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The long run impact of child abuse on health care costs and wellbeing in Australia

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Abstract

There are approximately 55,000 substantiated child abuse or neglect cases in Australia each year, according to Australian Institute of Health and Welfare data, 2005-06 to 2008-09 (AIHW2010). In 2008-09, one third of child maltreatment cases related to physical or sexual abuse. Our paper examines the relationship between physical and sexual abuse of children and adult physical and mental health conditions and associated health care costs in Australia. The analysis utilises confidentialised unit record file data from the National Survey of Mental Health and Wellbeing 2007, which includes 8841 persons aged from 16 to 85. The econometric results indicate that Australians with a history of being abused as a child suffer from significantly more physical and mental health conditions as adults and incur higher annual health care costs. In addition, we investigate the associations between child abuse, incarceration and self harm and the intergenerational impact of abuse, to extend the understanding of the long run costs of child abuse in Australia. We conclude that prevention child abuse is expected to generate long term socio-economic benefits.

Introduction

Child abuse and neglect are serious problems in Australia, with approximately 55,000 substantiated cases occurring each year since 2005/06 (AIHW 2010). One third of substantiated cases of child abuse and neglect in 2008/09 relate to physical and sexual abuse, as shown in Table 1.

Table 1: Substantiated child abuse and neglect cases, Australia 2008-09

	Number	**Per cent**
Physical abuse	11,789	22%
Sexual abuse	5,591	10%
Emotional abuse	21,662	40%
Neglect	15,579	29%
Total	54,621	100%

Source: Derived from Table A.1.1, AIHW (2010)

Previous studies on childhood abuse have described how adverse experiences and childhood trauma can lead to a variety of negative health outcomes such as substance abuse, depressive disorders, and attempt to suicide amongst adolescents and adults (Beautrais, Joyce et al. 1996; Farber, Herbert et al. 1996; Dube, Anda et al. 2001). In addition, previous research suggests that child maltreatment contributes to juvenile offending which in turn increases the probability of adult offending and incarceration (Stewart, Dennison et al. 2002; Lynch, Buckman et al. 2003).

There is strong evidence that child abuse has a substantial impact on subsequent health status over the course of an individual's lifetime. A link between child abuse and mental illnesses such as depression and anxiety has been demonstrated, as has a link between abuse and subsequent health-related behaviours such as smoking and risky sexual behaviours (Walker, Gelfand et al. 1999; Walker, Unutzer et al. 1999; Hobfoll, Bansal et al. 2002; Anda, Fleisher et al. 2004; Champion, Foley et al. 2004; Anda, Felitti et al. 2006).

In turn, these links have implications for the lifetime health care utilisation amongst those who have been abused during childhood. Tang et al (2006) compared health care utilisation and costs amongst women who reported that they were abused during childhood with those who did not report such abuse. The results indicate that health care costs nearly doubled

amongst those who reported combined sexual and physical abuse during childhood, with approximately half of this impact occurring indirectly through physical and mental health conditions. The study focused on ambulatory care such as GP visits, specialist consultations and allied health care services. Importantly, it did not include pharmaceutical or inpatient costs.

There is little published Australian evidence on the long term health care costs associated with child abuse in the peer reviewed literature. However, a recent commissioned report by Taylor et al (2008) for the Australian Childhood Foundation and Child Abuse Prevention Research Australia examined the long term health care costs associated with child abuse. The study applied attributable fractions to Australian administrative databases to estimate the prevalence and incidence cost of child abuse. The fractions used were derived from international studies based on child sexual abuse. These were then extrapolated to all child abuse.

In contrast to the top down approach undertaken by Taylor et al (2008), we derive bottom up estimates of the impact of child abuse on long run health and health care costs in Australia, for physical and sexual abuse. We apply the approach undertaken by Tang et al (2006) to unit record data from the Australian Bureau of Statistics' (ABS) 2007 National Survey of Mental Health and Wellbeing (SMHW). Tang et al's (2006) paper is a suitable template as it uses unit record data to estimate the long run health care costs of child abuse and the pathway through which child abuse impacts on the health system, to estimate both direct and indirect effects. Furthermore, the analysis disaggregates abuse into physical abuse, sexual abuse or combined physical and sexual abuse, enabling impacts of different type of child abuse to be separately determined. The National SMHW data includes variables comparable to those used in Tang's analysis, as well as more detailed information enabling us to extend the analysis.

