Colin Pritchard[1]*, Richard Williams[2], Tamas Hickish[3] and Mark Wallace[4]

[1]Research Professor, Emily Rosenorn-Lanng, London, UK
[2]Research Officer, Senior Lecturer, National Centre for PQ Social Work & Professional Practice, London, UK
[3]Professor, Faculty of Health & Social Sciences, Bournemouth University, London, UK
[4]Head of Economics, Latymer Upper School, London, UK

*Corresponding author: Colin Pritchard, Professor, National Centre for Post-Qualifying Social Work & Professional Practice, Faculty of Health & Social Sciences, Bournemouth University, Royal London House, Christchurch Rd; Bournemouth BH1 3LT, UK, Tel: 02380766487; 07825248004; Fax: 44 (0) 1202 967194; E-mail: cpritchard@bournemouth.ac.uk

Research Article

A Population-Based Study Comparing Child (0-4) and Adult (55-74) Mortality, GDP-Expenditure-on-Health and Relative Poverty in the UK and Developed Countries 1989-2014. Some Challenging Outcomes

Abstract

Purpose: To compare the UK Child (0-4) and Adult (55-74) Mortality with twenty developed countries 1989-2014 to explore whether the UK has lower priorities for children?

Design: WHO data on Child and Adult mortality examined within context of World Bank %GDP-Expenditure-on-Health (%GDPEH) data and Income Inequality i.e Relative poverty.

Settings: 21 developed countries.

Patients: National populations.

Outcome Measures: Child and Adult mortality rates per million (pm) population between 1989-2014. Confidence Intervals compares UK with other developed countries (ODC); odds ratios of average European to UK mortality calculated. Correlations explore links between mortalities, %GDPEH and Income Inequality.

Important Results: Highest average 1980-2014 %GDPEH is USA 12.6%, the lowest UK 7.0%. European average 8.5% a UK to European odds ratio 1:1.21.

Widest Income Inequality was USA 15.9 times, UK 13.8 was third, European average 8.5times.

Child Mortality fell in every country but *eleven* significantly better than Britain. Highest was USA 1383pm the UK fourth at 967pm. European average 728pm yielded a European to UK odds ratio of 1:1.33.

Income Inequality and CRM significantly correlated (RHO=+0.6188 p<0.001) and lowest Private: Public %GDP ratio and highest CMR (Rho=+0.3805 p<0.05).

Adult Mortality fell substantially in every country but UK significantly greater reductions than *Seventeen* counties. European average 9545pm to UK 10,754pm gave a European to UK odds ratio of 1:1.13.

Conclusion: Implications; Britain's results suggest a higher priority is given to adult health than children. The socio-economic context in which UK Child health operates appears to disadvantage UK children, indicating the need to address income inequalities and at least match European average health funding.

Introduction

Parents failing to meet the needs of their children are often categorized as `neglecting' parents so can this this be applied to nations? If so one criteria would be found in the UNICEF statement " *that in the final analysis C*hild Mortality Rates (CMR) *are an indicator of how well a nation meets the needs of its children*"

[1]. Therefore to assess how well the UK and Developed nations met their children's needs Child-Mortality-Rates (CMR) for the under-fives (0-4years) are compared. This is in line with the UN's Millennium Goals Objective which was to reduce under-five (0-4years) child mortality by 2% per annum in all member states [2].

This hypothesis stimulating study, utilizing the latest available WHO data [3] and examines a perspective that is seldom acknowledged - the tacit competing demands between child and health care, as all Western countries grapple with the impact of increased longevity and its demands on health services [4,5].

Consequently, we examine Adult-Mortality Rates (AMR) of people aged 55-74year, which is below the life-expectancy of all countries under-review [3] to compare them with changes in CMR.

Child and Adult mortality rates between the baseline years of 1989-91 are compared with the latest index years 2012-14 to determine whether there is any indication of possible different priorities between child and adult health care in the UK and the other twenty developed countries? An earlier study of child mortality found the highest CMR amongst the twenty-one developed nations were all the English-speaking-countries, raising the question of whether this pattern will occur in the case of adult mortality (55-74) [6,7].

Socio-Economic Context: The mortality rates are examined within the context of socio-economic factors that are likely to influence clinical outcomes. Firstly in regard to a nation's percentage of its Gross-Domestic-Product-Expenditure-on-Health (%GDPHE) which is the `economic input' into health care, and, relative poverty measured by the World Bank's Income Inequality ratios [8, 9].

