Child Maltreatment and Mortality in Young Adults

Leonie Segal, PhD,[a] Jason M. Armfield, PhD,[a] Emmanuel S. Gnanamanickam, PhD,[a] David B. Preen, PhD,[b] Derek S. Brown, PhD,[c] James Doidge, PhD,[d] Ha Nguyen, PhD[a]

abstract

BACKGROUND: Child maltreatment (CM) is a global public health issue, with reported impacts on health and social outcomes. Evidence on mortality is lacking. In this study, we aimed to estimate the impact of CM on death rates in persons 16 to 33 years.

METHODS: A retrospective cohort study of all persons born in South Australia 1986 to 2003 using linked administrative data. CM exposure was based on child protection service (CPS) contact: unexposed, no CPS contact before 16 years, and 7 exposed groups. Deaths were observed until May 31, 2019 and plotted from 16 years. Adjusted hazard ratios (aHRs) by CPS category were estimated using Cox proportional hazards models, adjusting for child and maternal characteristics. Incident rate ratios (IRRs) were derived for major causes of death, with and without CPS contact.

RESULTS: The cohort included 331 254 persons, 20% with CPS contact. Persons with a child protection matter notification and nonsubstantiated or substantiated investigation had more than twice the death rate compared with persons with no CPS contact: aHR = 2.09 (95% confidence interval [CI] = 1.62–2.70) to aHR = 2.61 (95% CI = 1.99–3.43). Relative to no CPS contact, persons ever placed in out-of-home care had the highest mortality if first placed in care aged ≥3 years (aHR = 4.67 [95% CI = 3.52–6.20]); aHR was 1.75(95% CI = 0.98–3.14) if first placed in care aged <3 years. The largest differential cause-specific mortality (any contact versus no CPS contact) was death from poisonings, alcohol, and/or other substances (IRR = 4.82 [95% CI = 3.31–7.01]) and from suicide (IRR = 2.82 [95% CI = 2.15–3.68]).

CONCLUSIONS: CM is a major underlying cause of potentially avoidable deaths in early adulthood. Clinical and family-based support for children and families in which CM is occurring must be a priority to protect children from imminent risk of harm and early death as young adults.

[a]*Health Economics and Social Policy Group, Australian Centre for Precision Health, University of South Australia, Adelaide, South Australia, Australia;* [b]*School of Population and Global Health, University of Western Australia, Perth, Western Australia, Australia;* [c]*Brown School, Institute for Public Health, Washington University in St Louis, St Louis, Missouri; and* [d]*Intensive Care National Audit & Research Centre, London, United Kingdom*

Dr Segal provided overarching project direction and study conceptualization, contributed to the analysis plan and interpretation of the findings, and had primary responsibility for the preparation of the manuscript and its revisions; Drs Armfield, Preen, Doidge, and Brown contributed to the analysis plan, interpretation of the findings, and revisions to the manuscript; Dr Gnanamanickam contributed to the data preparation, interpretation of the findings, and revisions to the manuscript; Dr Nguyen provided literature review and contributed to the analysis plan, data preparation, conduct of all data analyses, interpretation of the findings, and preparation of the manuscript and its revisions; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2020-023416

Accepted for publication Oct 2, 2020

WHAT'S KNOWN ON THIS SUBJECT: Child maltreatment (CM) impacts a wide range of health conditions across the life course, including mental illness and substance use disorders. Impacts on mortality in late adolescence and early adulthood have not been reported.

WHAT THIS STUDY ADDS: Persons exposed to CM have considerable excess risk of death during late adolescence and young adulthood. Adjusted hazard ratios were 1.75 to 4.67 times that of persons without CM exposure. Death from substances and suicide contributed most to excess mortality.

To cite: Segal L, Armfield JM, Gnanamanickam ES, et al. Child Maltreatment and Mortality in Young Adults. *Pediatrics.* 2021;147(1):e2020023416

Child maltreatment (CM) is a major public health and social welfare issue in Australia[1] and globally.[2,3] Large numbers of children are exposed, estimated at 25% of young people in the United States,[4] 20% of Australians,[5,6] and a higher proportion (up to 50%) of the global population.[3] The consequences of CM are extensive.[2,7] CM has profound effects on mental and physical health during childhood and across the life course.[7,8] It also impacts economic and social outcomes, such as school participation[9] and achievement, welfare dependency, addiction, risky sexual behaviors, and involvement in violence.[10] The described physiological effects of child abuse and neglect on brain development, stress, and inflammatory responses support the observations as causal.[11,12]

Despite a vast amount of literature on the impacts of child abuse and neglect, the effect on mortality has received limited attention, especially in adolescence and young adulthood. The seminal Adverse Childhood Experiences (ACEs) Study[13] found adults self-reporting >6 ACEs (CM and household dysfunction) died, on average, 20 years earlier than those reporting no ACEs.[14] But only 15% of study participants were younger than 40 years on enrollment. In a UK study of persons born in 1958, researchers reported higher adjusted hazard ratios (aHRs) for death before age 50 in persons with >2 ACEs compared with those with none,[15] and in a Swedish study of persons born in 1953, researchers reported a higher risk of death before age 65 in persons with child protection service (CPS) involvement relative to none.[16] In neither study did researchers report the specific mortality impact in early adulthood.

Late adolescence and early adulthood is a crucial developmental stage, in which the effects of mental illness, suicidality, and substance use drive a sharp increase in death rates.[17,18] Yet we know little about whether CM contributes to these premature deaths. With the current study, our aim was to address this evidence gap, examining all-cause and cause-specific mortality by CM exposure in individuals aged 16 to 33 years, as indicated by CPS involvement.

Studies ascertain CM exposure through either (1) surveys of survivors (years or decades after events), parents, educators, or other service providers or (2) administrative records of child protection agencies or death registries. All methods suffer potential sources of error. Survey-based methods are subject to recall failure (especially of early-in-life events), the distorting effect of community norms, social acceptability bias, survivor bias, and variable thresholds for CM. CPS involvement as an indicator of CM avoids these pitfalls but also can involve imperfect case ascertainment. However, in jurisdictions with widespread mandatory reporting of suspected CM, serious maltreatment is unlikely to go unreported. CPS administrative categories, designed to ensure a proportionate response by child protection authorities, can be used as indicators of the levels of CM exposure. CPS administrative data are really the only option for CM ascertainment to explore the association between CM and death in early adulthood at the population level, given the rareness of the outcome.

