

Child Abuse-related Deaths, Child Mortality (0–4 Years) and Income Inequality in the USA and Other Developed Nations 1989–91 v 2013–15: Speaking Truth to Power

The major concern for social work, namely child abuse-related deaths (CARD), involves parental neglect. Societal neglect, when measured by child mortality rates (CMR), is considered by bodies such as UNICEF to be indicative of how a nation meets the needs of its children. This population-based study analyses CARD and CMR for children aged from newborn to four years old between 1989–91 and 2013–15 to identify any relative child neglect in the USA and 20 other developed nations (ODN). World Health Organization data were used for CARD, CMR and undetermined deaths (UnD), a possible source of unreported CARD, juxtaposed against World Bank income inequality data. The USA had the highest number of CARD, the highest CMR and the worst income inequality. Five countries reduced their CARD significantly more than the USA, and 14 countries reduced their CMR more than the USA. Income inequality and CMR were correlated. Had the USA matched the CMR of Japan, where income inequality was narrowest, there would have been on average 16 745 fewer child deaths annually. CARD and UnD correlated, suggesting that UnD may contain unreported CARD. US CMR data indicate that services in the USA are less effective than those in ODN, possibly due to income inequality. These results will be unwelcome but child protection services must dare to speak truth to power.

KEY PRACTITIONER MESSAGES:

- The richest country in the world, the USA, has the highest rates of child abuse and total child mortality in the Western world.
- The USA has the highest income inequality in the West, highlighting the statistical link between child mortality and poverty.
- Children's services should lead the call for the necessary changes and 'speak truth to power'.

KEY WORDS: USA; child mortality; fatal child abuse; relative poverty; international

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'This population-based study analyses CARD and CMR for children aged from newborn to four years old between 1989–91 and 2013–15 to identify any relative child neglect in the USA and 20 other developed nations'

‘This study analyses the three child mortality categories, namely, CARD, UnD and CMR, within the context of income inequality’

Introduction

It was the seminal work of Kempe and colleagues in 1962 that alerted the Western world to the problems of child neglect and abuse, with child abuse-related deaths (CARD) seen as the extreme consequence of child neglect found in every nation (Burchinal *et al.*, 2011; Kempe *et al.*, 1962; Kempe and Kempe, 1978; Pritchard *et al.*, 2013; Pritchard and Mirza, 2016; Serinelli *et al.*, 2017). Consequently, much child protection policy has centred upon reducing parental neglect and abuse to reduce CARD (Sengoelge *et al.*, 2014; Sidebotham *et al.*, 2014; Malqvist, 2015; Cheng *et al.*, 2016).

Parents are considered as ‘neglecting’ if they fail to meet the needs of their children as compared with, and relative to, the majority of other parents in their society (London Child Protection Procedures, 2017). It is argued that this can also be true for nations, if relatively they fail to match the child mortality rates (CMR) of other countries, reflected in the UNICEF statement ‘that in the last analysis Child Mortality Rates (CMR) are an indication of how well a nation meets the needs of its children’ (UNICEF, 2001, p. 3). Hence, in an analysis of CARD, in order to explore the effectiveness of child protection services, we also analyse the total under-five (0–4 years) CMR, which were a major specific objective of the United Nations (UN) Millennium Development Goals, namely, to reduce CMR by two per cent per annum (UN, 2000, 2009). Thus, both CARD and CMR outcomes can be said to be an indication of how well the USA, compared to the 20 other developed nations (ODN), meets the needs of its children.

It had previously been argued that CARD might go unrecognised and, consequently, that a child's death might be categorised among undetermined deaths (UnD) rather than as a homicide, leading to an under-reporting of CARD (Creighton, 1993; Newton and Vandeven, 2006). Officially, this was because the authorities could not decide on the cause of death (World Health Organization (WHO), 2018). Consequently, UnD are also analysed to avoid the criticism that we may be under-reporting CARD contained in UnD rates.

This study analyses the three child mortality categories, namely, CARD, UnD and CMR, within the context of income inequality (World Bank, 2016), which is associated with a range of poorer outcomes in education, criminality and unemployment as well as health problems and child mortality (Cheng *et al.*, 2018; Hanf *et al.*, 2014; Sengoelge *et al.*, 2014; Smeeding and Thevenot, 2016; Tran *et al.*, 2017; Umberson *et al.*, 2014; Unger, 2013; Wilkinson and Pickett, 2009). We used income inequality ratios (World Bank, 2018) which are almost a standard surrogate measure of relative poverty and which are the difference between the top and bottom ten per cent of incomes. Moreover, the UN Millennium Development Goals (2009), in addition to reducing CMR by two per cent per annum, also included the aim to reduce both relative and absolute poverty, to which the USA and the 20 ODN were signatories, recognising the aetiological link with CMR.