The `economic input' into health is a country's total % GDPEH. It is recognised that this will be differently configured in the various countries and with varied fiscal value [8,9]. Moreover, there are two broad categories of sources of %GDPEH, monies coming from predominately `Public' sources such as State / Federal and the proportion of %GDPEH coming from `Private' sources, mainly insurance or work-related benefits [8,9]. Hence the need to report `Public' and `Private' sources as well as the total %GDPEH of each nation which includes both `Public' and `Private' sources. Taken together it is the total %GDPEH of a nation that is a practical indication of a country's economic commitment to health and social care, which is the fiscal context in which all health and social care services operate. Each nation acts as their own control over the years and from which ratios of change can be calculated.

Income Inequality [10,] is a measure of relative poverty, known to be associated with poorer child health outcomes [11-17] and is the other major socio-economic context in which all health services operate.

Clinical Outcomes are the latest WHO mortality data [5], with which to compare any changes between CMR (0-4 years) and AMR (55-74 years) in the UK and the Other Developed Countries (ODC) between 1989-91 and 2012-14.

There are two working null hypotheses. There will be:-

1) no statistical association between the child and adult mortalities and %GDPEH and Income Inequality, and,

2) no significant differences between UK child and adult mortalities and the Other Developed Countries (ODC).

Methodology

Socio-economic context- input

The *economic input* is the total percentage of GDP Expenditure to Health (%GDPEH), which is the combined public and private sources devoted to health and social services [8,9], illustrating the fiscal degree to which countries prioritise health. We do not know the differential proportion of %GDPEH going to child or adult services but it is suggested are any differences might be a reflection of significant different priorities between CMR and AMR outcomes over the period. Each country's %GDPHE can be tracked and an over-all average rate for the period 1989-2014 can be calculated. The time under review period covers twenty-seven separate recorded years of %GDPEH however, some countries missed reporting the occasional year that is noted in table 1.

Self-evidently, there are differences in the ways the countries configure their services. The biggest variation regards any differences between private and public sources of funding that goes to the total %GDPEH. We examine this in table 1 separately for the index years 2012-14 in column 6 and 7, and calculate a private to public funding ratio in column 8. The bigger the ratio, the higher the proportion of funding comes from public (State / Federal/ Direct Taxation) sources. There was no Public/Private data available for Belgium, which is noted in the table.

The USA has always had a substantially higher %GDPEH than every country, especially the UK [8,9], so we compare the UK's %GDPEH outcome only with the average of the other 15 Western European countries from which odds ratios are calculated.

To illustrate the changes of %GDPEH over time we report on the years 1980, 2000, 2010 and 2014 which is the latest available World Bank data. Private and Public sources of %GDPEH for 2014 are given, from which private to pubic %GDPEH ratios are calculated. It should be noted that %GDPEH did not always increase from previous years and any reductions in UK %GDPHE between 1980 and 2014 will be reported upon.

Relative Poverty: There are different ways of measuring *relative poverty*, but all countries apply a measure of how far a child or its family are below that country's average income, usually a third below the national average household income is considered to be in a state of relative poverty [19,20]. We use the World Bank Income Inequalities, which is the gap between the top and bottom 10% of incomes, which is a country-specific measure [20] and highlights relative differences in society. Some studies use Gross National Income (GNI) but this blurs significant variations as it is essentially average based. This is exemplified by the UK average income 2015/16 that was £26,300 but 60% received less than £20,000, whilst the top fifth averaged £85,000 and the bottom fifth averaged £7,000 [21].

Table 1: Total % Gross-Domestic-Product Expenditure on Health 1980 −2000-2014 (% rounded-up) and % GDP from Private & Public Source 2014s. (Based upon 27 years number missing years in brackets). Ranked by Highest Average %GDPHE.