To our knowledge, our paper is the first Australian paper to use regression analyses of unit record data to estimate the long run associations between child abuse and adult health outcomes and associated costs. This method enables us to estimate the degree and pathway through which different types of child abuse impact on health care costs and control for confounding factors, such as socioeconomic status.

Our paper expands on Tang et al's (2006) approach by including both men and women and being nation-wide in scope. Furthermore we extend the regression analyses beyond physical and mental health conditions and adult health care costs to estimate broader long run effects

of child abuse including suicide attempts, substance abuse and incarceration rates. We also investigate the likelihood of people who were abused as children becoming abusers themselves.

The results will enable the potential benefits of interventions aimed at preventing child abuse to be projected by including a broad range and precise estimates of long term costs and impacts, which differ by type of child abuse. Consistency between our results and Tang et al's (2006) findings suggest that the results may be generalisable to other OECD countries.

Data and Methods

Survey design

The SMHW was conducted by the ABS from August to December 2007. 8841 persons aged from 16 to 85 were interviewed, in private dwellings in all Australian states and territories, excluding very remote areas. The data are anonymised and additional steps taken to preserve the confidentiality of participants (Pink 2009).

Variables

The 2007 SMHW includes detailed data on mental and physical health conditions, health services utilisation, social networks, demographic and socioeconomic information. From these data we derive the variables utilised in our analyses which are described below.

- *Total health care costs in the last 12 months:* To derive total health care costs, we combine Pharmaceutical Benefits Scheme (PBS) and Medical Benefits Scheme (MBS) costs with SMHW data on service utilisation in the last 12 months, for physical and mental health. Service utilisation includes hospitalisations; consultations with general practitioners, specialists, and allied health professionals; and medications. Where items are not listed in PBS or MBS data, out of pocket costs declared in the SMHW are used.
- *Number of physical health conditions:* This is derived by adding the number of types of self reported chronic health conditions.
- *Number of mental health conditions:* This is derived by adding the number of self reported ICD disorders in the last 12 months.
- *Abused as a child:* SMHW includes information post traumatic shock, including the experience of physical and sexual abuse and, in the case of physical abuse, whether the abuser was a parent/guardian, romantic partner or another person. Self reported age when

first abused enables us to derive categories of child abuse comparable with those used by Tang et al; *physical abuse only*, *sexual abuse only* (which includes rape and other sexual abuse) and *combined abuse* (i.e. both physical and sexual).

- *Age cohorts:* 16 to 29 (base case), 30 to 44, 45 to 59, 75 to 85.
- *Social marital status:* Married (registered or de facto) or not married
- *Sex:* Female or not female
- *Socio Economic Status (SES):* Following Tang et al, we create an index of socioeconomic status from reported levels of education, occupation (using Australia New Zealand Standard Classifications of Occupations categories) and income (quintiles). Each of these are classified into 5 categories (1 being the lowest and 5 the highest) which sum to an index of 3 to 15. For observations where income quintile is missing, we allocate the median quintile (3) and also construct a separate dummy variable for 'missing income'.
- *Support:* Tang et al comment that it would have been useful if they could have included social support, which is associated with wellbeing and health services utilisation. We construct an indicator of social support from whether SMHW respondents report having friends and/or family in whom they can rely or confide. This indicator is also disaggregated to examine the impact of different types of support.
- *Remoteness:* Because our study is nationwide we control for degree of remoteness which is expected to impact on service utilisation due to differences in accessibility of services. An index of 3 categories is used, based on the Australian Standard Geographical Classification remoteness structure (1 indicating major cities, 2 inner regional areas and 3 other).
- *Incarcerated:* Ever been in jail, prison or a correctional facility.
- *Self harm:* A range of dummy variables indicating self harm include: *Ever attempted suicide*, a*lcohol abuse/harmful use*, *alcohol dependence*, *drug abuse/harmful use* and *drug dependence.*
- *Accidental harm:* Reports having accidentally injured or killed another person.
- *Purposeful harm:* Reports having injured, tortured or killed another person on purpose.