METHODS

Study Design and Participants

We used a retrospective cohort study design using linked administrative data. The study cohort included all children born in South Australia (SA), Australia, between January 1, 1986, and May 31, 2003, with records ascertained from the SA birth registry and perinatal statistics collection, surviving to age 16 years (based on the death registry), totaling 331 254 persons.

Data were linked across multiple administrative data sets by SA-NT DataLink[19] using deterministic and probabilistic algorithms, with extensive clerical review, drawing on >50 administrative data sets. A unique identifier was assigned to all cohort members, and approved data items were extracted by data custodians. Deidentified data were delivered to the research team for merging across data sets.

The study is part of the Impacts of Child Abuse and Neglect (iCAN) research program,[6] established to estimate the health and social consequences of CM in SA. Ethics approval for the study was obtained from the SA Health Human Research Ethics Committee (HREC14SAH28) and the University of South Australia Human Research Ethics Committee (HREC000032801).

Study Data

Child and Family Characteristics

The birth registry provided data on each child's date of birth, sex, maternal age (<21 or ≥21 years), and residential location (at birth), which was mapped onto the Index of Relative Socioeconomic Disadvantage (IRSD)[20] and allocated to quintiles of disadvantage by using Australia-wide cut points. The SA perinatal statistics collection defined maternal marital status (married/de facto, or not married), smoking status (smoking, not smoking, or unknown), employment (employed or not employed), all attributes associated with poor child outcomes,[21] and for the infant, an indicator of serious perinatal and/or congenital issues (still hospitalized at 28 days postbirth or discharged within 28 days of birth).

Child Protection Data

The Department for Child Protection (DCP) data files contained complete

records of child protection contacts in SA, including notifications (child protection reports), investigations, and substantiations from January 1, 1986, to June 30, 2017, and out-of-home care (OOHC) placements for all children entering care from January 1, 1990, to June 30, 2017, and for those children in care on January 1, 1990, with entry to care from January 1, 1986.

A child protection notification occurs when the notifier believes the child is at risk for, or has experienced, serious harm or high-level chronic neglect.[22] In SA, most occupations with potential child contact (such as health professionals, social workers, educators, child care workers, police, and legal professionals) are mandated notifiers, with penalties for failure to report. Child protection notifications are also taken from the public. A child protection investigation is instigated when a notification reaches a designated concern threshold and is within the DCP remit (eg, familial); the outcome options are substantiated, not substantiated, or no finding possible.

Children are placed in OOHC when DCP determines that leaving the child with their family poses an unacceptable risk of (further) serious harm.[22] Periods in OOHC range from overnight to 18 years. For this study, children were classified by the age of first entry to care: before or after 3 years, a core developmental pivot. The preschool years (3–4 years of age) represent a period of dramatic growth in physical, affective, and cognitive development, with increasing mastery over motor skills, impulse control, socialization skills, and language.[23,24] Rapid brain development and relational patterning is ocurring in the first few years of life. This cut point has been used previously in exploring CM-associated outcomes.[9]

Persons with CPS contact are heterogenous in terms of CM exposure. DCP has adopted a hierarchical categorization that indicates increasing levels of concern to guide its response.[22] Persons were categorized into groups on the basis of DCP descriptors, plus a subcategorization of children entering OOHC, resulting in 7 mutually exclusive exposure groups plus no exposure. Persons with only notification(s) were allocated to 1 of 3 groups reflecting assessment of the risk of harm; persons who had been the subject of an investigation were allocated to 2 groups depending on whether alleged maltreatment was substantiated; and persons who had ever entered OOHC were divided into 2 groups depending on age of first entry to care (Table 1).

Death data were drawn from the SA death registry (all deaths registered in SA from January 1, 1990, to May 31, 2019, noting month and year, ≥1 (up to 9) 4-digit cause-of-death codes (according to the *International Classification of Diseases, 10th Revision* [ICD-10]),[25] and/or descriptive text fields. Where only a descriptive text field was recorded, L.S. and research assistant J. Burgemeister independently allocated cause-of-death codes, resolving any discrepancies with H.N. A hierarchical classification system was adopted, informed by all recorded cause-of-death codes. The first allocation was to intentional self-harm (suicide) (ICD-10 codes X60–X84 and Y20); the second was to poisonings, alcohol, drugs, other substances, and mental illness (ICD-10 codes F00–F99, R45, T36–T65, X40–X45, Y10–Y19, and Y48 [but not X60–X84 and Y20]); the third was to vehicle crashes and other unintentional injuries (ICD-10 codes C01–V99 [but not the codes for suicide, substances, or mental illness]); and, finally, the fourth was to natural causes (ICD-10 chapters I to IV, VI to XVIII, XXI, and XXII but no codes in chapters V, IXX, or XX).

Data Analyses

Cumulative deaths per 1000 persons aged ≥16 years were computed for

TABLE 1 CPS Categories Adopted for This Study to Indicate CM Exposure

	CM Exposure	Description
Unexposed group		
1	No CM	No CPS involvement: no record with SA DCP, categorized as unexposed to CM and taken as the reference category
Exposed groups		
2	NOC	Individual is the subject of NOC notification(s) only. Reports had inadequate information or did not reach CM concern thresholds.
3	Other notification	Individual is the subject of notification(s) type(s) AAR, NGI, ROU, extrafamilial (referred to police as a criminal matter), or DNA but not CPM (see below) and with no record of investigation or OOHC.
4	CPM notification	Individual is the subject of CPM notification(s), indicating high suspicion of risk of serious CM-related harm, classified as "screened in." No record of investigation or OOHC.
5	Investigation	Investigation(s) recorded; no record of substantiation or OOHC
6	Substantiation	Substantiation(s) of abuse or neglect recorded and never placed in OOHC
7	OOHC before age 3	At least 1 OOHC placement record and first entered care before their third birthday
8	OOHC from age 3	At least 1 OOHC placement record and first entered care on or after their third birthday