Column -1 Country & Current Rank	2 Total %GDP 1980	3 Total %GDP 2000	4 Total %GDP 2010	5 %GDP Public 2014	6 %GDP Private 2014	7 Total %GDP 2014	8 Private: Public Ratio	9 Total Average 1980-14
1. USA	9.0	13.4	17.0	7.95	9.15	17.1	1.0.87	12.6
2. Germany	8.4	10.1	11.6	8.62	2.62	11.3 *	1.3.29	9.6
3= France	7.0	10.3	11.6	9.22	2.47	11.5 *	1.3.73	9.5
3= Switzerland	7.3	10.2	10.9	6.9	4.80	11.7 *	1.1.44	9.5
5. Canada	7.0	8.8	11.1	7.30	3.10	10.4*	1:2.25	9.3
6= Netherlands	7.4	8.0	12.1	6.88	4.02	10.9 *	1;1.71	8.7
6=. Sweden	8.9	8.2	9.5	9.75	2.15	11.9	1:4.53	8.7
8. Austria [23]	7.4	9.0	11.1	8.61	2.59	11.2	1:3.32	8.5
9. Belgium [23]	6.3	9.0	10.6	n/a	n/a	10.6	n/a	8.3
10. Norway	7.0	8.4	9.4	8.17	1.53	9.7	1:5.34	8.1
11.Australia [23]	6.1	8.0	8.9	7.49	3.71	11.2	1:2.02	8.0
12=. Italy	7.0	8.1	9.4	7.10	2.10	9.2 *	1:3.38	7.9
12=. Denmark [23]	8.9	8.3	11.1	9.47	1.33	10.8 *	1:7.12	7.9
14= New Zealand	5.9	7.7	10.0	8.84	2.16	11.0	1:4.09	7.8
14= Finland	6.3	7.2	9.0	7.20	2.50	9.7	1:2.88	7.8
16. Portugal [23]	5.3	8.8	10.9	6.82	2.68	9.5 *	1:2.54	7.5
17= Ireland	8.2	6.1	9.2	6.00	1.80	7.8 *	1:3.33	7.3
17=. Japan [22]	6.5	7.7	9.6	8.44	1.76	10.2	1:4.80	7.3
19 Greece [21]	5.9	7.9	9.5	4.87	3.23	8.1 *	1:1.51	7.2
20. Spain	5.3	7.2	9.6	7.37	1.63	9.0 *	1:4.52	7.1
21. U.K [NHS]	**5.6**	**7.0**	**9.4**	**7.52**	**1.58**	**9.1 ***	**1:4.76**	**7.0**
Other Countries (-UK) average	**7.1**	**9.0**	**10.6**	**7.73**	**2.89**	**10.6**	**1:3.29**	**8.5**
OC: UK ratios	**1:1.26**	**1:1.29**	**1:1.13**	**1:1.03**	**1:1.83**	**1:1.16**	**1:0.69**	**1:1.21**

NB * GPDEH 2014 % lower than in 2010 % Lowest Public/Private Ratio & Highest CMR Rho=+0.3805 p<0.05. Lowest Public /Private Ratio & Highest AMNR Rho= -0.1323 n.sig.

It is acknowledged that CMR (0-4years) are not only influenced by poverty but by various other separate cultural, socio-economic and social policy factors but such issues are also often associated with relative poverty [22-27].

Clinical outputs

Clinical Outputs are the combined boy and girl 0-4 years CMR rates per million (pm) of population, compared with Adult (55-74)-Mortality-Rates (AMR) of both sexes of people aged 55-74 per million, which is below the life-expectancy of all the countries under review and is the age-band in which reducing adult deaths might be feasible [3]. In this total population-based study it was not possible to examine what if any factors that might have influenced the child and adult rates, which would require a country-specific study. On the other hand, these 21 Western countries are amongst the very richest in the world [8], though this is not to deny there are differences between them. For example based upon US Census Bureau data, who report mortality by ethnicity, African American children die at virtually double the rate of White 0-4 year olds and such feature occurs in other Western countries but here we are reviewing the nation's mortality rates in their entirety [6,9,11-17].

The countries reviewed are the twenty-one liberal democratic countries which have broadly similar socio-economic situations and it is acknowledged that this hypothesis stimulating paper can only provide a broad over-view and it is acknowledged that explanations for any differences between countries would require country-specific research

Statistics

Confidence Intervals (95%) are used to determine any significant differences between UK child and adult mortalities with each of the Other Developed Countries (OCD) over the period. Actual odds ratios are calculated and included in the normal binominal based confidence intervals.

Spearman Rank Order correlations (Rho) test any statistical association between %GDPHE, the mortalities and Income Inequality and odds ratios are calculated for the average European to UK for child and adult mortalities.

Results

Socio-economic context

(a) Input %GDPEH: Table 1 presents the countries' %GDPEH, ranked by the highest *average* GDP spending on

079

health (1980-2014). A perusal of table 1 shows that countries varied in their GDP commitment to health but over-all rose substantially in every country between 1980 and 2014.

The top three countries average over the 1980-2014 were the USA at 12.6%, Germany at 9.6% and France and Switzerland at 9.5%. The lowest average countries were the UK at 7.0%, Spain at 7.1% and Greece at 7.2%.

The USA was always the highest sender and in 2000 spent 13.4%, by 2010, 17.0% and in 2014 17.1%. The contrast with the UK is notable. I n 1980 UK %GDPEH was 5.6%, rising to 7.0% by 2010 it had risen to 9.4% (its highest ever rate) and by 2014 was 9.1%, when it is 18th of 21 countries but over the whole period its average 7.0% was lowest of all.

The average of the other countries (minus the UK) over this period was 9.0% in 2000, 10.6% in 2010 and 10.6% in 2014.

Columns 5 and 6 of table 1 show %GDPEH from Public and Private Sources from each nation.