Statistical methods

Prior to undertaking econometric analyses, the data are weighted using p-weights and replicate weights to enable population estimates and correct standard errors to be calculated,

accounting for the probability of selection and the survey sampling design. Details on how these weights are constructed by the ABS are described in the SMHW CURF Technical Manual (Pink 2009). All of the statistical analyses are undertaken with STATA version 10 using 'svy' commands, which produce robust standard errors, adjusted according to the survey design. To maintain the confidentiality of survey respondents, the expanded CURF data are accessed remotely via the ABS's Remote Access Data Laboratory (RADL).

Firstly, following Tang et al (2006), we estimate the impact of child abuse on adult physical and mental health, the impact of child abuse on adult health care costs and the degree to which the impact of child abuse on adult health care costs occurs via physical and mental health conditions. In models 1 and 2 the *number of physical health conditions* and *number of mental health conditions* respectively are regressed on *age cohorts, SES, social marital status, support* and *remoteness*. Whereas Tang et al (2006) used OLS to estimate the impact of child abuse on physical and mental health conditions, we employ a negative binomial model. This technique is appropriate as the dependent variables in models 1 and 2 are count variables and the data are over-dispersed[1].

Models 3 and 4 examine the impact of child abuse on total adult health care costs. Because *total health care cost* is highly skewed, various functional forms were investigated for estimating the total cost equations. Based on link test results, the preferred models for estimating total costs used a square root transformation. This differs from Tang et al's paper in which a logarithmic transformation of total cost was employed. In model 3, using OLS, the square root of *total health care cost* is regressed on the same explanatory variables used in models 1 and 2. In model 4, model 3 is repeated with the *number of physical health conditions* and *number of mental health conditions* included as additional explanatory variables. We also disaggregate the support variable into support from *friends only, family only* or *friends and family* and test for significant differences between the coefficients of type of social support in each of models 1 to 4. To test whether the current health impacts of child abuse depend on years since childhood, models 1 to 4 are also rerun with abuse interacted with current age. Finally, to provide insight into the impact of age when abuse commenced on long run health, the models are rerun with abuse interacted with the age when abuse commenced.

[1] i.e. the variance is greater than the mean

In Part 2, we extend the analyses to investigate the impact of child abuse on other long-run indicators of wellbeing. Model 5 is a logit estimation of the probability of incarceration, using the same explanatory variables as model 3. Models 6 to 10 estimate the probability of self harm, in terms of *attempted suicide*, a*lcohol abuse/harmful use, alcohol dependence, drug abuse/harmful use* and *drug dependence* respectively. Again, the explanatory variables are the same as those employed in model 3. Models 6, 7, 8 and 10 are all estimated using logit whereas for model 9 (*alcohol abuse*) the probit method is employed because the logit estimation failed the link test.

Finally, in Part 3 (models 11 and 12), we examine the likelihood of people who were abused as children becoming abusers themselves. Socioeconomic covariates remain the same as previously; however, abused as a child is further disaggregated into whether the perpetrator of physical abuse was a parent/guardian or someone else. Model 11 is a logit estimation of the probability of causing *accidental harm* to others, whilst model 12 estimates the probability of causing *purposeful harm* to others.

For parts 2 and 3, logit results are reported as odds ratios i.e. the predicted probability of an event (such as incarceration) occurring divided by the probability of the event not occurring. Odds ratios do not follow a symmetrical distribution, whereas the log of the odds ratio is symmetrically distributed. The relationship between the standard errors of the odds ratio, se(OR), given in the tables, and the standard error of the log of the odd ratio, se(lnOR), is as follows: se(OR) = exp(lnOR)*se(lnOR), where lnOR is the estimated logit coefficient (For further detail see May Boggess (2005)). It follows that se(lnOR) can be calculated by se(OR)/OR. Calculation of t statistics (for testing the null hypothesis that OR=1 or equivalently logOR=0) and corresponding p values reported in the results tables require transforming the reported odds ratios into the log scale and dividing by se(lnOR).