The study has three null working hypotheses that over the period between 1989–91 and 2013–15 there will be:

- i No significant differences in reductions in CARD between the USA and the ODN;
- ii No significant differences in reductions in CMR between the USA and the ODN; and
- iii No significant associations between income inequality and the three child mortality categories.

Methodology

It must be acknowledged that the USA is a federation of states, which vary considerably, and many states have bigger populations than some of the ODN that will be reviewed, such as Ireland and Norway. However, in an international comparison, the focus has to be upon the whole nation, as possible differences between the 50 US states would require a state by state-specific study. The comparative baseline years were the 1989–91 average, compared with the three-index year average of 2013–15, which are the latest available WHO international data, updated June 2018 (WHO, 2018). The baseline year of 1989 coincides with the latest *International Classification of Diseases 10th Edition* (WHO, 2016), which is used by the WHO (2018) in its annual statistics. Each nation is compared against itself based upon the baseline and index years, and thus can serve as its own control over the period for the three types of mortality. A few countries have slightly earlier index years such as France and Portugal (2012–14) but the few differences are indicated in Tables 1 and 2 (see the Results section).

CARD

It is probable that there will be different definitions of ‘child abuse’ in the various countries, but taking the confirmed murder of a child as abuse-related is a very strong definition of the extremes of abuse, as it led to a child's death, whether within or outside the family. However, as the focus is upon children aged from newborn to four years old, the vast majority of such deaths are within the family (Pritchard, 2004; Pritchard *et al.*, 2013). CARD are confirmed homicides perpetrated by a third-party assailant (WHO, 2018). The total combined boy and girl CMR per million (pm) is extrapolated for infants (<1 year) and young children (1–4 years) from which an under-five (0–4 years) CARD rate is calculated. The main analysis will be upon the under-five (0–4 years) death rates but data for the under-one-year-olds (<1 years) for both CARD and UnD are reported to provide a comprehensive review.

UnD

It has been argued that CARD might be under-reported and ‘hidden’ in the WHO (2018) category of UnD (Creighton, 1993; Newton and Vandeven, 2006). UnD are designated ‘other external causes’ and defined as:

‘deaths of undetermined intent ... when it is not possible for the medical or legal authorities to determine whether it was accidental, self-harm or an assault ... [including] poisoning ... [ranging from] drugs to vapours and gases ..., hanging ..., suffocation ..., drowning and submersion [but in each case] ... intent could not be determined ... including inexplicable deaths.’ (Found in codes that define the various sub-types of deaths (7240, W20–64,75; X10–39,50; Y10–89) (WHO, 2018)

As the above types of lethality contain a degree of violence, it can be seen why UnD might be thought of as instances of under-reported CARD (Creighton, 1993; Newton and Vandeven, 2006). However, an UnD will always remain ‘undetermined’, but considering the methods of lethality, a violent UnD in an

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‘CARD are confirmed homicides perpetrated by a third-party assailant’

Table 1. Child abuse-related deaths (CARD) (<1 and 0–4 years) and undetermined deaths (UnD) (children aged <1 and 0–4 years) (rates per million) 1989–81 v 2013–15: countries are ranked according to the current combined under-fives (0–4 years) CARD and UnD rates (Combined 0–4)