Private: Public GDP Funding Ratio: The USA was the only country whose Private source of funding exceeding its Public source, 9.15% to 7.97% from Pubic courses a ratio of 1:0.87. The next lowest private: public ratio was Switzerland at 1: 1.44 and Greece at 1:1.51. The broadest ratio was Denmark at 1:7.2, Norway 1:5.34, Japan 1:480 and the UK at 1:4.76; the average was 1: 3.39. Thus except the USA, and to a less extent Switzerland and Greece, the other countries health was funded mainly but not exclusively from governmental/ public sources. However, of the 20 countries, between 2010 and 2014 only Australia, Austria, Finland, Japan, Norway, Sweden and the USA increased their total %GDPEH, the other countries percentage had fallen over the period, possibly reflecting the impact of the 2008 financial crisis. In regard to the UK %GDPEH *fell* from the previous year in the years 1984, 1987, 1988; 1994; 1997 and, in 2011 and again in 2013.

(b) Income Inequality: Table 2 lists the Income Inequality of the top 10% compared with the bottom 10% of incomes. The widest ratio was the USA at15.9 times, followed by Portugal 15.0 times and the UK 13.8 times. The narrowest were Japan 4.5 times, Finland 5.6 and Norway 6.1 times.

The Western European average was 8.8 which yields a European to UK a ratio of 1:1.57. Equivalent of the UK inequality was more than half as high again as the average for Western Europe.

There was no significant correlation between Income Inequalities and % GDPEH (Rho= +0.1566 n.sig).

In regard to the socio-economic contextual factors the UK had the lowest average %GDPEH and the third highest relative poverty level.

Clinical outcomes

(a) Child Mortality Rates (CMR): Table 3 shows that over the period there were substantial (>30%) reductions of CMR (0-4years) in *every* country. The current highest rates are all

Table 2: Income Inequalities: Top 10% to Bottom 10% (Source World Bank 2016).

Country 2015-2016	10%-10%	Other Country: UK Ratio
1.USA	15.9	1: 0.87
2.Portugal	15.0	1:0.92
3.UK	**13.8**	1:1.0
4. Australia	12.5	1:1.10
5.N. Zealand	12.4	1:1.11
6.Italy	11.6	1:1.19
7.Spain	10.3	1.1.34
8.Greece	10.2	1.1.35
9=. Ireland	9.4	1:1.47
9=.Canada	9.4	1:1.47
11.Netherland	9.2	1:1.50
12.France1	9.1	1:1.52
13.Switzerland	9.0	1:1.53
14.Belgium	8.2	1:1.68
15.Denmark	8.1	1:1.70
16=..Germany	6.9	1:2.00
16=.Austria	6.9	1:2.00
18.Sweden	6.2	1:2.23
19. Norway	6.1	1:2.26
20.Finland	5.6	1:2.46
21.Japan	4.5	1:3.07
Europe Average	**8.8**	**1:1.56**
Europe to UK ratio		**1:1.57**

English-speaking countries, led by the USA at 1383pm, New Zealand 1303pm, Canada 1106pm and the UK fourth at 967pm and is the highest in Western Europe. The lowest were Finland at 518pm, Norway 568pm, Japan 579pm and Sweden 5879pm.

The overall Western European average, minus the UK is 728pm yields a European to UK odds ratio of 1: 1.33, indicating that UK child mortality is almost a third higher than the rest of Western Europe.

It is noteworthy that the four lowest CMR countries also had the narrowest Income Inequalities.

There were notable falls in Portugal of -77%, Norway -725% and Finland -65%. Conversely with falls of only −36% in Canada, -43% the USA and New Zealand -45% all failed to meet the UN Millennium Goal objective of an annual 2% reduction in under-fives mortality. The average European reduction of CMR over the period was -61%, the UK fell only 50%, the fourth lowest reduction, whilst in 1989-91, when the UK had the 9th highest CMR the situation has relatively deteriorated as the UK is now 4th highest.

There was no significant correlation between baseline and index year CMR correlated (Rho= +0.2958 p<0.1 trend) indicating only a slight a degree of consistency in CMR over the period reviewed confirming some countries made different progress in reducing CMR.

080

The was a strong positive correlation between Income Inequality and CMR (Rho=+0.6175 p<0.005) indicating the statistical association of CMR and relative poverty in the developed world. There was no significant correlation between lowest CMR and average %GDPHE Rho= −0.1646 n.sig. However there was a significant correlation between the lowest Private: Pubic %GDPEH and the highest child mortality rate (Rho=+0.3805 p<0.05) but not with adult mortality rate (Rho= −0.1323 n.sig).

(b) Adult Mortality Rates (55-74): Table 4 shows the highest AMR was the USA 12284pm, Denmark 12,056pm and Germany 11,740; the UK were seventh highest at 10,754pm.

The lowest were in Australia 80812pm, Switzerland 8,460pm and Japan 8563pm.

The European average fell from 16,107pm to 9,545pm, a 41% reduction, the UK reduction of 48% was third biggest reduction, and over the period. UK adult death rates relatively improved from being 3rd highest to now being 7th out the 21 countries.