Results Part 1: Health and health care costs

Table 2: Descriptive statistics (p-weighted)

Variable	Mean	Median	Range
Total health care costs in last 12 months	$452.77	$152.04	$0 - 31,745
Number of physical health conditions	1.7	1	0 - 14
Number of mental health conditions	0.4	0	0 - 11
Physical abuse only	5.9%	0	0 - 1
Sexual abuse only	7.2%	0	0 - 1
Combined abuse	2.4%	0	0 - 1
Age	44.3	43	16 - 85
Social marital status = married	57.0%	1	0 - 1
Sex = female	50.3%	1	0 - 1
Socio Economic Status (SES)	9.2	9	3 - 15
Income missing	15.4%	0	0 - 1
Support (any)	98.8%	1	0 - 1
Support of family only	8.9%	0	0 - 1
Support of friends only	2.9%	0	0 - 1
Support of friends and family	87.0%	1	0 - 1
Remoteness	1.5	1	1 - 3
Incarcerated	2.4%	0	0 - 1
Ever attempted suicide	3.2%	0	0 - 1
Alcohol abuse/harmful use	22.2%	0	0 - 1
Alcohol dependence	3.8%	0	0 - 1
Drug abuse/harmful use	7.2%	0	0 - 1
Drug dependence	2.9%	0	0 - 1
Accidental harm	1.4%	0	0 - 1
Purposeful harm	1.1%	0	0 - 1

The descriptive statistics presented in table 2 indicate that 15.5% of Australians aged 16 to 85 were physically and/or sexually abused as children. In the total 16 to 85 year old population, average per capita health care costs are $452 per annum, although health costs are heavily skewed, with median cost being $152 per person. Average numbers of physical and mental health conditions are 1.7 and 0.4, respectively. When health conditions and costs are disaggregated by child abuse type, the results suggest that people who were abused as children are more likely to suffer from physical and mental health problems and have greater

annual health care costs, as illustrated in table 3. The largest difference is for people who were both physically and sexually abused as children. On average, people in this group have 1.5 more mental health problems than people who were not abused and $1856 greater total health care costs.

Table 3: mean number of physical and mental health conditions and total health care costs per person in the last 12 months, by abuse type

Type of abuse as a child	Mean number of physical conditions	Mean number of mental conditions	Mean total annual health care costs
Not abused	1.5	0.3	367.89
Physical only	2.1	0.6	517.21
Sexual only	2.4	0.8	810.66
Combined	2.8	1.8	2224.38

Table 4 summarises the results of models 1 and 2 which estimate the impact of child abuse on adult[2] physical and mental heal conditions, controlling for other factors. The results are presented as incidence rate ratios (IRRs).

Table 4: Negative binomial regressions of the number of physical and mental health conditions

	Model 1: number of physical health conditions		Model 2: number of mental health conditions	
Variable	**I.R.R. (s.e.)**	***p* value**	**I.R.R. (s.e.)**	***p* value**
Physical abuse only	1.42 (0.08)	0.000	1.72 (0.22)	0.000
Sexual abuse only	1.51 (0.09)	0.000	2.42 (0.26)	0.000
Combined abuse	1.89 (0.18)	0.000	4.50 (0.65)	0.000
Age 30 to 44	1.60 (0.08)	0.000	1.19 (0.10)	0.055
Age 45 to 59	2.26 (0.13)	0.000	0.99 (0.12)	0.941
Age 60 to 74	3.10 (0.14)	0.000	0.47 (0.07)	0.000
Age 75 to 85	3.40 (0.17)	0.000	0.19 (0.04)	0.000
Married	0.98 (0.03)	0.559	0.55 (0.05)	0.000
Female	1.21 (0.04)	0.000	1.12 (0.09)	0.149
SES	0.97 (0.01)	0.000	0.93 (0.01)	0.000
Income missing	0.94 (0.05)	0.279	1.05 (0.12)	0.675
Support (any)	0.64 (0.10)	0.005	0.37 (0.10)	0.000
Remoteness	0.99 (0.02)	0.795	0.90 (0.05)	0.068

[2] Based on the age profile of the survey participants 'adult' includes people aged from 16 to 85.