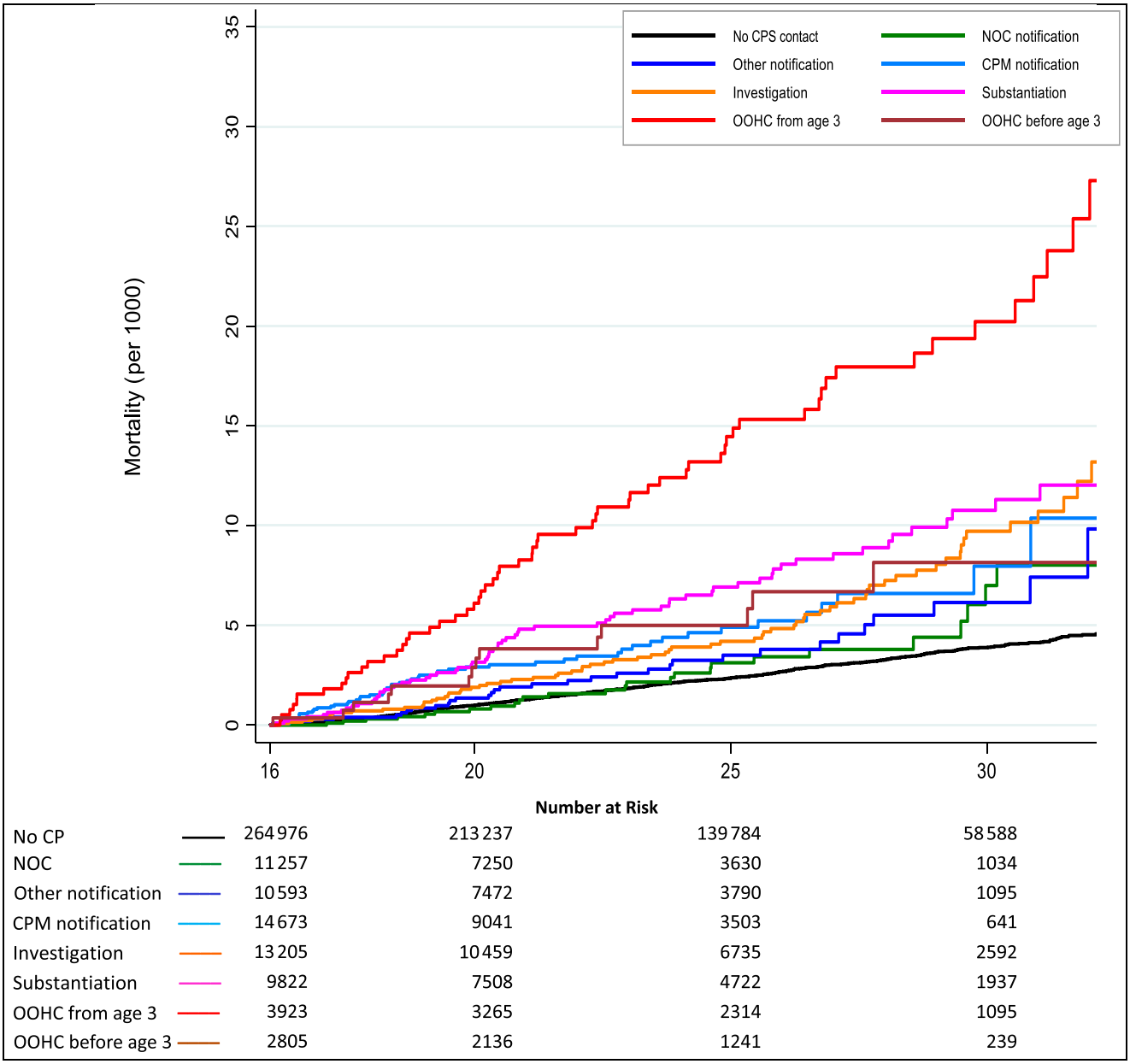
AAR, adolescent at risk; DNA, divert notifier action (child at risk but being looked after by another agency so not followed-up by Department for Child Protection); NGI, no grounds for intervention (historic threat no longer current); ROU, report on unborn (extreme child protection concerns, such as major substance use disorder in expectant mother), referred to other agencies.

TABLE 2 Characteristics of Children and Their Mothers by CPS Involvement: Crude Number and Percentage