European current average was 9545pm, giving a European to UK odds ratio of 1:1.13 compared to the child mortality European to UK odds ratio of 1:1.33.

Table 3: Western Countries ,1 year & 0-4 years Child Mortality Rates (CMR) per million 1989-91 v 2012-14, percentage of change & Current Other Country v UK ratio.

Country, Current Rank v 1989-91 v 2012-14	0-4 CMR 1989 - 2014	% of Change	0-4 Rest v UK Ratio
1-2. USA	2420 - 1383	-43 #	1:0.70
2-3. New Zealand 2010-12	2361 - 1303	-45 #	1:0.74
3-14. Canada. 2010-12	1740 - 1106	-36 #	1:0.87
4-9.U. K 2011-13	**1929 - 967**	**-50**	**1:1.0**
5-5. Belgium 2011-13	2013 - 910	-55	1:1.06
6-13. Switzerland 2011-13	1783 - 872	-51	1:1.11
7-11. Australia	1886 - 823	-56	1:1.17
8-14=. France 2011-13	1740 - 815	-52	1:1.19
9-16. Netherlands	1729 - 812	-53	1:1.19
10-17. Ireland 2011-13	1659 - 795	-52	1:1.22
11-7. Denmark	1993 - 793	-60	1:1.22
12-10. Italy 2010-12	1895 - 756	-60	1:1.28
13-8. Austria	1944 - 748	-61	1:1.29
14-4. Greece 2011-13	2039 - 730	-64	1:1.32
15-1. Portugal	2993 - 702	-77	1:1.38
16-18. Germany	1611 - 659	-59	1:1.47
17-12. Spain	1790 - 657	-63	1:1.47
18-19. Sweden	*1520 - 587*	*-61*	*1:1.65*
19-21. Japan	*1218 - 579*	*-52*	*1:1.67*
20-6. Norway	2005 - 568	-72	1:1.70
21 -20. Finland	*1463 - 518*	*-65*	*1:1.87*
Europe (-UK) Average	*1878 - 728*	*-61%*	*1:0.75*
Europe : UK Ratio 1:	*1.03 - 1.33*	*-29%*	*1: 1.29*

# Indicates failed UN millennium goals.
Income Inequality v CMR Rho= +0.6188 p<0.001. GDPHE & CMR Rho=+0.2074 n.sig

Table 4: Adult Mortality Rates (55-74) per million [pm] Current Rest versus UK Ratio.

Country, Ranks 2014 v 1989	AMR 1989-91	AMR 2012-14	% Change	Rest v UK ratio
1- 4. USA	19168	12284	-36%	1:0.88
2- 6. Denmark	21104	12056	-43%	1:0.89
3- 6. Germany 1990-2014	18230	11740	-35%	1:0.92
4- 12. Belgium 2011-13	16874	11387	-33%	1:0.94
5- 10. Austria	17693	11148	-37%	1:0.96
6- 9. Finland	17845	10791	-40%	1:0.99
7- 3. UK 2011-13	**20554**	**10754**	**-48%**	**1:1.0**
8- 18. Greece 2011-13	14093	10693	-24%	1:1.01
9- 8. Portugal	17902	10354	-43%	1:1.04
10- 11. Netherlands	16938	10170	-40%	1:1.06
11- 1. Ireland 2011-13	22003	10101	-54%	1;1.07
12- 13. Canada 2010-12	16392	9948	-39%	1:1.08
13- 5. N. Zealand 2010-12	18843	9682	-49%	1:1.11
14- 17. France 2011-13	14299	9573	-33%	1:1.12
15- 7. Norway	18042	9569	-47%	1;1.12
16- 14. Sweden	16297	9551	-41%	1:1.13
17- 15. Italy 2010-12	15661	9489	-39%	1:1.13
18- 16. Spain	14625	8890	-39%	1:1.21
19- 21. Japan	11818	8563	-28%	1:1.26
20-19 Switzerland 2011-13	13589	8460	-38%	1:1.27
21- 20. Australia	12394	8081	-35%	1:1.33
Rest (-UK) Average	16107	9545	-41%	1:1.17
Rest to UK Ratio	1:1.28	1:1.13	1:0.88	1:1.13

Income Inequality & AMR Rho=+0.0169 n.sig
%GDPEH v AMR Rho= +0.1815 n.sig suggesting greater priority had been given to adult health care?

There was a significant correlation between AMR baseline and index years (Rho=+0.68701 p <0.001), indicative of a degree of continuity over time in respect to adults. There were no significant correlations between AMR and Income Inequality (Rho= +0.0091 n.sig) or between lowest AMR and GDPHE (Rho= −0.1432 n. sig). It is noteworthy that there was no correlation between the latest CMR and AMR (Rho−=+0.1506 n.sig) again suggesting differing priorities in some countries.