According to models 1 and 2, child abuse is significantly associated with increased numbers of adult physical and mental health conditions. People who were physically abused experience 1.42 times the number of physical conditions and 1.72 times the number of mental health conditions as people who were not abused. IRRs for people who were sexually abused are slightly higher than those for physical abuse. Combined physical and sexual abuse increases the rate of physical health conditions by 1.89 and the rate of mental health conditions by a factor of 4.5, relative to individuals who were not abused as children.

Comparing models 3 and 4, in table 5, illustrates the degree to which physical and mental health conditions mediate the impact of child abuse on adult health care costs. Model 3 indicates that child abuse significantly increases adult total health care costs per annum. When the number of physical and mental health conditions are added, in model 4, the coefficient of physical abuse becomes highly insignificant, suggesting that all of the impact of physical abuse (only) on health costs occurs through increased numbers of health problems. In contrast, the coefficients of sexual abuse (only) and combined abuse remain statistically significant. Comparing the size of the coefficients of sexual and combined abuse in model 3 with the corresponding coefficients in model 4, suggests that approximately half of the impact of sexual and combined abuse on long run health care costs occurs through physical and mental health conditions. This evidence suggests that there is also a direct impact of sexual and combined abuse on health care costs. This may be capturing differences in the severity of conditions or a tendency for people with a history of child abuse to be more dependent on the health care system.

Table 5: OLS regressions of the square root of total health care costs in the last 12 months

	Model 3 (without health conditions)		**Model 4 (with health conditions)**	
Variable	**Coefficient (s.e.)**	***p* value**	**Coefficient (s.e.)**	***p* value**
Number of physical conditions			1.60 (0.13)	0.000
Number of mental conditions			4.28 (0.57)	0.000
Physical abuse only	1.77 (0.72)	0.017	-0.17 (0.67)	0.795
Sexual abuse only	5.52 (1.11)	0.000	2.30 (0.99)	0.023
Combined abuse	16.68 (3.50)	0.000	9.07 (2.65)	0.001
Age 30 to 44	2.98 (0.62)	0.000	1.80 (0.55)	0.002
Age 45 to 59	4.41 (0.67)	0.000	2.71 (0.63)	0.000
Age 60 to 74	6.41 (0.63)	0.000	4.53 (0.68)	0.000
Age 75 to 85	9.12 (0.66)	0.000	7.45 (0.73)	0.000
Married	-0.67 (0.44)	0.135	0.39 (0.40)	0.332
Female	2.88 (0.49)	0.000	2.40 (0.41)	0.000
SES	-0.39 (0.08)	0.000	-0.20 (0.07)	0.006
Income missing	-0.76 (0.64)	0.238	-0.65 (0.58)	0.267
Support (any)	-8.69 (2.92)	0.004	-3.91 (3.01)	0.199
Remoteness	-1.51 (0.28)	0.000	-1.35 (0.25)	0.000
Constant	24.59 (3.17)	0.000	15.00 (3.32)	0.000

To obtain further insight into the relationship between support and health, models 1 to 4 are rerun with *support* disaggregated into *support from friends only*, *support from family only* and *support from family and friends*. In models 1, 3 and 4 there is no statistically significant difference between the coefficients of support type. However, in model 2 Wald test results reveal that the support type coefficients are significantly different from each other at the 1% significance level. The incidence rate ratio (IRR) for *support from family and friends* in model 2 is 0.32 (p=0.000), indicating 0.32 times the rate of mental health conditions for this group compared to people with no support. In comparison, the IRRs for *support from friends only* and *family only* are 0.610 (p=0.042) and 0.532 (p=0.082) respectively. However, the difference impact of support type on the number of mental health conditions does not result in a detectable difference in total health care costs, (models 3 and 4).