	No CPS, No. (%)	Notifications			Investigation, No. (%)	Substantiation, No. (%)	OOHC		All, No. (%)
		NOC, No. (%)	Other, No. (%)	CPM, No. (%)			After Age 3, No. (%)	Before Age 3, No. (%)	
Cohort characteristics[a]									
All persons	264 976 (80.0)	11 257 (3.4)	10 593 (3.2)	14 673 (4.4)	13 205 (4.0)	9822 (3.0)	3923 (1.2)	2805 (0.8)	331 254 (100.0)
Birth year									
1986–1991	100 824 (85.7)	2184 (1.9)	2261 (1.9)	1794 (1.5)	4673 (4.0)	3380 (2.9)	1733 (1.5)	748 (0.6)	117 597 (100.0)
1992–1997	92 187 (79.3)	3941 (3.4)	3985 (3.4)	5452 (4.7)	4795 (4.1)	3364 (2.9)	1333 (1.1)	1128 (1.0)	116 185 (100.0)
1998–2003	71 965 (73.8)	5132 (5.3)	4347 (4.5)	7427 (7.6)	3737 (3.8)	3078 (3.2)	857 (0.9)	929 (1.0)	97 472 (100.0)
Sex									
Male	137 116 (51.7)	6114 (54.3)	4030 (38.0)	7442 (50.7)	6544 (49.6)	4638 (47.2)	2121 (54.1)	1437 (51.2)	169 442 (51.2)
Female	127 480 (48.1)	5139 (45.7)	6562 (61.9)	7223 (49.2)	6651 (50.4)	5176 (52.7)	1801 (45.9)	1357 (48.4)	161 389 (48.7)
Birth outcome									
Discharged <28 days postbirth	258 243 (97.5)	10 969 (97.4)	10 309 (97.3)	14 240 (97.0)	12 761 (96.6)	9480 (96.5)	3725 (95.0)	2601 (92.7)	322 328 (97.3)
Still in hospital at 28 days	4886 (1.8)	235 (2.1)	206 (1.9)	375 (2.6)	374 (2.8)	286 (2.9)	153 (3.9)	178 (6.3)	6693 (2.0)
Mother's characteristics at child's birth									
Age									
<21 y	13 891 (5.2)	1501 (13.3)	1445 (13.6)	2666 (18.2)	3118 (23.6)	2458 (25.0)	1181 (30.1)	738 (26.3)	26 998 (8.2)
≥21 y	250 614 (94.6)	9720 (86.3)	9129 (86.2)	11 929 (81.3)	10 000 (75.7)	7252 (73.8)	2723 (69.4)	2033 (72.5)	303 400 (91.6)
Marital status									
Married/de facto	238 811 (90.1)	8951 (79.)5	8255 (77.9)	10 759 (73.3)	8952 (67.8)	6402 (65.2)	2239 (57.1)	1353 (48.2)	285 722 (86.3)
Not married	26 165 (9.9)	2306 (20.5)	2338 (22.1)	3914 (26.7)	4253 (32.2)	3420 (34.8)	1684 (42.9)	1452 (51.8)	45 532 (13.7)
Employment status									
Employed	199 072 (75.1)	6608 (58.7)	6276 (59.2)	6929 (47.2)	6876 (52.1)	4666 (47.5)	1865 (47.5)	895 (31.9)	233 187 (70.4)
Not employed	65 904 (24.9)	4649 (41.3)	4317 (40.8)	7744 (52.8)	6329 (47.9)	5156 (52.5)	2058 (52.5)	1910 (68.1)	98 067 (29.6)
SEIFA (IRSD)									
Q1 (lowest)	64 297 (24.3)	3968 (35.2)	3934 (37.1)	5997 (40.9)	5873 (44.5)	4586 (46.7)	2044 (52.1)	1464 (52.2)	92 163 (27.8)
Q2	51 446 (19.4)	2552 (22.7)	2427 (22.9)	3333 (22.7)	2741 (20.8)	2033 (20.7)	819 (20.9)	610 (21.7)	65 961 (19.9)
Q3	44 016 (16.6)	1699 (15.1)	1623 (15.3)	2085 (14.2)	1785 (13.5)	1282 (13.1)	487 (12.4)	285 (10.2)	53 262 (16.1)
Q4	44 774 (16.9)	1603 (14.2)	1313 (12.4)	1753 (11.9)	1321 (10.0)	912 (9.3)	302 (7.7)	217 (7.7)	52 195 (15.8)
Q5 (highest)	50 683 (19.1)	1243 (11.0)	1095 (10.3)	1287 (8.8)	1115 (8.4)	688 (7.0)	163 (4.2)	158 (5.6)	56 432 (17.0)
Smoking status									
Smoking	14 631 (5.5)	1739 (15.4)	1711 (16.2)	3312 (22.6)	1968 (14.9)	1829 (18.6)	583 (14.9)	686 (24.5)	26 459 (8.0)
Not smoking	55 379 (20.9)	3262 (29.0)	2535 (23.9)	3950 (26.9)	1687 (12.8)	1175 (12.0)	254 (6.5)	202 (7.2)	68 444 (20.7)
Unknown and/or missing[b]	194 966 (73.6)	6256 (55.6)	6347 (59.9)	7411 (50.5)	9550 (72.3)	6818 (69.4)	3086 (78.7)	1917 (68.3)	236 351 (71.4)

Expressed as column percentages, except for birth cohort, which is expressed as row percentage. Q, quintile; SEIFA, Socioeconomic Index for Areas.

[a] High missing for smoking status reflects reporting from 1998 only.



Number at Risk

No CP	264 976	213 237	139 784	58 588
NOC	11 257	7250	3630	1034
Other notification	10 593	7472	3790	1095
CPM notification	14 673	9041	3503	641
Investigation	13 205	10 459	6735	2592
Substantiation	9822	7508	4722	1937
OOHC from age 3	3923	3265	2314	1095
OOHC before age 3	2805	2136	1241	239

Cumulative Death Rate at the Specified Age – deaths per 1000 persons Alive at Age 16

No CP	1.0	2.4	3.9
NOC	0.8	3.1	7.0
Other notification	1.4	3.5	6.2
CPM notification	2.9	4.9	8.0
Investigation	1.9	4.2	9.8
Substantiation	3.2	6.9	10.8
OOHC from age 3	6.1	14.6	20.4
OOHC before age 3	2.9	5.0	8.2

FIGURE 1
Mortality from age 16 years, by CPS involvement (crude rates).

each category of CPS involvement as 1 minus Kaplan-Meier estimator, adjusting the denominator continuously for censoring at May 31, 2019.

Multivariable Cox proportional hazards regression models were used to estimate aHRs for all-cause mortality. The proportional hazards assumption was assessed by using the global proportional hazards tests for univariable and multivariable models, log-log plots, and the scaled Schoenfeld residuals plot.

Covariates were included in the model to adjust for potential confounders, assessed at birth, and before any possible impact of CM. Child characteristics included sex, birth year (1986–1991, 1992–1997, or 1998–2003), and whether the child was still hospitalized or was discharged 28 days postbirth. This latter variable was chosen as a summary measure of serious neonatal vulnerability, avoiding the need to include potentially highly correlated variables (such as prematurity and low birth weight).

Family measures comprised maternal age at the child's birth, quintile area-level socioeconomic status, mother's marital status, maternal smoking, and employment.

Incidence death rates by cause-of-death categories were calculated for persons with any CPS contact and with no CPS contact by dividing total deaths within each cause-of-death category by total person-years (16 years to May 30, 2019), accounting for death. Poisson regression for the count of deaths, offsetting for total person-time at risk, was used to estimate incident rate ratios (IRRs).

TABLE 3 Cox Proportional Hazards Models for Risk of Death From Age 16 Years, by CPS Involvement: Crude and Adjusted Analyses