Comparing Other Countries with UK Child and Adult Mortality Outcomes: Table 5 shows the Confidence Intervals results of comparing the other countries CMR and AMR outcomes with those of the UK over the period.

The UK had significantly bigger child mortality reductions than Canada and the USA but *eleven* other countries had significantly greater falls in CMR than the UK.

The converse was the case in regard to reducing AMR as whilst Ireland had a significantly bigger reduction than the UK, Britain's adult death rates fell significantly more than *seventeen* other countries, including France, Germany and the USA, possibly suggesting greater priority had been given to adult health care?

Table 5: Comparing Other Countries v UK Child and Adult Mortality Confidence Intervals # UK Better Outcome.

Confidence Intervals of Other Countries versus UK: Child Mortality Rates (0-4) (CMR) v Adult (55-74) Mortality Rates 1989-2014. [**Bold** significant]						
	CMR (Other: UK)			AMR (Other: UK)		
	Lower	OR	Upper	Lower	OR	Upper
Australia	**1:1.03**	**1:1.15**	**1:1.29**	**1:0.77#**	**1:0.8**	**1:0.83**
Austria	**1:1.16**	**1:1.3**	**1:1.46**	**1:0.80#**	**1:0.83**	**1:0.86**
Belgium	1:0.99	1:1.11	1:1.24	**1:0.75#**	**1:0.78**	**1:0.8**
Canada	**1:0.71#**	**1:0.79**	**1:0.88**	**1:0.83#**	**1:0.86**	**1:0.89**
Denmark	**1:1.13**	**1:1.26**	**1:1.41**	**1:0.89#**	**1:0.92**	**1:0.95**
Finland	**1:1.25**	**1:1.42**	**1:1.61**	**1:0.84#**	**1:0.87**	**1:0.89**
France	1:0.96	1:1.07	1:1.2	**1:0.75#**	**1:0.78**	**1:0.81**
Germany	**1:1.09**	**1:1.23**	**1:1.38**	**1:0.79#**	**1:0.81**	**1:0.84**
Greece	**1:1.25**	**1:1.4**	**1:1.57**	**1:0.67#**	**1:0.69**	**1:0.71**
Ireland	1:0.93	1:1.05	1:1.17	**1:1.10**	**1:1.14**	**1:1.18**
Italy	**1:1.12**	**1:1.26**	**1:1.41**	**1:0.83#**	**1:0.86**	**1:0.89**
Japan	1:0.93	1:1.05	1:1.20	**1:0.70#**	**1:0.72**	**1:0.75**
Netherlands	1:0.95	1:1.07	1:1.20	**1:0.84#**	**1:0.87**	**1:0.90**
New Zealand	1:0.82	1:0.91	1:1.01	1:0.98	1:1.02	1:1.05
Norway	**1:1.57**	**1:1.77**	**1:1.20**	1:0.95	1:0.99	1:1.02
Portugal	**1:1.91**	**1:2.14**	**1:2.39**	**1:0.87#**	**1:0.9o**	**1:0.94**
Spain	**1:1.21**	**1:1.37**	**1:1.54**	**1:0.83#**	**1:0.86**	**1:0.89**
Sweden	**1:1.15**	**1:1.3**	**1:1.47**	**1:0.86#**	**1:0.89**	**1:0.92**
Switzerland	1:0.92	1:1.03	1:1.15	**1:0.81#**	**1:0.84**	**1:0.87**
USA	**1:0.79 #**	**1:0.88**	**1:0.97**	**1:0.79#**	**1:0.82**	**1:0.84**

NB# UK had significantly better outcomes.

Discussion

Main findings

The null hypothesis of no statistical association between the mortalities and %GDPHE is accepted but rejected for CMR and relative poverty, as measured by Income Inequality, where there was a strong positive significant correlation. However, the second hypothesis is rejected, as over the period the UK had very different outcomes than many of the other countries – eleven countries significantly better than the UK child mortality outcomes, whereas the UK was more successful in reducing adult mortality than seventeen other developed countries. These results need to be considered in the context that the UK had the lowest average % GDP devoted to health over the period; the third worst relative poverty and the fourth highest CMR. Moreover the four countries with the narrowest Income Inequality also had the lowest child mortality, whilst the three of the top four Income Inequalities also had the highest child mortality rates. Five of the top seven countries with the highest CMR were English-speaking, this might suggest that there are possible cultural factors operating in cultures who give higher priority to adults?

The UK CMR outcomes are relatively disappointing but dealing in rates it is easy to forget that we are speaking of child (0-4) deaths but translating rates back into actual numbers gives a more stalk perception. Currently there were 3,619 UK deaths and 27,045 in the USA and unlike the USA, the UK CMR just met the UN Millennium goal of reducing CMR by 2% p.a. However, if the UK and USA had matched Portugal's current rate, who previously had the highest CMR, there would have been 1,339 fewer under-five deaths in the United Kingdom and 13,793 less in the USA.

