the UK and 462 deaths in Sweden for children aged between 28 days and 4 years. The mortality rates for neonates, children aged 28 days to 4 years and children aged <5 years were all significantly higher in the UK than in Sweden ($p < 0.001$; table 1)

Table 1 shows cause-specific mortality data for neonatal and postneonatal age groups according to the ICD-10 classification for 3 years. The limitations of the ICD code are illustrated by the fact that the third most common cause of death in both countries using the ICD code was symptoms, signs, abnormal clinical and laboratory findings not classified elsewhere.

Mortality rates in both countries and mortality rate ratios are given in table 2, using the clinical-based classification. The mortality rates for the majority of the causes of death were significantly more frequent in the UK than in Sweden (table 2). The mortality rate ratios ranged from 13.71 for prematurity to 1.27 for congenital malformations. SIDS, trauma, neoplasms, metabolic disorders, unclassified and miscellaneous deaths and deaths associated with pregnancy and labour were not significantly different between the two countries. There were no causes of death that were significantly more frequent in Sweden than in the UK. The three most common causes of death in the UK were prematurity, congenital malformations and infections with mortality rates ranging from 138.5 to 63.9 per 100 000. In contrast, the three main causes of death in Sweden were congenital malformations, disorders of pregnancy and labour and infections, with mortality rates ranging from 88.6 to 34.8 per 100 000.

Infections were the third most common cause of death in both countries. The causes of deaths due to infections are illustrated in table 3. Treatable infections in both the neonatal period and beyond were significantly more frequent in the UK ($p < 0.001$). Specifically in the neonatal period, both neonatal sepsis ($p < 0.001$) and congenital pneumonia ($p = 0.001$) resulted

Table 2 Mortality rates in UK and Sweden: 2006–2008

Disease	Mortality rates per 100 000		Rate ratio	p Value
	UK	Sweden		
<i>Prematurity</i>	138.5	10.1	13.71	<0.001
Paediatric respiratory disorders	5.9	0.9	6.56	<0.001
Haematological and immunological disorders	3.3	0.6	5.50	0.01
<i>Neonatal respiratory disorders</i>	34.2	8.9	3.84	<0.001
Cardiovascular disorders	28.1	9.2	3.05	<0.001
<i>Necrotising enterocolitis</i>	16.2	5.4	3.00	<0.001
External causes of mortality	4.3	1.6	2.69	0.02
<i>Other neonatal disorders</i>	18.6	7.3	2.55	<0.001
Gastrointestinal disorders	7.6	3.2	2.38	0.005
<i>Respiratory distress syndrome</i>	10.1	5.4	1.87	0.01
<i>Neonatal haemorrhage</i>	21.7	11.7	1.85	<0.001
Infections	63.9	34.8	1.84	<0.001
Non-infectious CNS disorders	19.7	12.0	1.64	0.003
Trauma	14.9	11.7	1.27	0.2
<i>Congenital malformations</i>	112.1	88.6	1.27	<0.001
Metabolic disorders	14.9	13.0	1.15	0.4
<i>Pregnancy and labour problems</i>	41.0	39.9	1.03	0.8
SIDS	26.7	26.0	1.03	0.8
Unclassified and miscellaneous disorders	18.0	20.6	0.87	0.3
Neoplasm	14.5	17.1	0.85	0.3
Overall mortality	614.3	328.0	1.87	<0.001

Italic entries represent neonatal disorders. CNS, central nervous system.

in significantly more deaths in the UK than in Sweden. The mortality rate ratios were 2.39 and 7.5, respectively. In young children, respiratory infections ($p=0.008$), septicaemia ($p<0.05$) and meningitis ($p<0.001$) all resulted in significantly more deaths in the UK than in Sweden, with mortality rate ratios of 1.59–1.96.

DISCUSSION

This brief review of child mortality in the two countries looked at different causes of death. Mortality rates were significantly

Table 3 Mortality rates due to infections

	Mortality rates per 100 000		Rate ratio	p Value
	UK	Sweden		
Neonatal infections (0–27 days)				
Neonatal sepsis	18.9	7.9	2.39	<0.001
Congenital pneumonia	4.5	0.6	7.50	0.001
Congenital viral infections	1.6	0.6	2.67	0.2
Other neonatal infections	3.0	3.2	0.94	0.8
All neonatal infections	27.9	12.3	2.27	<0.001
Paediatric infections (28 days–4 years)				
Respiratory infections	11.2	6.0	1.87	<0.01
Septicaemia	10.5	6.6	1.59	<0.05
Meningitis	4.9	2.5	1.96	<0.001
Viral infections	6.6	5.1	1.29	0.3
Other paediatric infections	2.8	2.2	1.27	0.5
All paediatric infections	36.0	22.5	1.60	<0.001
Total	63.9	34.8	1.84	<0.001

higher for most diseases in the UK. This included diseases of the newborn and young children. Prematurity, congenital malformations and all neonatal diseases had significantly higher mortality rates in the UK. Similarly, most diseases in children had significantly higher mortality rates in the UK.