| Country & Ranks Combined & CARD | <1 CARD | 0–4 CARD | % change | <1 UnD | 0–4 UnD | Combined 0–4 | % change |
|---------------------------------|---------|----------|----------|--------|---------|--------------|----------|
| 1. USA | 57 | 32 | –3% | 177 | 75 | 107 | 0% |
| 2013–15 | 70 | 31 | | 309 | 76 | 107 | |
| 2. New Zealand | 53 | 18 | –35% | 211 | 84 | 112 | –15% |
| 2011–13 | 38 | 12 | | 344 | 83 | 95 | |
| 3. Belgium | 22 | 16 | –25% | 464 | 128 | 144 | –72% |
| 2013–15 | 29 | 12 | | 104 | 28 | 40 | |
| 4. Japan | 62 | 27 | –81% | 351 | 97 | 124 | –73% |
| 2013–15 | 13 | 5 | | 93 | 28 | 33 | |
| 5. Norway | 37 | 14 | –14% | 5 | 3 | 17 | +59% |
| 2013–15 | 38 | 12 | | 22 | 15 | 27 | |
| 6. France | 14 | 7 | –14% | 804 | 225 | 232 | –89% |
| 2012–14 | 17 | 6 | | 51 | 20 | 26 | |
| 7. UK | 28 | 14 | –86% | 256 | 81 | 95 | –74% |
| 2013–15 | 2 | 2 | | 63 | 23 | 25 | |
| 8. Australia | 39 | 17 | –59% | 151 | 77 | 94 | –74% |
| 2013–15 | 13 | 7 | | 42 | 17 | 24 | |
| 9. Germany | 39 | 12 | –34% | 48 | 49 | 61 | –62% |
| 1990–2013-15 | 24 | 8 | | 38 | 15 | 23 | |
| 10. Greece | 12 | 3 | +166% | 620 | 159 | 162 | –86% |
| 2013–15 | 24 | 8 | | 38 | 15 | 22 | |
| 11. Netherlands | 9 | 7 | –43% | 218 | 65 | 72 | –61% |
| 2013–15 | 17 | 4 | | 46 | 17 | 21 | |
| 12=. Canada | 30 | 15 | –87% | 219 | 74 | 89 | –78% |
| 2011–13 | 15 | 5 | | 78 | 15 | 20 | |
| 12=. Italy | 7 | 3 | –33% | 155 | 58 | 61 | –33% |
| 2013–15 | 2 | 13 | | 6 | 7 | 20 | |
| 14. Finland | 105 | 45 | –78% | 92 | 25 | 70 | –76% |
| 2013–15 | 11 | 6 | | 22 | 11 | 17 | |
| 15. Portugal | 11 | 3 | 0 | 430 | 163 | 166 | –90% |
| 1980–2012-14 | 4 | 3 | | 31 | 13 | 16 | |
| 16. Denmark | 15 | 14 | –86% | 15 | 10 | 24 | –50% |
| 1994–2013–15 | 12 | 2 | | 47 | 12 | 14 | |
| 17. Sweden | 10 | 6 | +17% | 20 | 9 | 15 | –17% |
| 1987–2013-15 | 16 | 7 | | 29 | 6 | 13 | |
| 18. Spain | 6 | 2 | +50% | 265 | 83 | 85 | –86% |
| 2013–15 | 11 | 3 | | 21 | 9 | 12 | |
| 19. Switzerland | 13 | 12 | –75% | 20 | 10 | 22 | –50% |
| 2013–15 | 17 | 3 | | 13 | 8 | 11 | |
| 20. Austria | 34 | 16 | –25% | 404 | 147 | 163 | –94% |
| 1980–2013-15 | 6 | 6 | | 14 | 4 | 10 | |
| 21. Ireland | 9 | 6 | –34% | 170 | 62 | 68 | –87% |
| 2012–14 | 0 | 4 | | 0 | 5 | 9 | |

Correlating 0–4 years CARD and UnD $Rho = +0.4146, p < 0.05$.

under-five year old might be thought suspicious (Creighton, 1993; Newton and Vandeven, 2006; Pritchard *et al.*, 2013).

It is reiterated that the examination of UnD is to minimise any inadvertent under-reporting of CARD, though it is not being suggested that the majority of UnD are ‘hidden’ CARD. Furthermore, as child abuse is now high on professional and public agendas, it is thought to be less likely than 20 or 30 years ago that many CARD will be missed and so included in the UnD category. Though we report rates of infants (<1 year) and young children (0–4 years) UnD, by their very nature, they remain undetermined.

There is also the problem of how the different countries register ambiguous deaths of children, but this is minimised by utilising the same categories across the nations reviewed, as in effect each nation is compared against itself over the period. The use of baseline and index years for each country's death rates

‘The examination of UnD is to minimise any inadvertent under-reporting of CARD’

Table 2. Chi square results comparing undetermined deaths (UnD) and child abuse-related deaths (CARD) in under-fives (0–4 years) in the USA with those in other developed countries from 1989–91 v 2013–15