	Univariable		Multivariable[a]	
	HR (95% CI)	*P*	aHR (95% CI)	*P*
Child attributes				
CPS contact (reference: no CPS contact)				
NOC	1.28 (0.87–1.90)	.211	1.31 (0.88–1.95)	.180
Other notification(s)	1.55 (1.09–2.21)	.016	1.71 (1.18–2.48)	.004
CPM	2.35 (1.78–3.11)	<.001	2.35 (1.75–3.14)	<.001
Investigation	2.20 (1.73–2.81)	<.001	2.09 (1.62–2.70)	<.001
Substantiation	2.88 (2.24–3.71)	<.001	2.61 (1.99–3.43)	<.001
OOHC from age 3 y	5.77 (4.45–7.48)	<.001	4.67 (3.52–6.20)	<.001
OOHC before age 3 y	2.35 (1.39–4.00)	.002	1.75 (0.98–3.14)	.060
Birth year (reference: born 1986–1991)				
1992–1997	0.89 (0.77–1.03)	.127	0.84 (0.71–1.00)	.047
1998–2003	0.73 (0.56–0.96)	.025	0.78 (0.19–3.14)	.725
Sex (reference: female)				
Male	2.17 (1.90–2.48)	<.001	2.17 (1.89–2.50)	<.001
Birth outcome (reference: discharged at <28 d)				
Still in hospital at 28 d	2.54 (1.90–3.39)	<.001	2.24 (1.66–3.03)	<.001
Mother's characteristics at child's birth				
Age (reference: ≥21 y)				
<21 y	1.75 (1.47–2.10)	<.001	1.15 (0.94–1.42)	.175
Marital status (reference: married or de facto)				
Not married or de facto	1.53 (1.31–1.79)	<.001	1.03 (0.86–1.23)	.769
Employed (ref)				
Not employed	1.20 (1.04–1.40)	.014	1.07 (0.89–1.28)	.483
IRSD (reference: Q4–Q5 least disadvantaged)				
Q2–Q3	1.24 (1.06–1.45)	.008	1.13 (0.96–1.32)	.144
Q1	1.36 (1.15–1.60)	<.001	1.07 (0.90–1.27)	.433
Smoking status (reference: not smoking)				
Smoking	1.60 (0.97–2.65)	.068	1.18 (0.71–1.97)	.523

[a] Adjusted for child's birth year, sex, birth outcome, Aboriginal status, and mother's age and marital status, whether employed, smoking status, and IRSD at the time of the child's birth.

All analyses were conducted by using Stata 16.0 (Stata Corp, College Station, TX).

RESULTS

Characteristics of the Cohort

There were 331 254 children in the study cohort, of whom 20% (n = 66 278) had some record of CPS contact by age 16 years, and only 2.0% (n = 6728) had ever been in OOHC. Of those to enter OOHC, 42.0% (n = 2805) had their first placement before 3 years of age, (increasing from 30% to 56% over the study time frame) (Table 2).

All measures of disadvantage were more common in persons with CPS contact compared with those with no CPS contact; with the percentages experiencing disadvantage higher in CPS groups suggestive of more serious CM exposure. For example, 10% of children with no CPS contact had mothers who were neither married nor in a de facto relationship at the time of their birth, but 20% to 22% of children with a notifier only concern (NOC) or other notification, 32% to 35% of children who had been the subject of an investigation (substantiated or not), and 43% to 51% of children who had entered OOHC had mothers who were neither married nor in a de facto relationship at the time of their birth.

Cumulative Mortality

Unadjusted mortality rates (per 1000 persons) from 16 years of age, by CPS categories, are plotted in Fig 1. The highest mortality was experienced by those who had been placed in OOHC and whose first entry to care occurred after their third birthday. By 33 years of age, mortality in this group was 30.9 per 1000 compared with 5.1 per 1000 in those with no CPS contact. Young people who had been the subject of a substantiated child protection notification, confirming serious CM exposure, also had considerably higher mortality across the age range than the no CPS contact group, reaching 13.7 per 1000 by age 33 years. Individuals who

TABLE 4 Cause of Death by CPS Involvement, Number, Incidence Rate (per 100 000 Person-Years), and IRR: Crude Estimates

Major Causes of Death[a]	No CPS Contact[b]		CPS Contact[c]		IRR (95% CI) for CPS Versus No CPS	*P*
	No. of Deaths	Incidence Rate[d]	No. of Deaths	Incidence Rate[e]		
Suicide or intentional self-harm (codes X60–X84, Y20)	154	6.31	90	17.77	2.82 (2.15–3.68)	<.001
Poisonings, alcohol, drugs, other substances, and mental illness (of unknown intent) (codes F00–F99, F20–F99, R45, T36–T65, X40–X45, Y10–Y19, and Y48)[f]	60	2.46	60	11.86	4.82 (3.31–7.01)	<.001
Auto crash and other unintentional injuries (codes V01–V99) and no record of substances or mental illness[g]	204	8.35	60	11.85	1.42 (1.05–1.90)	.010
Natural causes (chapters I to IV, VI to XVIII, XXI, and XX, with no cause-of-death codes in chapters V, XIX, or XX)	204	8.35	84	16.59	1.99 (1.52–2.57)	<.001
Missing	40	1.63	23	4.54	2.77 (1.58–4.74)	<.001
All deaths	662	27.11	318	62.80	2.32 (2.02–2.65)	<.001

[a] *ICD-10*, see ref 26.
[b] No CPS involvement to age 16 years.
[c] Any CPS contact to age 16 years.
[d] Per 100 000 person-years (person-years of observation from the 16th birthday to May 31, 2019, is 2 442 010 in those with no CPS contact, taking account of premature deaths).
[e] Per 100 000 person-years (person-years of observation from the 16th birthday to May 31, 2019, is 506 419 in those with some CPS contact, taking account of premature deaths).
[f] Including assault (codes X85–Y09 and Y35) if substances are involved.
[g] Including assault if there is no involvement of substances.

had entered OOHC before their third birthday experienced lower mortality than those who had entered care after age 3.

Association Between CPS Involvement and Mortality

Adjusted and unadjusted hazard ratios (HRs) for risk of death (by CPS category) are reported in Table 3. In unadjusted analysis, persons with any CPS involvement, other than NOC only, had significantly higher HRs than children with no CPS involvement (HRs = 1.55–5.77). After controlling for sociodemographic attributes and birth outcome, aHRs remained significantly elevated across all but 1 CPS category. Among those who had entered OOHC for the first time after their third birthday, aHR was highest (4.67; 95% confidence interval [CI] = 3.52–6.20), whereas for persons who had entered OOHC for the first time before 3 years of age, the aHR was 1.75 (95% CI = 0.98–3.14) compared with the no CPS group. For those who had experienced a child protection matter (CPM) notification, or an investigation whether substantiated or not, the aHR was more than twice that of the no CPS group.

None of the indicators of maternal and/or household socioeconomic status at the time of the cohort members birth were significant in the multivariable model. Being male (compared with female) and still in hospital at 28 days (compared with discharged by 28 days) conferred more than twice the risk of death.