To determine whether the impacts of child abuse on current health outcomes differ depending on current age, the models in part 1 are re-estimated with abuse types interacted with current age. When interactions between current age and abuse type are added to models 1 to 4 the interaction terms are all insignificant, in models 1, 2 and 4. In model 3, the coefficient of the interaction of current age with *combined abuse* is negative (-0.302) and weakly significant (p=0.050), suggesting that the impact of combined abuse on health costs may reduce marginally over time. Interactions of current age with physical abuse only and sexual abuse only remain insignificant in model 3. Overall there is little evidence that the impact of abuse on adult health care costs reduces with age.

To determine whether the impacts of child abuse on current health outcomes differ depending on the age when the abuse commenced, models 1 to 4 are re-estimated with the abuse variables disaggregated by age first abused (*0-5, 6-11* and *12-17)*. There are no significant differences between the coefficients for *physical abuse only commencing at age 0-5, physical abuse only commencing at age 6-11* and *physical abuse only commencing at age 12-17*, in any of the models. Similarly, there are no significant differences between the age-specific coefficients for *sexual abuse only*. However, in model 2 (only), there are statistically significant differences between the age-specific coefficients of *combined abuse* (p-value for Wald test = 0.0002). This indicates that the impact of *combined abuse* on the *number of mental health conditions* differs depending on the age at which the abuse commenced. The IRRs for combined abuse increase as the age first abused increases. The IRR for *combined abuse commencing at age 0-5* is 3.055 (p=0.000), the IRR for *combined abuse commencing at age 6-11* is similar, 3.140 (p=0.000). In contrast, the IRR for *combined abuse commencing at age 12 to 17* is 8.204. The possibility that rape may be more common than other (non-rape) sexual abuse for combined abuse commence at older ages has been considered. However, the data reveals little difference between reports of rape compared to other sexual assault for combined abuse commenced at different ages. Further interpretation of the larger impact on mental health conditions of combined abuse commenced at older ages is beyond the scope of this paper.

Results Part 2: Extended analyses of wellbeing

Table 6: Logit estimation of the probability of incarceration (model 5)

Variable	Odds ratio (s.e.)	*p* value	Marginal effect (s.e.)	*p* value	X[3]
Physical abuse only	4.196 (1.076)	0.000	0.010 (0.005)	0.025	0
Sexual abuse only	1.322 (0.573)	0.523	0.001 (0.002)	0.561	0
Combined abuse	8.832 (3.532)	0.000	0.025 (0.011)	0.026	0
Age 30 to 44	3.023 (1.302)	0.013	0.002 (0.001)	0.004	1
Age 45 to 59	3.615 (1.300)	0.001	0.008 (0.004)	0.035	0
Age 60 to 74	1.017 (0.447)	0.969	0.000 (0.001)	0.969	0
Age 75 to 85	0.526 (0.289)	0.247	-0.001 (0.001)	0.171	0
Married	0.724 (0.212)	0.274	-0.001 (0.001)	0.345	1
Female	0.112 (0.036)	0.000	-0.025 (0.006)	0.000	1
SES	0.733 (0.027)	0.000	-0.001 (0.000)	0.002	9
Income missing	1.042 (0.292)	0.885	0.000 (0.001)	0.887	0
Support (any)	0.728 (0.589)	0.697	-0.001 (0.004)	0.740	1
Remoteness	1.267 (0.173)	0.087	0.001 (0.000)	0.068	1

Predicted probability of incarceration for a typical individual = 0.003

The typical individual, based on median characteristics in table 2, is a 43 year old (age cohort 30 to 44) married female, living in a major city, has a median socioeconomic status and social support from family and/or friends. According to model 5, the probability of this typical individual having been incarcerated is 0.003 or 0.3%. Compared to this typical case, the marginal effect on the probability of incarceration of having been physically abused as a child is 0.010, i.e. the probability of incarceration increases from 0.3% to 1.3%. Combined physical and sexual abuse as a child increases the probability of incarceration by 0.025, from 0.03 to 0.028 or 2.8%.