| Country v USA | UnD chi square | CARD chi square |
|---------------|-----------------|-----------------|
| Austria | 88.7 | 3.19 |
| p value | < 0.0001 | <0.07 |
| Australia | 0.313 | 2.84 |
| p value | <0.7 | <0.1 |
| Belgium | 33.9 | 0.31 |
| p value | < 0.0001 | <0.7 |
| Canada | 30.3 | 3.64 |
| p value | < 0.0001 | <0.06 |
| Denmark | 2.24 | 7.07 |
| p value | <0.3 | < 0.008 |
| Finland | 23.7 | 18.0 |
| p value | < 0.0001 | < 0.001 |
| France | 92.1 | 0.332 |
| p value | < 0.0001 | <0.8 |
| Germany | 12.5 | 0.517 |
| p value | < 0.001 | <0.8 |
| Greece | 65.4 | 2.08 |
| p value | < 0.0001 | <0.2 |
| Ireland | 34.75 | 0.239 |
| p value | < 0.0001 | <0.4 |
| Italy | 15.4 | 5.31 |
| p value | < 0.001 | <0.03* |
| Japan | 32.4 | 10.2 |
| p value | < 0.0001 | < 0.001 |
| Netherlands | 20.0 | 0.62 |
| p value | < 0.001 | <0.5 |
| New Zealand | 0.711 | 0.693 |
| p value | <0.3 | <0.3 |
| Norway | 1.89 | 0.657 |
| p value | <0.5 | <0.3 |
| Portugal | 78.0 | 0.181 |
| p value | < 0.0001 | <0.7 |
| Spain | 40.0 | 0.216 |
| p value | < 0.0001 | <0.4 |
| Sweden | 0.126 | 0.90 |
| p value | <0.5 | <0.5 |
| Switzerland | 3.18 | 4.20 |
| p value | <0.08 | < 0.04 |
| UK | 27.4 | 7.07 |
| p value | < 0.0001 | < 0.008 |

*The USA had a better result.

Values in bold are significantly different from the USA.

provides virtual controls against which to measure the country's progress over the period.

CMR

The total combined CMR (pm) was extrapolated for infants (<1 year) and young children (1–4 years) from which an under-five (0–4 years) CMR was calculated (WHO, 2018).

Relative Poverty in Developed Countries.

There is a long-standing debate about definitions of poverty, crucially between 'relative' poverty in Western countries and 'absolute' poverty in the developing world (Laderichi *et al.*, 2003; *The Economist*, 2011; US Census Bureau, 2019; Wilkinson and Pickett, 2009; World Bank, 2016). Recently, the World Bank stated that, while there is no internationally agreed

'There is no internationally agreed definition of poverty'

‘Relative poverty can be measured using the World Bank *income inequality* ratio which is the gap between the top and bottom ten per cent of incomes’

definition of poverty, in effect, each country determines a ‘relevant welfare measure’ juxtaposed against a selected poverty line for that country in relation to its total population (World Bank, 2016). The Western and US concept of relative poverty is usually proportionate to national average incomes, so a family income that is 60 per cent below the average is designated as being in relative poverty (US Census Bureau, 2019). It would have been of relevance if the spending on ‘looked-after-children’ and on child health could be analysed, but the World Bank (2018), which provides the international data, only reports on the global *total* health and social care expenditure of a country, namely, the percentage of gross domestic product expenditure on health (%GDPEH).

The discussion of children's deaths in terms of rates pm might be thought to be over sanguine as rates are statistics. The numbers of children dying especially between the most unequal country, the USA, and the most equal country, Japan, as measured by income inequality (World Bank, 2018; Pritchard *et al.*, 2018a), provide a stronger sense of the real meaning of any differences between them. Hence, we calculate what differences there would have been in the numbers of young child (0–4 years) deaths if the USA had matched the CMR of Japan in the first 15 years of this century (2000–15).

Relative poverty can be measured using the World Bank *income inequality* ratio which is the gap between the top and bottom ten per cent of incomes (World Bank, 2018). The benefit of using this ratio is that it is country-specific, thereby reflecting the relative positions of poorer families within that society, which avoids the blurring that occurs when averages are used. For example, in 2015, the UK's average income was approximately £27 000, yet 60 per cent of the population received under £20 000 per annum indicating that the mode income is far lower than the mean (Office for National Statistics, 2016).

However, it should be stressed that CARD do not only occur in poorer families, indeed, they occur across the social classes and ethnicities (Bennett *et al.*, 2006; Pritchard *et al.*, 2013; Serinelli *et al.*, 2017; Sidebotham *et al.*, 2014), but in a population-based study, the detailed complexities of the multiple causes of CARD lie outside the study's competence.

Statistics

In order to compare the US outcomes with those of the 20 ODN, a series of chi square tests were used to determine any significant differences in the under-fives (0–4 years) CARD and UnD rates over the period 1989–91 v 2013–15. Chi square tests were used to examine CARD for both mortality categories as the rates were relatively low. Owing to larger rates, a series of \pm 95% confidence intervals were calculated using the SPSS statistical package in order to compare reductions in CMR in the USA and the other countries. All three types of mortality were examined within the context of relative poverty, using the World Bank (2018) measure of income inequality. Spearman's rank order (Rho) correlations were calculated to identify any statistical link between each type of mortality with income inequality as well as to explore any statistical overlap between CARD and UnD.