Almost counter-intuitively, there was no correlation between either CMR, AMR and %GDPHE, but there was a small but significant link between lower Private to Public %GDP ratios and higher child mortality. Pointing again to what has long been known that relative poverty and child mortality is statistically linked, though the actual mechanisms are unclear [6,7,12-16]. However, relative poverty and social exclusion in the UK is worsening [31-34], which suggests that there needs to be major change if the UK were to match the Western European child mortality average as relative poverty seems to be an all-pervasive factor in CMR.

Study limitations

The study cannot explain the differences found between the countries, such as the UK's comparative excess of child mortality; nor why the UK outcomes on reducing adult deaths were so much better. This might have been influenced by the law of diminishing returns, as previously the UK had the third highest AMR so in countries with initially high baseline rates it is easier to make proportionately bigger reductions following new investment, whereas those with initially lower rates is

harder to achieve comparable reductions over the same time [28-30]. Only country-specific research can explain these individual results.

Despite these limitations, the study provides a perspective of how twenty-one developed nations *'meet the needs of its children'* compared with its outcomes for adults and provides a baseline for future comparative research.

Conclusions

These results appear to indicate that in practice the UK has given greater priority to adult than child health. It not being suggested that there should be any reduction in adult health resources but if the UK is to `*meet the needs of its children'* [1] then relative poverty will need to be reduced and probably greater resources devoted to child health will be require in an attempt to off-set the accumulative impact of relative poverty upon children. This study gives support to the case that only a prolonged effort to reduce income inequalities, will improve CMR for disadvantaged children even in the Western world [35,36].

Summarizing the UK situation. It has the third widest income inequality, the lowest average (1980-2014) %GDPHE, the fourth highest CMR, which is the highest in Western Europe and a third higher than the other European countries. This is a matter of some concern especially as the reverse is true for UK achievements in reducing adult deaths.

Paradoxically, notwithstanding the UK children's results, the AMR outcomes confirms that the NHS is one of the most effective and efficient in the world, achieving more with proportionately less. Indeed, this study is not a criticism of the UK children's services, but rather shows the socio-economic context in which they operate and perhaps achieve more than we have a right to expect. However, with a comparatively chronic under-resourced NHS [37] and the long-standing structural relative poverty the UK is unlikely to be unable to match other countries' achievements and therefore the UK, along with the USA can be said to relatively neglect `to *meet the needs of its children'* [1].

References

1. UNICEF (2001) Child Deaths by Injury in Rich Nations. Florence, Innocenti Research Centre, Report No 2. United Nations International Children's Emergency Fund: 2001. **Link:** https://goo.gl/7Dupzc

2. UNMDG Task Force (2009) Millennium Development Goals: A Report. New York, United Nations: 2009. **Link:** https://goo.gl/r7xgRJ

3. WHO (2016) Annual Health Statistics. **Link:** https://goo.gl/kCkxgk

4. American Cancer Society (2014) The economic impact of cancer. **Link:** https://goo.gl/ievR2v

5. DOH (2011) Improving Outcomes: A strategy for Cancer. Department of Health, London: 2011. **Link:** https://goo.gl/9wUAEM

6. Pritchard C, Williams R (2011) Poverty and child (0-14 years) mortality in the USA and other Western countries as an indicator of "how well a country meets the needs of its children" (UNICEF). Int J Adol Med Health 3: 251-255. **Link:** https://goo.gl/ebmJPW

7. Pritchard C, Wallace MS (2015) Comparing UK and Other Westerns Countries' Health Expenditure, Relative Poverty & Child Mortality. Are British children doubly disadvantaged? Children & Society 462-472. **Link:** https://goo.gl/KZMpAi

8. World Bank (2016) GDP Expenditure on Health. **Link:** https://goo.gl/53hVG5

9. US Bureau of Statistics (2014) Statistical Abstract of the United States. **Link:** https://goo.gl/2VGJfN

10. World Bank (2011). Measuring Poverty: Poverty Reduction & Equity. **Link:** https://goo.gl/UJD6PP

11. Wilkinson R, Pickett K (2009) The Spirit Level, London, Allen Lane. **Link:** https://goo.gl/StHvDV

12. Freemantle N, Wood J, Griffin C (2009) What factors predict differences in infant and peri-natal mortality in primary care trusts in England? A prognostic model. BMJ 339: 287-292. **Link:** https://goo.gl/gX8FKa

13. Barr B, Taylor-Robinson D, Whitehead M (2012) Impact on health inequalities in England of rising prosperity 1998-2007 and implications for performance incentives: longitudinal ecological study. BMJ 345: e7831. **Link:** https://goo.gl/p8oLRt