Models 6 to 10 look at the associations between child abuse and self harm; which is indicated by attempted suicide and drug and alcohol problems. According to model 6, reported in table 7, a typical individual has a 1.5% probability of attempting suicide. This estimate excludes "successful" suicide attempts; however, the ABS reports that death by suicide is rare in Australia, with less than 1 case per ten thousand population per year. The results of model 6

[3] X = the value assigned to each explanatory variable for calculations of marginal effects relative to a 'typical individual'. This is based on median characteristics as given in table 2.

indicate that physical, sexual and combined abuse significantly and substantially increase the likelihood of attempting suicide. Compared to a typical individual, the marginal effects of physical abuse (only) and sexual abuse (only) on the probability of attempting suicide are 4.8 and 5.7 percentage points, respectively. A person who was both physically and sexually abused as a child is 22.7 percentage points more likely to attempt suicide.

Table 7: Logit estimation of the probability of attempted suicide (model 6)

Variable	**Odds ratio (s.e.)**	***p* value**	**Marginal effect (s.e.)**	***p* value**	**X**
Physical abuse only	4.352 (0.887)	0.000	0.048 (0.014)	0.000	0
Sexual abuse only	5.011 (1.152)	0.000	0.057 (0.015)	0.000	0
Combined abuse	20.691 (6.458)	0.000	0.227 (0.055)	0.000	0
Age 30 to 44	1.095 (0.275)	0.720	0.001 (0.004)	0.716	1
Age 45 to 59	1.029 (0.231)	0.900	0.000 (0.003)	0.901	0
Age 60 to 74	0.685 (0.199)	0.199	-0.005 (0.003)	0.150	0
Age 75 to 85	0.145 (0.080)	0.001	-0.013 (0.004)	0.000	0
Married	0.435 (0.093)	0.000	-0.019 (0.006)	0.002	1
Female	1.726 (0.299)	0.003	0.006 (0.003)	0.013	1
SES	0.898 (0.033)	0.005	-0.002 (0.001)	0.030	9
Income missing	0.580 (0.149)	0.038	-0.006 (0.003)	0.034	0
Support (any)	0.412 (0.240)	0.133	-0.021 (0.021)	0.314	1
Remoteness	1.184 (0.149)	0.185	0.003 (0.002)	0.191	1

Predicted probability of attempted suicide for a typical individual = 0.015

Models 7 and 8 examine the relationship between child abuse and long run drug problems. Model 7 is a logit estimation of the probability of drug abuse, which is defined in the SMHW as a pattern of use contributing to physical or psychological harm including poor judgement or dysfunctional behaviour (Ewing 2008, p. 93). For a typical individual, the predicted probability of drug abuse is 3.8%. People who were abused as children are significantly more likely to abuse drugs. The marginal impact of physical and sexual abuse on the likelihood of abusing drugs are each approximately 0.06. The marginal impact of combined abuse is almost 3 times as great as physical or sexual abuse alone, increasing the likelihood of drug abuse from 3.8% to 18.7%, on average.

Table 8: Logit estimation of the probability of drug abuse (model 7)

Variable[4]	**Odds ratio (s.e.)**	***p* value**	**Marginal effect (s.e.)**	***p* value**	**X**
Physical abuse only	2.746 (0.516)	0.000	0.060 (0.189)	0.001	0
Sexual abuse only	2.674 (0.578)	0.000	0.058 (0.018)	0.001	0
Combined abuse	5.768 (1.447)	0.000	0.149 (0.043)	0.000	0
Age 30 to 44	1.114 (0.208)	0.565	0.004 (0.006)	0.558	1
Age 45 to 59	0.436 (0.085)	0.000	-0.021 (0.004)	0.000	0
Age 60 to 74	0.030 (0.014)	0.000	-0.037 (0.005)	0.000	0
Married	0.613 (0.085)	0.001	-0.023 (0.008)	0.003	1
Female	0.366 (0.045)	0.000	-0.060 (0.011)	0.000	1
SES	0.965 (0.025)	0.179	-0.001 (0.001)	0.203	9
Income missing	1.192 (0.339)	0.539	0.007 (0.012)	0.569	0
Support (any)	0.636 (0.288)	0.322	-0.021 (0.025)	0.414	1
Remoteness	1.154 (0.119)	0.171	0.005 (0.004)	0.137	1