Results

Combined CARD and UnD 1989–91 v 2013–15

Table 1 shows the ranking of the current combined under-fives (0–4 years) CARD and UnD rates; the highest rates were observed for the USA at 107 pm, New Zealand at 95 pm and Belgium at 40 pm; the lowest rates were observed for Ireland at 9 pm, Austria at 10 pm and Switzerland at 11 pm.

CARD 1989–91 v 2013–15

In column two of Table 1 are listed infant (<1 year) CARD rates. The country with the highest rate of infant CARD was the USA at 70 pm, followed by New Zealand and Norway at 38 pm; the lowest rates were observed for Ireland at 0 pm and Italy and the UK at 2 pm.

The countries with the highest under-five (0–4 years) CARD rates were the USA at 31 pm, followed by Italy at 13 pm and New Zealand, Belgium and Norway at 12 pm. Sixteen countries had rates lower than 10 pm, the lowest being Denmark and the UK at 2 pm and Portugal, Spain and Switzerland at 3 pm.

UnD 1989–91 v 2013–15

It is noteworthy that *every country had higher rates of UnD than CARD* for both infants and newborn to four-year-olds. Seven countries had infant (<1 year) UnD rates over 50 pm; the highest were observed for New Zealand at 344 pm, the USA at 309 pm and Belgium at 104 pm. The under-fives (0–4 years) UnD rates were led by New Zealand at 83 pm, the USA at 76 pm and Belgium and Japan at 28 pm; the lowest were observed for Austria at 4 pm, Ireland at 5 pm and Sweden at 6 pm. There was a significant positive correlation between the under-fives (0–4 years) CARD and UnD rates over the period ($Rho = +0.4146$, $p < 0.05$), suggesting that there might be possible under-reporting of CARD in the UnD category.

Over the period, there were substantial falls (more than –20%) in under-fives (0–4 years) CARD rates in 13 countries, including the UK where rates fell by 86 per cent, and 16 countries had CARD rates of less than 10 pm. Overall, 15 countries substantially reduced their under-fives (0–4 years) UnD rates, with 16 countries having rates less than 20 pm. Table 2 presents the chi square results comparing outcomes in the USA with those in other countries; five countries experienced significantly bigger reductions than the USA for under-fives (0–4 years) CARD, including the UK, with three countries having statistical trends – the chi square just falling short of statistical significance < 0.05 . However, the USA had a slight but significantly better result than Italy ($X^2 = 5.31$ $p < 0.03$). In respect to under-fives (0–4 years) UnD, 14 countries, including the UK, had significantly greater falls than the USA over the period.

Total CMR 1989–91 v 2013–15

It should be noted that every one of the countries reduced its CMR over the period; 18 countries reducing their CMR by more than 50 per cent. However, Canada and the USA, with falls of only 37 and 48 per cent, respectively, did

‘The country with the highest rate of infant CARD was the USA at 70 pm’

‘Every country had higher rates of UnD than CARD for both infants and newborn to four-year-olds’

‘Every one of the countries reduced its CMR’

'The CMR of the USA was equivalent to 40 per cent more than the CMR of 18 other countries'

not meet the UN Millennium Development Goals target of a two per cent reduction per annum.

Table 3 lists all the 21 developed nations ranked according to the highest current under-five (0–4 years) CMR. The USA was again highest at 1249 pm, followed by three of the four other English-speaking countries, New Zealand at 1160 pm, Canada at 1094 pm, Belgium at 1091 pm and the UK at 885 pm. The lowest were Finland at 451 pm, Norway at 552 pm and Sweden at 577 pm.

The CMR of the USA was equivalent to 40 per cent more than the CMR of 18 other countries and was more than double the CMR of Finland, Norway, Sweden and Spain.

Based upon confidence interval analysis, whilst the USA had significantly greater reductions than Canada, 18 countries had significantly bigger falls in their CMR than the USA over the period.