One of the limitations is that the classification of death involves subjective decision making. It is therefore highly likely that there are small inaccuracies in the classification of deaths between the two countries that have different histories and cultures. The difficulties in classifying deaths and comparing mortality rates, especially in neonates have been described.⁹ It is possible that some neonatal deaths were coded under prematurity in the UK rather than under other neonatal conditions. Such miscoding would increase the mortality rate ratio for prematurity but conversely decrease the mortality rate ratios for other neonatal diseases.

Prematurity is recognised as a major cause of mortality in young children. Socioeconomic factors and socioeconomic inequalities have a major influence on premature birth.^{10–11} Socioeconomic inequalities as represented by the GINI index are greater in the UK than in Sweden.¹² The preterm birth rate is higher in the UK than in Sweden.^{13–14} It has also been increasing in the UK, whereas in Sweden it has remained constant.^{13–14} The contribution of preterm births to the high infant mortality rate in the UK has been highlighted recently by both researchers and the Royal College of Paediatrics and Child Health.^{2–15} The high mortality rate from prematurity in the UK is not a reflection on the quality of neonatal intensive care. It is, however, a reflection on the adverse social determinants of health in the UK that result in a large number of preterm births.

Congenital malformations were the second most common cause of mortality in both countries. The mortality rate in the UK was, however, significantly higher than in Sweden. Studies in the UK have shown that socioeconomic inequalities result in significantly lower termination rates, following antenatal diagnosis of a congenital anomaly, in more deprived areas.¹⁶ Socioeconomic inequalities are a significantly greater problem in the UK than in Sweden, and are therefore likely to be a major cause for the significantly greater number of deaths in the UK for both prematurity and congenital malformations.

Infections were the third most common cause of death in both countries. The mortality rates from infections in the UK were almost twice those in Sweden. In the majority of cases, the infections were conditions for which we have a variety of medicines which are effective. Both the UK and Sweden have free public healthcare systems and it is of concern that within the UK a significantly higher number of young children do not receive timely treatment for life-threatening infections. Concern regarding suboptimal treatment of meningococcal disease has been previously raised in the UK.¹⁷

The differences in mortality rates for a wide variety of clinical conditions including respiratory disorders in both young children and neonates, cardiovascular, gastrointestinal and neurological disorders raise important questions about the organisation and delivery of services for young children in the UK. Higher rates of hospitalisation for south Asian children with asthma in the UK have been reported.¹⁸ It has been suggested that this is due to difficulties in accessing primary healthcare. The lack of training in paediatrics for all general practitioners (GPs) in the UK has been highlighted and contrasts with Sweden where all GPs have paediatric training.²

The majority of research funding within the UK is focused on clinical trials of new technologies and in particular different medicines.^{19–21} Our findings suggest that it would be more

appropriate to fund research into service delivery to examine reasons why children do not receive existing treatment in a timely manner, rather than evaluating new medicines. The former is more likely to result in a significant reduction in mortality than the latter.

There are major differences in child mortality between the two countries. Action is needed to reduce the socioeconomic inequalities in the UK.²² Additionally, one needs to learn from practices in Sweden with regards to the delivery of healthcare to families with young children.

Competing interests None declared.

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Supplementary Table 1 Clinical grouping of infections according to the ICD-10 codes