14. Sengoelge M, Hesselberg M, Ormandy D (2014) Housing, income inequality ad child injury mortality in Europe: A cross-sectional study. Child Care Health Dev 40: 283-291. **Link:** https://goo.gl/YKw8gz

15. Umberson D, Williams K, Thomas PA, Liu H, Thomeer MB (2014) Race, gender and, social relationships and health. Chains of disadvantage: childhood adversity. J Health Soc Behav 55: 20-38. **Link:** https://goo.gl/n8zn6u

16. Cheng TL, Johnson SB, Goodman E (2016) Breaking the Intergenerational Cycle of Disadvantage: The Three Generation Approach. Pediatrics 137: e20152467 **Link:** https://goo.gl/GxZdkb

17. Sidebotham P, Fraser J, Covington T, Freementle J, Pulikottil-Jacob R, et al. (2014) Understanding why children die in high-income countries. Lancet 384: 915-927. **Link:** https://goo.gl/qBiKKv

18. Laderichi CR, Saith R, Stewart F (2003) Does it matter that we do not agree on definitions of poverty? A comparison of 4 approaches. Oxford Devel Stud 31: 253-274. **Link:** https://goo.gl/PpjujR

19. Economist (2011) Measure by Measure: The world's richest countries try to measure its poor (Editorial) 2011. **Link:** https://goo.gl/FNbtPW

20. World Bank (2016) Income Inequalities. Link: https://goo.gl/NzsrwT

21. Office of National Statistics (2017) Household income & inequality in the UK> Financial year ending 2015/16. **Link:**

22. House JS, Schoeni RF, Pollack H (2009) The health effects of Social and Economic Policy. Washington D, National Poverty Centre: 2009. **Link:** https://goo.gl/95RTqe

23. Feinstein L, Hearn P, Renton R (2009) Reducing Inequalities: Releasing the talents of all. London, Institute of Education. 2009.

24. Brinda EM, Rajkumar AP, Enemark U (2015) Association between gender inequality index and child mortality rates: A cross-national study of 138 countries. BMC Public Health 97: 144-168. **Link:** https://goo.gl/E2bNEG

25. Hant M, Nacher M, Guihenneuc C (2009) What factors predict differences in ingant and peri-infant mortality in primary care trusts in England? A prognostic model. BMJ 339: 671-678. **Link:** https://goo.gl/ER2z7i

26. Lightfoot TJ, Johnston WT, Simpson J, et al. (2012) Survival of childhood acute lymophblastic leukemia: Impact of social inequalities in the United Kingdom. Eur J Cancer 48: 263-269. **Link:** https://goo.gl/yMAqfa

27. Whitworth MA (2013) Local inequality and crime: Exploring how variation in the scale of inequality measures affect the relationship between poverty and crime. Urban Studies 50: 725-741. **Link:** https://goo.gl/H9o4o2

28. Murphy K, Toplel R (2003) Diminishing returns. The costs and benefits of improving health. Perspect Bio Med 46: 3 Suppl; 108-128. **Link:** https://goo.gl/eeZWqm

29. Luce BR, Maukopf J, Sloan FA (2006) The return on investment in health care. Value Health 9: 146-156. **Link:** https://goo.gl/T5kErM

30. Vukmir RB, Howell RN (2010) Emergency medicine provider efficiency: the learning curve, equilibration and point of diminishing returns. Emerg Med J 27: 916-920. **Link:** https://goo.gl/g7t8k2

31. Credit Suisse (2014) Global Wealth Data Book 2014. **Link:** https://goo.gl/cNxLkf

32. Milburn Report (2014) 2nd Annual State of the Nation Report, Social Mobility and Child Poverty Commission. **Link:** https://goo.gl/mHMU9H

33. Taylor-Robinson D, Whitehead M, Barr D (2014) Great leap backwards. BMJ 349: g7350. **Link:** https://goo.gl/s8PJWi

34. JRF (2016) Monitoring poverty and social exclusion. Joseph Rowntree Fund. **Link:** https://goo.gl/oW5QXX

35. Malqvist M (2015) Abolishing inequality, a necessity for poverty reduction and the realisation of child mortality targets. Archive Disease Childhood Suppl 1; S5-9. **Link:** https://goo.gl/xDJHZE

36. Tran TD, Luchters S, Fisher J (2016) Early childhood development: impact of national human development, family, poverty, parenting practices and access to early childhood education. Child Care Health Dev 43: 415-426. **Link:** https://goo.gl/UeBgKT

37. Harding AJE, Pritchard C (2016) UK and Twenty Comparable Countries GDP Expenditure-on-Health 1980-2013: The Historic and Continued Low Priority of UK Health Related Expenditure. Int J Health Policy Manag 5: 519–523. **Link:** https://goo.gl/5f3nqU