Cause of Death

Cause of death is presented in Table 4 by history of CPS contact, describing the number of deaths, cause-specific death rates per 100 000 person-years, and IRRs (CPS versus no CPS contact). We found that persons with CPS contact (indicating CM exposure) were more likely to die in circumstances involving poisonings, alcohol, drugs, other substances, or mental illness (incidence rate ratio [IRR] = 4.82 [95% CI = 3.31–7.01]) or suicide (IRR = 2.82 [95% CI = 2.15–3.68]), but also natural causes (IRR = 1.99 [95% CI = 1.52–2.57]), compared with children with no CPS contact.

The biggest absolute contributor to excess risk was suicide, at 11.46 per 100 000 person-years (17.77–6.31).

DISCUSSION

This is the first study to estimate the impact of CM on all-cause and cause-specific mortality from midadolescence into early adulthood by using population-level data. CPS contact as an indicator of CM history was found to be strongly associated with increased risk of death between ages 16 and 33 years. Substantial excess risk of early death was found for every CPS contact category except NOC (a category not reaching CM concern thresholds), after adjusting for a range of potential confounders. The strength of association was highest in categories indicating more serious maltreatment exposure, supporting the relationship as causal, when taken together with well-described mechanisms linking CM exposure to disturbed emotional and behavioral responses, a high sense of shame and low impulse control,[11,12,26,27] risk factors for substance use, and suicide. Multivariable modeling identified excess risk of death with CM exposure, ranging from an aHR of 1.71 (95% CI = 1.18–2.48) to an aHR of 4.67 (95% CI = 3.52–6.20), compared with persons with no CPS contact. Noting heterogeneity within each group (such

as exposure to other adversities or protective factors), the strength of the observed associations is remarkable.

These finding suggest persons with CM expsoure are at substantial excess risk of death during late adolescence and early adulthood, possibly greater than risk differentials at older ages (noting in the Swedish study[16] that researchers reported an aHR of 1.76–2.91 for persons with CPS contact compared with those with no contact, for death before age 65 years). This conclusion is consistent with a view that youth and young adulthood is a period of particular vulnerability for persons with a CM history.

For persons who had entered OOHC for the first time before their third birthday, effect estimates were lower (aHR = 1.75) than those for persons with suspected (CPM) or substantiated maltreatment who did not enter OOHC (aHR = 2.09–2.62) and lower than those for persons who had entered care after their third birthday (aHR = 4.67). A possible explanation is that for children who first enter care during infancy, exposure to CM during the early formative years of rapid brain development and relational patterning is reduced, thereby limiting potential harms (the purpose of early removal). Consistent with this, in our cohort, persons who had entered care before age 3 had, on average, 40% longer total time in care than children who had first entered care from age 3. But, as noted below, further exploration of the pattern of OOHC is warranted.

Distinguishing the impact of CM exposure from CPS involvement (particularly removal) presents an ongoing methodologic challenge[28] and is a crucial area for further study. It would be valuable, in a future study, to explore more fully the role of CM exposure (type, age, and relationship to perpetrator), the timing and extensiveness of child protection system contact, and for children entering OOHC, the ages of entry to and exit from care, total time in care, placement changes, type of care, family reunification, and how these characteristics interact with child sex, socioeconomic status, and birth cohort to impact risk of death.

In terms of cause of death, the largest absolute differential in mortality rates (persons with any CPS contact versus those with none) related to deaths involving poisonings, alcohol, other substances, mental illness, and suicide. Mental health and/or substance-related causes accounted for 20.9 excess deaths per 100 000 person-years, compared to natural causes at an extra 8.2 deaths per 100 000 person-years. This is consistent with extensive evidence linking CM to mental illness, suicide, and substance use.[10–12]

In the adjusted analysis, being male (compared with female) carries a substantial excess risk of death in youth and young adults (aHR = 2.17), which underscores an imperative to do more to support boys and young men, especially those who are victims of CM. In a large US study of teenagers, researchers found that the relative risk for attempted suicide in boys with CM history (compared to those with none) was considerably higher than that in girls (eg, for familial sexual abuse [aHR = 15.04 for males but aHR = 4.34 for females, with CM history versus those with none]).[10]

Our study has a number of strengths. First, it is based on data from an entire population, all births in SA between 1986 and 2003, totaling 331 254 persons. This is particularly critical for a study of mortality, in which sampling (say a survey in early adulthood) will inevitably exclude the most vulnerable: those who have died or become homeless or incarcerated or those with serious addictions. Second, the use of validated, linked administrative data for CM history, mortality status, and socioeconomic covariates ensure high-quality data. Third, the covariates were collected at the time of the child's birth, before CM exposure, and as such, are not compromised by possible location on the causal pathway. Fourthly, CM is a complex construct, and our use of distinct categories of CPS involvement, postulated to indicate the seriousness of CM exposure and risk of harm, is more informative.

This study is timely, providing new, contemporary evidence in an underresearched area, covering deaths recorded through May 31, 2019. In the context of escalating child protection costs globally, for delivering CPS and addressing the consequences of CM,[29] (in SA, CPS costs increased from A $174 million in 2008–2009 to A $504 million in 2017–2018),[30] generating current policy-relevant evidence to guide policy and practice change is crucial.

Some study limitations remain. CPS involvement is a robust indicator of likely CM, and yet some maltreatment is not reported to CPS, and some children about whom reports are made and investigations take place will not suffer maltreatment; with potential for misunderstandings, or social class or racial bias. But with occupations that have contact with children, designated mandated notifiers, and protocolized decision rules in use, this source of error is expected to be low. CPS involvement data are limited to contact with the SA child protection system, and registered deaths outside of SA are not captured, representing a small, unavoidable source of bias.

The core findings that CM is associated with substantial excess risk of death during late adolescence and early adulthood and that the more severe the CM exposure the higher the excess risk, we suggest, are widely generalizable. They have strong theoretical underpinning and are consistent with published studies reporting large effects of CM on mental health.[8] At the same time, excess risk of death associated with specific CPS categories could vary across jurisdictions given differences in thresholds for child protection notification, investigation, substantiation and removal, type of OOHC options, and policy settings, including access to adoption and early intervention services. Replication of this study in other jurisdictions would be valuable.

Policy Implications

Suicide prevention is a high priority in Australia and internationally. Suicide represents a major cause of early death and associated, potential life-years lost globally.[31,32] This study highlights the importance of incorporating CM into suicide prevention policy frameworks. It adds weight to the evidence base that CM is toxic to developing brains and to the creation of an intact sense of self,[11,12,33] with consequences for suicide risk. A consistently heightened stress response impacts on allostatic load and metabolic health. These pathways have implications for mental health and physical health across the life course.