Clinical disease	ICD code	Cause of death
Neonatal Sepsis	P36	Bacterial sepsis of newborn
	B37.7	Candida septicaemia
	A41	Septicaemia, Other
Congenital pneumonia	P23	Congenital pneumonia
	B25.0	CMV pneumonia
Congenital viral infections	P35	Congenital viral infection
	B25	CMV
	B33	Other viral infections
Other neonatal infections	P37	Other congenital infectious and parasitic diseases
	P39	Other infections specific to perinatal period
Septicaemia	A02	Salmonella septicaemia
	A39	Meningococcal septicaemia
	A40	Streptococcal septicaemia
	A41	Septicaemia, other
	B37	Candida septicaemia
Meningitis	A17	Tuberculous meningitis
	A87	Viral meningitis
	G00	Bacterial meningitis
	G03	Bacterial meningitis, unspecified
	G04	Encephalitis, myelitis and encephalomyelitis
	G08	Intracranial and intraspinal phlebitis and thrombophlebitis
Respiratory infections	A19	Miliary tuberculosis
	A37	Whooping cough
	J13	Streptococcus pneumonia
	J14	Haemophilus influenzae pneumonia
	J15	Pneumonia, not classified
	J18	Pneumonia, organism unspecified
	J20	Acute bronchitis
	J21	Acute Bronchiolitis
	J22	Unspecified acute LRTI
	J69.0	Pneumonitis due to food and vomit
	J 86	Pyothorax
J 90	Pleural effusion	
Viral infections	A08	Viral and other specified intestinal infections
	B00	Herpes simplex
	B01	Chicken pox
	B02	Herpes zoster
	B17	Other acute viral hepatitis
	B19	Unspecified viral hepatitis
	B25	CMV disease
	B27	Infectious mononucleosis
	B33	Other viral diseases
	B34	Viral infection, unspecified site
	I 40	Acute myocarditis
	J00	Acute nasopharyngitis

	J 03	Acute tonsillitis
	J 04	Acute laryngitis
	J05	Acute obstructive laryngitis
	J06	Acute URTI of multiple sites
	J10	Influenza virus identified
	J11	Influenza virus not identified
	J 12	Viral pneumonia
Other paediatric infections	A09	Diarrhoea and GIT presumed infectious origin
	A48	Toxic shock syndrome
	A49	Bacterial infection, site unspecified
	B20	HIV disease resulting in infectious and parasitic diseases
	B99	Other unspecified infectious diseases
	H66	Suppurative and unspecified otitis media
	I 38	Endocarditis
	K35	Acute appendicitis
	K65	Acute peritonitis
	L01	Impetigo
	L03	Cellulitis
	M86	Osteomyelitis
	N39	Urinary Tract Infection

ARCHIVES OF DISEASE IN CHILDHOOD

UK death rate of pre-school kids almost double that of Sweden

Prematurity, congenital abnormalities, and infections all taking toll on young children in UK

The death rate among pre-school children in the UK is almost double that of Sweden, with prematurity, congenital abnormalities, and infections all taking a significant toll, finds research published online in ***Archives of Disease in Childhood***.

The findings prompt the researchers to call for a stronger focus on prevention to improve the UK's position on the European child mortality league table.

The researchers compared causes of death among children under the age of 5 in the UK and Sweden, using nationally collated data spanning the period 2006-2008 to tease out the reasons behind child death rates in the UK.

The child death rate is considered by UNICEF to be a barometer of children's health within any given country, say the researchers, but it is higher in the UK than in many other European countries.

The researchers chose Sweden as the comparator country as it has one of the lowest child death rates in Europe; it has comparable levels of economic and social development; like the UK, its healthcare is free at the point of access; and it spends the same proportion of its gross domestic product (about 8%) on healthcare.

During the study period, the total number of live births was 2, 295,964 in the UK and 315,884 in Sweden.

But the death rate among this age group was significantly higher in the UK—almost double—amounting to 614 per 100,000 of the pre-schooler population, compared with 328/100,000 in Sweden.

The primary causes of death in the UK were problems associated with premature birth, inborn (congenital) abnormalities, and infections, the respective rates of which per 100,000 of the pre-schooler population were 138.5, 112.1, and 63.9.

The equivalent figures for the same three conditions in Sweden were 10.1—representing a 13-fold difference— 88.6, and 34.8.

The three main causes of death for the under 5s in Sweden were inborn abnormalities, complications of pregnancy and labour, and infections.

But both newborns and young children were significantly more likely to die of treatable infections, such as pneumonia, meningitis, and systemic blood poisoning (septicaemia) in the UK than they were in Sweden.

Prematurity is recognised as a major cause of mortality in young children, explain the researchers, who point out that socioeconomic factors and health inequalities have a major influence on the rate of premature birth, which is higher in the UK than it is in Sweden. And while the premature birth rate has remained stable in Sweden, it has been rising in the UK.

“The high mortality rate from prematurity in the UK is not a reflection on the quality of neonatal intensive care,” emphasise the researchers. “It is, however, a reflection on the adverse social determinants of health in the UK that result in a large number of preterm births.”

And unlike in Sweden, many family doctors (GPs) in the UK don't have any training in paediatrics, they add.

“The differences in mortality rates for a wide variety of clinical conditions, including respiratory disorders in both young children and neonates, cardiovascular, gastrointestinal, and neurological disorders raise important questions about the organisation and delivery of services for young children in the UK,” write the researchers.

They go on to suggest that money would be better spent looking into why children don't get prompt care with existing treatments rather than evaluating new medicines.