

Supplementary appendix

Supplement to: Abrahams N, Mhlongo S, Chirwa E, et al. Child abuse and neglect-related murders in South Africa: a comparison of two national surveys in 2009 and 2017. *Lancet Child Adolesc Health* 2024; published online June 26. [https://doi.org/10.1016/S2352-4642\(24\)00110-X](https://doi.org/10.1016/S2352-4642(24)00110-X).

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Risk factors for non-fatal child abuse and neglect and development of the INSPIRE framework to end violence against children.

Risk factors for child abuse has been identified. Using a public health approach key risk factors are: at the individual level (age, gender, disability, exposure to violence, poverty and education etc.); relational level (parenting practices, emotional bonding, peer violence, parental violence etc.); community level (poverty, gang violence, alcohol and drugs etc.); societal level (social norms on violence, discipline, social protection services, laws etc).⁶ A more recent review of risk factors in LMICs identified no specific risk factors for physical abuse for both boys and girls while being a girl was associated with both emotional and sexual abuse.⁷ Factors associated with emotional abuse included poverty, lower education of mothers and adults in the homes. The authors indicated that a broad spectrum of risk factors should be considered for physical abuse of children.⁷

In 2016 the World Health Organisation (WHO) together with development agencies released INSPIRE - an evidence based framework which include a technical package of guidelines including seven strategies for countries to end violence against children.⁸ This was in response to the sustainable development goal (SDG) target 16.2 to end all forms of violence against children.⁹ Analysis on uptake and use of INSPIRE show at least 67 countries, including South Africa, have used or adopted some aspect of INSPIRE but report also document many challenges reported by countries in scaling of the wide number of interventions.⁹

Table S1: Sampling frame of the Medical Legal Laboratories for 2009 and 2017 studies

Mortuary strata	2009		2017	
	Number of mortuaries	Sample (Sampling Fraction)	Number of mortuaries	Sample (Sampling Fraction)
Small: < 500 autopsies performed per year	81	20 (24.7)	96	55 (57.3)
Medium: 500-1499 autopsies performed per year	33	13 (39.4)	31	19 (61.3)
Large: > 1499 autopsies performed per year	8	5 (55.5)	10	7 (70.0)
Total	122	38 (31.1)	137	81 (59.1)

Missing Data and how Child Abuse and Neglect cases were identified

In 2017 none of the cases had missing age and sex was missing for only a few cases (n=8). However, in 2017 police data were not available for 127 unweighted cases (weighted n=214) identified at the mortuaries. Comments related to the circumstances of the deaths extracted either from the mortuary register or the autopsy file were used to identify CAN. For example, a comment 'death linked to gang violence' assisted us to categorise this case as a non-CAN death. If comments were not available, we considered the age of the child and the cause of death. We considered all physical injuries indicators of physical abuse. Cases with gunshots, stabs, blunt trauma, strangulations, evidence of sexual violence were considered together with the place of injury and a decision was reached collectively based on probability of events. For example, a child of under 5 years who died from blunt force injury in the home was an indication that the child was murdered. We considered all children under the age of 15 with evidence of sexual abuse as CAN-related murders. For children aged 15 years and older and who had evidence of sexual assault we reviewed the place of death and manner of death to determine the probability of the death being related to child abuse and neglect. Most child murders with no police data were of boys (unweighted n=102/127, 80.3%), aged 15 years and older (unweighted n=81/127, 63.8%), with injury patterns similar to South African adult male on male interpersonal violence. At the end of the review process, we had 24 unweighted cases (weighted n=42) of child murders, all under the age of 15 years, for which we were unable to allocate a CAN category and these cases were excluded in the analysis. Also see further description of the 24 cases in table S2 .

Table S2: Summary description of child murder cases with unknown CAN status (2017)

		Weighted N= 42 N (%)	Unweighted N=24 N (%)
Sex	Male	28 (66.7%)	15 (62.5%)
	Female	14 (33.3%)	9 (37.5%)
Age group	0-4yrs	21 (50.6%)	12 (50.0%)
	5-9yrs	9 (21.4%)	5 (20.8%)
	10-14yrs	12 (28.0%)	7 (29.2%)
Cause of death	Gunshot wounds	19 (45.1%)	8 (33.5%)
	Stab wounds	8 (19.0%)	4 (16.7%)
	Blunt force trauma	6 (14.2%)	6 (25.0%)
	Strangulation/asphyxiation	6 (14.6%)	4 (16.7%)
	Other	3 (7.1%)	2 (8.3%)

Table S3: Assumptions related to incidence rate ratio (IRR) used in the study with explanations

Assumption	Explanation
1. Stable population: For accurate interpretation of IRR, it is essential that the population under study remains relatively stable over time. Changes in population size or composition can impact the IRR	Our study is based on the South African population. This is an open population and the mid-year estimates of the two respective years was used as provided by the Thembisa model which takes the growth in the population into account.
2. Rare disease: When the disease is rare, the odds ratio (OR) approximates the IRR. However, this assumption is not always necessary for IRR interpretation.	This is not relevant. Child abuse and neglect related deaths are rare events in terms of the overall under 18 population.
3. Matching on time: Some studies match cases and controls based on time (e.g., concurrent sampling). In such cases, the IRR can be interpreted without assuming a stable population.	We matched the child abuse and neglect-related murders with the estimated total under 18s population of South Africa at both time points.
Temporal stability: refers to the consistency of exposure and outcome measurement over time.	
4. Consistent exposure measurement: The exposure assessment method should yield consistent results over time. Any changes in exposure measurement (e.g., different instruments, recall bias) can affect the validity of IRR estimates.	We used the same sampling frame of mortuaries, the same sampling cluster design, the same methodology. The only difference is that in the latter survey a provincial stratification was added which led to the sampling fraction in the sampling frame to be higher.
5. Consistent outcome measurement: Similarly, outcome assessment (e.g., disease diagnosis) should remain stable throughout the study period.	We used identical protocols except for the provincial stratification.
Measurement consistency relates to the reliability and validity of exposure and outcome measurements.	
6. Reliable exposure assessment: The exposure measurement method should yield consistent results across different assessments.	Our exposure is the year of study with the estimated mid-year under 18 population of South Africa which is an open population. The same source of these population estimates was used.
7. Valid outcome assessment: The outcome measurement (e.g., disease diagnosis) should accurately reflect the true disease status.	These were all incident true child abuse and neglect-related murders since they were captured from mortuaries using the same survey sampling approach of mortuaries from the mortuaries sampling frame.

<p>8. Rare disease assumption: When the disease is rare, the IRR can be approximated using OR, assuming measurement consistency.</p>	<p>This is not relevant since we used IRR directly.</p>
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Table S4: Count and percentages distribution of all child murder cases in the police system by mortuary strata

Mortuary strata	2009		2017	
	All child murder cases identified†	Police data available‡	All child murder cases identified†	Police data available‡
Small	304 (29.8%)	304 (100.0%)	228 (25.5%)	190 (83.3%)
Medium	448 (44.0%)	448 (100.0%)	239 (26.8%)	189 (79.1%)
Large	266 (26.2%)	266 (100.0%)	426 (47.7%)	299 (70.2%)
Total	1018	1018 (100.0%)	893	679 (76.0%)
† Percentage of murder cases across mortuary size				
‡ Percentage of the child murder cases identified in each mortuary strata				