The excess risk of suicide and substance-related deaths are considerable, and death as an outcome is incontrovertible and potentially avoidable. A commensurate response, involving greater support for at-risk children and families, is urgently required across clinical services, child protection, and the wider human services sector. Suicide intervention strategies must begin early in life. For pediatricians, primary care physicians, psychiatrists, and other clinicians working with children and adolescents, the need to be alert to the maltreating family context when seeing emotional and behavioral problems is reinforced.[12]

Other research by the lead author[34] found that mental health services in SA are grossly inadequate to support the mental health of infants, children, adolescents, and their families. In this mortality study, we highlight the tragic consequences of this gap. There are evidence-based interventions for healing parent and child relationships,[26,35,36] but vulnerable families typically do not have access to such programs in Australia and internationally.[37]

No indicators of family socioeconomic status were associated with mortality in the multivariable model (findings consistent with the study by Jackisch et al[16]) and, as hypothesized, the observed socioeconomic gradient in health is primarily driven by CM history.[38] In studies that seek to describe influences on health disparities, the inclusion of CM as a covariate should be standard.

CONCLUSIONS

In this study, we provide strong evidence of a substantial excess risk of death in young adults related to CM exposure. This finding reinforces other evidence of the serious consequences of childhood trauma across the life course.[13] There is no reason to expect that these results would not have wide applicability, given the findings are a reflection of underlying physiological pathways between CM and brain development (affecting thinking, behaviors, and emotional responses) and the effect of CM on relational patterning and sense of self.

For children who first enter OOHC early, DCP engagement may reduce risk. SA DCP policies and practices have changed over the time frame of our data, with a shift toward earlier-in-life identification of children at high risk.[22] At the same time, there are strong community pressures and ethical considerations that ensure child removal is used as a last resort. Gathering more evidence to better understand when child removal is beneficial is needed.

The imperative to keep children safe must extend beyond childhood. Most children exposed to CM who come to the attention of child protection agencies are not placed in OOHC, but the outcomes of children who are placed in care, as well as those who are not, suggests not enough is being done to ameliorate harms or prevent further maltreatment. Children with suspicion of CM are at serious increased risk of death as youth and/or young adults. And yet the balance of child protection funding is often focused on OOHC.[30]

Changes to the service response, including the more effective engagement with and upskilling of clinicians in a coordinated, cross-sectoral response to childhood trauma, is desirable. For pediatricians, who are increasingly seeing children with behavioral and development problems,[39] this also means being alert to the possibility of toxic stress driving observed challenging behaviors,[12] and recognizing the potential serious consequences if relational trauma is not addressed and the unique preventive opportunity. As a society, we simply must do better to protect children not just against current harms but also to the extreme consequences of CM across the life course.

ACKNOWLEDGMENTS

We acknowledge the SA families and children whose deidentified, historic administrative data were used in this linked-data analysis. We also acknowledge SA-NT DataLink integration authority and the technical team for generating unique identifiers, enabling deidentified linkable data for the study. We would like to thank the data custodians and officers from the SA government agencies whose support for this study, through the provision of data and advice, has made the research possible, foremost of which is the SA DCP. The authors take full responsibility for the content of the article. We also acknowledge the assistance of Judith Burgemeister in the coding of cause of death text fields and in final manuscript preparation

ABBREVIATIONS

ACE: adverse childhood experience
aHR: adjusted hazard ratio
CI: confidence interval
CM: child maltreatment
CPM: child protection matter
CPS: child protection service
DCP: Department for Child Protection
HR: hazard ratio
ICD-10: *International Classification of Diseases, 10th Revision*
IRR: incident rate ratio
IRSD: Index of Relative Socioeconomic Disadvantage
NOC: notifier only concern
OOHC: out-of-home care
RR: rate ratio
SA: South Australia

Address correspondence to Leonie Segal, PhD, Health Economics and Social Policy Group, Australian Centre for Precision Health, University of South Australia, GPO Box 2471 (CWE-48), Adelaide, SA 5001, Australia. E-mail: leonie.segal@unisa.edu.au

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported through the Australian National Health and Medical Research Council (GNT1103439).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

COMPANION PAPER: A companion to this article can be found online at www.pediatrics.org/cgi/doi/10.1542/peds.2020-031963.