Relative Poverty–Income Inequality

Table 4 lists the income inequality ratio which is the ratio between the top ten per cent and bottom ten per cent of incomes. The widest ratio between the top ten per cent of incomes and the income of the bottom ten per cent was 15.9 times in the USA, followed by 15.0 times in Portugal and 13.8 times in the UK. The least income inequality was found in Japan where the top ten per cent of incomes was 4.5 times that of the bottom ten per cent, with Finland at 5.6 times and Norway at 6.1 times; and these countries also had some of the lowest

Table 3. Child mortality rates (CMR) (per million) for under-fives (0–4 years) in the USA and other developed nations (ODN) 1989–91 v 2013–15, percentage of change; other developed nations (ODN) compared USA by confidence intervals: bold significant difference

| Country ranking 1989–91 v 2013–15 | 0–4 CMR 1989–2015 | % change | ODN:USA ratio | Confidence interval Lower - upper |
|--------------------------------------|----------------------|----------|---------------|--------------------------------------|
| 1. USA | 2420–1249 | –48% | 1:1.00 | 1:0.91–1:1.10 |
| 2. New Zealand 2011–13 | 2361–1160 | –51% | 1:1.08 | 1:0.95–1:1.16 |
| 3. Canada 2011–13 | 1740–1094 | –37% | 1:1.14 | 1:0.74–1:0.91* |
| 4. Belgium | 2013–1091 | –46% | 1:1.14 | 1:0.86–1:1.05 |
| 5. UK | 1929–885 | –51% | 1:1.41 | 1:1.01–1:1.25 |
| 6. Switzerland | 1783–871 | –51% | 1:1.43 | 1:0.95–1:1.17 |
| 7. Greece | 2039–843 | –59% | 1:1.48 | 1:1.12–1:1.39 |
| 8. Denmark | 1993–815 | –60% | 1:1.53 | 1:1.13–1:1.40 |
| 9. France 2012–14 | 1740–810 | –53% | 1:1.54 | 1:1.00–1:1.23 |
| 10. Australia | 1886–806 | –57% | 1:1.55 | 1:1.09–1:1.34 |
| 11. Germany 1990–92 | 1611–796 | –51% | 1:1.57 | 1:0.94–1:1.16 |
| 12. Netherlands | 1729–789 | –53% | 1:1.58 | 1:1.01–1:1.26 |
| 13. Ireland 2012–14 | 1659–767 | –54% | 1:1.62 | 1:1.00–1:1.25 |
| 14. Portugal 2012–14 | 2993–752 | –75% | 1:1.66 | 1:1.85–1:2.28 |
| 15. Austria | 1944–737 | –62% | 1:1.69 | 1:1.22–1:1.52 |
| 16. Italy | 1895–684 | –64% | 1:1.83 | 1:1.43–1:1.60 |
| 17. Japan | 1218–655 | –46% | 1:1.91 | 1:0.96–1:1.08 |
| 18. Spain | 1790–627 | –65% | 1:1.99 | 1:1.32–1:1.65 |
| 19. Sweden | 1520–577 | –62% | 1:2.16 | 1:1.21–1:1.53 |
| 20. Norway | 2005–552 | –72% | 1:2.26 | 1:1.67–1:2.11 |
| 21. Finland | 1463–451 | –69% | 1:2.77 | 1:1.48–1:1.90 |
| ODN (-USA) Average | 1866–803 | –57% | 1:1.56 | 1:1.09–1:1.34 |

*The USA had a better result.
Significant differences are given in bold.

Table 4. Income inequality: Top ten per cent times the bottom ten per cent of incomes

| Country and ranking | Top v bottom 10% of incomes |
|-----------------------------|-----------------------------|
| 1. USA | 15.9 |
| 2. Portugal | 15.0 |
| 3. UK | 13.8 |
| 4. Australia | 12.5 |
| 5. New Zealand | 12.4 |
| 6. Italy | 11.6 |
| 7. Spain | 10.3 |
| 8. Greece | 10.2 |
| 9=. Ireland | 9.4 |
| 9=. Canada | 9.4 |
| 11. Netherlands | 9.2 |
| 12. France | 9.1 |
| 13. Switzerland | 9.0 |
| 14. Belgium | 8.2 |
| 15. Denmark | 8.1 |
| 16=. Germany | 6.9 |
| 16=. Austria | 6.9 |
| 18. Sweden | 6.2 |
| 19. Norway | 6.1 |
| 20. Finland | 5.6 |
| 21. Japan | 4.5 |
| Total average (-USA) | 8.6 times |

Correlating child mortality rates 0–4 years with income inequality $Rho = +0.5870$, $p < 0.005$.

Correlating child mortality rates <1 year with income inequality $Rho = +0.5825$, $p < 0.005$.

Correlating child abuse-related deaths with income inequality $Rho = -0.0738$, not significant.

Correlating undetermined deaths with income inequality $Rho = +0.2837$, not significant.