REFERENCES

1. Australian Institute of Health and Welfare. *Child Protection Australia 2017–18. Child Welfare Series No. 70. Cat. No. CWS 65*. Canberra, Australia: Australian Institute of Health and Welfare; 2019
2. Gilbert R, Widom CS, Browne K, Fergusson D, Webb E, Janson S. Burden and consequences of child maltreatment in high-income countries. *Lancet*. 2009;373(9657):68–81
3. World Health Organization. *Global Health Observatory data repository. Child maltreatment: global estimates*. Geneva, Switzerland: World Health Organization; 2014. Available at: http://apps.who.int/gho/data/view.main.VIOLENCECHILDMALTREATMENTv. Accessed July 30, 2020
4. US Department of Justice; Finkelhor D, Turner H, Shattuck A, Hamby S, Kracke K. *Children's Exposure to Violence, Crime, and Abuse: An Update. Juvenile Justice Bulletin*. September 2015. Washington, DC: US Department of Justice, Office of Juvenile Justice and Delinquency Prevention; 2015
5. Australian Bureau of Statistics. *Personal Safety, Australia, 2016*. Canberra, Australia: Australian Bureau of Statistics; 2017
6. Segal L, Nguyen H, Mansor MM, et al. Lifetime risk of child protection system involvement in South Australia for Aboriginal and non-Aboriginal children, 1986–2017 using linked administrative data. *Child Abuse Negl*. 2019;97:104145
7. Hughes K, Bellis MA, Hardcastle KA, et al. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *Lancet Public Health*. 2017;2(8):e356–e366
8. Fryers T, Brugha T. Childhood determinants of adult psychiatric disorder. *Clin Pract Epidemiol Ment Health*. 2013;9:1–50
9. Armfield JM, Gnanamanickam E, Nguyen HT, et al. School absenteeism associated with child protection system involvement, maltreatment type, and time in out-of-home care. *Child Maltreat*. 2020;25(4):433–445
10. Duke NN, Pettingell SL, McMorris BJ, Borowsky IW. Adolescent violence perpetration: associations with multiple types of adverse childhood experiences. *Pediatrics*. 2010;125(4). Available at: www.pediatrics.org/cgi/content/full/125/4/e778
11. Child Welfare Information Gateway. *Understanding the Effects of Maltreatment on Brain Development: Issue Brief*. Washington, DC: US Department of Health and Human Services, Children's Bureau; 2015
12. Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*. 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e232
13. Centers for Disease Control and Prevention. *Adverse Childhood Experiences*. Atlanta, GA: Centers for Disease Control and Prevention; 2019
14. Brown DW, Anda RF, Tiemeier H, et al. Adverse childhood experiences and the risk of premature mortality. *Am J Prev Med*. 2009;37(5):389–396
15. Kelly-Irving M, Lepage B, Dedieu D, et al. Adverse childhood experiences and premature all-cause mortality. *Eur J Epidemiol*. 2013;28(9):721–734
16. Jackisch J, Brännström L, Almquist YB. Troubled childhoods cast long shadows: childhood adversity and premature all-cause mortality in a Swedish cohort. *SSM Popul Health*. 2019;9:100506
17. Australian Bureau of Statistics. *Deaths, Australia, 2018*. Canberra, Australia: Australian Bureau of Statistics; 2019: 3302.0
18. Erskine HE, Moffitt TE, Copeland WE, et al. A heavy burden on young minds: the global burden of mental and substance use disorders in children and youth. *Psychol Med*. 2015;45(7):1551–1563
19. Schneider M, Radbone CG, Vasquez SA, Palfy M, Stanley AK. Population data centre profile: SA NT DataLink (South Australia and Northern Territory). *Int J Popul Data Sci*. 2019;4(2):1136
20. Australian Bureau of Statistics. *Census of Population and Housing: Socio-Economic Indexes for Areas, Australia, 2016*. Canberra, Australia: Australian Bureau of Statistics; 2018:2033.0.55.001
21. Segal L, Nguyen H, Gent D, Hampton C, Boffa J. Child protection outcomes of the Australian nurse family partnership program for aboriginal infants and their mothers in Central Australia. *PLoS One*. 2018;13(12):e0208764
22. National Council on Crime and Delinquency Child Research Center. *The Structured Decision Making System Mandatory Reporting Guide, Version*

1.0. Adelaide, South Australia: Department for Child Protection South Australia; 2018

23. Centers for Disease Control and Prevention. *Child Development*. Atlanta, GA: Centers for Disease Control and Prevention; 2020
24. Dworkin PH. The preschool child: developmental themes and clinical issues. *Curr Probl Pediatr*. 1988;18(2): 73–134
25. World Health Organization. ICD-10 version: 2019. Available at https://icd.who.int/browse10/2019/en. Accessed August 1, 2020
26. Furber G, Amos J, Segal L, Kasprzak A. Outcomes of therapy in high risk mother-child dyads in which there is active maltreatment and severely disturbed child behaviors. *J Infant Child Adolesc Psychother*. 2013;12:84–99
27. Amos J, Segal L. Disrupting intergenerational maternal maltreatment in middle childhood: therapeutic objectives and clinical translation. *Front Psychiatry*. 2018;9:623
28. Berger LM, Bruch SK, Johnson EI, James S, Rubin D. Estimating the "impact" of out-of-home placement on child well-being: approaching the problem of selection bias. *Child Dev*. 2009;80(6): 1856–1876
29. Fang X, Brown DS, Florence CS, Mercy JA. The economic burden of child maltreatment in the United States and implications for prevention. *Child Abuse Negl*. 2012;36(2):156–165
30. Productivity Commission. *Report on Government Services 2019*. Canberra, Australia: Productivity Commission; 2019
31. Australian Bureau of Statistics. *Causes of Death, Australia, 2018*. Canberra, Australia: Australian Bureau of Statistics; 2019
32. Naghavi M; Global Burden of Disease Self-Harm Collaborators. Global, regional, and national burden of suicide mortality 1990 to 2016: systematic analysis for the Global Burden of Disease Study 2016. *BMJ*. 2019;364:l94
33. Amos J, Segal L, Cantor C. Entrapped mother, entrapped child: agonic mode, hierarchy and appeasement in intergenerational abuse and neglect. *J Child Fam Stud*. 2014;24:1442–1450
34. Segal L, Guy S, Leach M, Groves A, Turnbull C, Furber G. A needs-based workforce model to deliver tertiary-level community mental health care for distressed infants, children, and adolescents in South Australia: a mixed-methods study. *Lancet Public Health*. 2018;3(6):e296–e303
35. Domoney J, Fulton E, Stanley N, et al. For baby's sake: intervention development and evaluation design of a whole-family perinatal intervention to break the cycle of domestic abuse. *J Fam Viol*. 2019;34: 539–551
36. Grube WA, Liming KW. Attachment and biobehavioral catch-up: a systematic review. *Infant Ment Health J*. 2018;39(6): 656–673
37. Kessler RC, Angermeyer M, Anthony JC, et al. Lifetime prevalence and age-of-onset distributions of mental disorders in the World Health Organization's World Mental Health Survey Initiative. *World Psychiatry*. 2007;6(3): 168–176
38. Segal L, Doidge J, Amos J. Determining the Determinants: Is Child Abuse and Neglect the Underlying Cause of the Socio-Economic Gradient in Health? In: Laverty M, Callaghan L, eds. *Determining the Future: A Fair Go and Health for All*. Ballan, Victoria: Connor Court Publishing; 2011
39. Hiscock H, Danchin MH, Efron D, et al. Trends in paediatric practice in Australia: 2008 and 2013 national audits from the Australian Paediatric Research Network. *J Paediatr Child Health*. 2017;53(1):55–61

Child Maltreatment and Mortality in Young Adults

Leonie Segal, Jason M. Armfield, Emmanuel S. Gnanamanickam, David B. Preen, Derek S. Brown, James Doidge and Ha Nguyen

Pediatrics 2021;147;
DOI: 10.1542/peds.2020-023416 originally published online December 14, 2020;

PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Child Maltreatment and Mortality in Young Adults

Leonie Segal, Jason M. Armfield, Emmanuel S. Gnanamanickam, David B. Preen, Derek S. Brown, James Doidge and Ha Nguyen

Pediatrics 2021;147;
DOI: 10.1542/peds.2020-023416 originally published online December 14, 2020;