CMR, virtually half the level of the USA. The average income inequality for the ODN was 9.2, which yielded an ODN average to USA ratio of 1:1.73. There was a positive correlation between high CMR and wide income inequality ($R = +0.5338$, $p < 0.01$), indicating that higher CMR are statistically associated with relative poverty.

There were no significant correlations between income inequality and rates of under-fives (0–4 years) CARD ($Rho = -0.1519$, not significant) nor with rates of under-fives (0–4 years) UnD ($Rho = +0.2214$, not significant), which might be counter-intuitive but suggests a different dynamic interaction between poverty and children dying from CARD and UnD.

Excess Deaths – Comparing the Most and Least Unequal Countries

While discussing the deaths of children in the context of rates and percentages may be considered as cold and dispassionate, nonetheless there is a strong statistical association between income inequality and CMR. We ask, therefore, what might this mean in actual numbers of dead children between the most unequal country, the USA, and the most equal country, Japan, based upon income inequalities?

Table 5 lists the annual CMR of both countries and the excess numbers of deaths are calculated for each year of this century had the USA matched Japan's CMR. On average over the 15 years, annually, there would have been 16 745 fewer deaths of under-five-year-old American children – a stark result indeed.

'Had the USA matched Japan's CMR... annually, there would have been 16 745 fewer deaths of under-five-year-old American children'

Table 5. Child mortality rates (CMR) (per million) in Japan and the USA 2000–15 and annual excess numbers of deaths of under-fives (0–4 years) in the USA during this period

| Year | Japan CMR | USA CMR | Numbers of excess deaths |
|------------------------|------------|-------------|--------------------------|
| 2000 | 899 | 1722 | 15 684 |
| 2001 | 845 | 1687 | 15 357 |
| 2002 | 821 | 1677 | 16 774 |
| 2003 | 787 | 1667 | 17 485 |
| 2004 | 754 | 1636 | 17 669 |
| 2005 | 739 | 1635 | 18 257 |
| 2006 | 723 | 1624 | 18 237 |
| 2007 | 708 | 1618 | 18 953 |
| 2008 | 701 | 1604 | 18 366 |
| 2009 | 750 | 1471 | 17 997 |
| 2010 | 644 | 1433 | 15 904 |
| 2011 | 689 | 1401 | 14 398 |
| 2012 | 608 | 1391 | 15 594 |
| 2013 | 563 | 1384 | 16 230 |
| 2014 | 579 | 1383 | 15 686 |
| 2015 | 543 | 1381 | 15 355 |
| Average 2000–15 | 721 | 1556 | 16 745 |

On average 16 745 fewer child deaths would have occurred annually if CMR in the USA had matched CMR in Japan where income inequality was narrowest.

Discussion

While there are inherent difficulties in comparative international mortality studies (Alkema and You, 2012), the data being drawn from the WHO (2018) are the most consistent and reliable in the field, because of the uniform and consistent manner in which the data have been collated over the years. Equally, while there are debates about poverty (World Bank, 2016), the World Bank data on income inequality (World Bank, 2018) are probably the best comparative data available, not least because they are country-specific.

The main limitation is that we cannot explain the differences between countries, which would require country-specific research. Nor do we seek to ascribe causes for the US results other than to place them within the context of relative poverty, recognising that there will be other inter-related factors influencing CARD, including healthcare, child welfare services, education, ethnicity, housing and others, but relative poverty seems to be a factor in all these other features (Wilkinson and Pickett, 2009; Burchinal *et al.*, 2011; Unger, 2013; Umberson *et al.*, 2014; Smeeding and Thevenot, 2016; Tran *et al.*, 2017; Cheng *et al.*, 2016).

The significant positive correlation between CARD and UnD rates perhaps gives some support to the possibility that UnD rates might contain some under-reported CARD (Creighton, 1993; Newton and Vandeven, 2006). On the other hand, great caution needs to be used lest we inadvertently add further distress to grieving parents where it was not possible to determine the cause of their child's death. Crucially, and perhaps counter-intuitively, at national levels, there was no statistical correlation between CARD, UnD and income inequality.

Main Findings

First, we can reject the three null hypotheses for, although CARD have fallen substantially by more than 40 per cent in 19 countries, as have UnD, the

'The significant positive correlation between CARD and UnD rates perhaps gives some support to the possibility that UnD rates might contain some under-reported CARD'

USA had the highest CARD and had experienced significantly worse outcomes for the rates of under-five (0–4 years) CARD than five others countries, and 14 countries in relation to rates of under-five (0–4 years) UnD.

Second, while every country has reduced its CMR, every country but Canada and the USA has met the UN Millennium Development Goal target of reducing its CMR by two per cent per annum). Furthermore, 14 countries had significantly greater reductions in CMR than the USA.

Thirdly, the juxtaposition of CMR and relative poverty is in line with many clinical and practice studies from the USA and across the developed world, which have consistently shown an association with poorer health outcomes of children from lower socio-economic groups (e.g. UN, 2000, 2009; Burchinal *et al.*, 2011; Unger, 2013; Cheng *et al.*, 2016; Umberson *et al.*, 2014; Probst *et al.*, 2018; Smeeding and Thevenot, 2016; Watkins *et al.*, 2016; Tran *et al.*, 2017), but, of course, this is not the only factor. Hence, we confidently reject the third null hypothesis.

The disproportionately high American CMR may not surprise those who recognise the wide extent of relative poverty in the USA, which is the worst in the developed world, despite having the highest %GDPEH (Pritchard *et al.*, 2018a; Pritchard and Keen, 2016). We do not have specific international data of the %GDPEH directly devoted to children and childcare. However, total %GDPEH in the USA between 1980 and 2015 averaged 12.7 per cent compared to Japan's average of 7.5 per cent (Pritchard *et al.*, 2018a). In 2015, %GDPEH in the USA was the highest at 16.8 per cent compared to 10.7 per cent in Japan, which was 17th of the 21 countries (Pritchard *et al.*, 2018a). Therefore, the better result achieved by Japan than the USA was not because Japan expended more resources than the USA. Hence, while the multiple causes of CMR are complex, in view of the high US %GDPEH, it does suggest that relative poverty might well be a strong factor. However, further and more detailed research would be required to be more precise.

The issue of excess deaths between those nations with worst and best relative poverty – USA and Japan – produced an excess of US children's deaths averaging 16 745. This gives support to the clarion call that something more needs to be done about child health and relative poverty in the USA (Malqvist, 2015; Smeeding and Thevenot, 2016; Tran *et al.*, 2017); but not just in the USA, as child mortality in ODN is often found to be linked to relative poverty (De Graaf *et al.*, 2013; Hanf *et al.*, 2014; Sengoelge *et al.*, 2014; Sidebotham *et al.*, 2014; Watkins *et al.*, 2016; Cheng *et al.*, 2016; Pritchard *et al.*, 2018a, 2018b).

Perhaps the most remarkable statistic on child deaths in the richest country in the world – the USA – can be gleaned from the US *National Vital Statistics Report* (US Department of Health and Human Services, 2017), in which US mortality is reported for the major ethnic groups. From Table 2, it can be calculated that for every White child who died there were 2.1 deaths of Black children (US Department of Health and Human Services, 2017, p. 23). However, it is recognised that ethnic minorities in ODN also have poorer health and social outcomes compared with the indigenous (mainly white) population (Alkema and You, 2012; De Graaf *et al.*, 2013; Hanf *et al.*, 2014; Sidebotham *et al.*, 2014; Watkins *et al.*, 2016; Wilkinson and Pickett, 2009). This disproportionate extent of mortality amongst ethnic minorities, related as it is to poverty, should give a further sense of urgency for the need for change.

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‘These results provide unpalatable evidence that relatively and comparatively the USA... appears to be ‘neglecting’ its children when compared to ODN’

These results provide unpalatable evidence that relatively and comparatively the USA (at a socio-economic structural level, compared to ODN) appears to be ‘neglecting’ its children when compared to ODN. We suspect that most US child protection and paediatric practitioners will have sympathy with this argument, but what they may not appreciate is just how disadvantaged their vulnerable children are compared with most of the developed world.

It is acknowledged that the message in this study might be considered somewhat strong. For this we make no apology. The data that we have drawn upon are authoritative, and we believe the analysis to be robust as the methodology has been tested across a range of international studies including neurology, suicide as well as child abuse deaths (Pritchard *et al.*, 2013, 2017; Pritchard and Hansen, 2015).

Childcare and health protection services, practitioners and academics need to speak up for children and families, and dare to speak truth to power, both to the electorates and governments. For if we do not, who will? A national campaign is needed to combat child mortality and its causes as, despite the call in the UN Millennium Development Goals to reduce child poverty and child mortality, the USA has seriously lagged behind ODN and such complacency needs to be challenged. We leave the last word to one of the great founders of the USA, William Penn (Penn, 1693), who prophetically said, ‘It is a reproach to Government and Religion to suffer such poverty and excess’.

Conflict of Interest

The authors have no vested interest in this study. Furthermore, there was no external funding for this project.

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