Predicted probability of drug abuse for a typical individual = 0.038

Table 9: Logit estimation of the probability of drug dependence (model 8)

Variable	**Odds ratio (s.e.)**	***p* value**	**Marginal effect (s.e.)**	***p* value**	**X**
Physical abuse only	2.838 (0.849)	0.001	0.028 (0.013)	0.027	0
Sexual abuse only	2.343 (0.702)	0.006	0.021 (0.009)	0.028	0
Combined abuse	5.378 (1.545)	0.000	0.064 (0.022)	0.003	0
Age 30 to 44	1.174 (0.329)	0.568	0.002 (0.004)	0.574	1
Age 45 to 59	0.290 (0.090)	0.000	-0.011 (0.003)	0.001	0
Age 60 to 74	0.015 (0.018)	0.001	-0.016 (0.004)	0.000	0
Married	0.604 (0.118)	0.012	-0.010 (0.005)	0.035	1
Female	0.403 (0.098)	0.000	-0.023 (0.009)	0.013	1
SES	0.926 (0.038)	0.068	-0.001 (0.001)	0.112	9
Income missing	1.484 (0.800)	0.467	0.007 (0.012)	0.545	0
Support (any)	0.435 (0.299)	0.230	-0.020 (0.024)	0.399	1
Remoteness	1.125 (0.188)	0.484	0.002 (0.002)	0.459	1

Predicted probability of drug dependence for a typical individual = 0.016

[4] Observations for the age 75 to 85 cohort were dropped from models 7 and 8 due to perfect prediction; no respondent in this cohort reported drug abuse or dependence. This reduces the sample size from 8841 to 8040.

Predicted probabilities of drug dependence are about half as great as drug abuse, at 1.6% for a typical case. This increases by 2.8 percentage points for a person who was physically abused and 2.1 percentage points for someone who was sexually abused as a child. Again, the marginal effect for combined abuse is higher, increasing the probability of drug dependence from 1.6% to 8%.

Models 9 and 10, reported in tables 10 and 11, investigate the impact of child abuse on alcohol abuse and dependence, respectively. Model 9 was initially run as a logit model; however, the link test result indicated that the link function was inappropriate. Re-estimating the model as a probit function passes the link test. The probit results are therefore reported in table 10.

Table 10: Probit estimation of the probability of alcohol abuse (model 9)

Variable	**Odds ratio (s.e.)**	***p* value**	**Marginal effect (s.e.)**	***p* value**	**X**
Physical abuse only	0.450 (0.079)	0.000	0.091 (0.021)	0.000	0
Sexual abuse only	0.482 (0.085)	0.000	0.099 (0.022)	0.000	0
Combined abuse	0.776 (0.119)	0.000	0.186 (0.040)	0.000	0
Age 30 to 44	0.094 (0.073)	0.206	0.013 (0.010)	0.182	1
Age 45 to 59	0.103 (0.081)	0.207	0.017 (0.014)	0.234	0
Age 60 to 74	-0.261 (0.078)	0.002	-0.033 (0.009)	0.000	0
Age 75 to 85	-0.521 (0.115)	0.000	-0.054 (0.010)	0.000	0
Married	-0.188 (0.061)	0.003	-0.032 (0.010)	0.002	1
Female	-0.825 (0.045)	0.000	-0.203 (0.015)	0.000	1
SES	-0.001 (0.008)	0.868	-0.000 (0.001)	0.868	9
Income missing	0.001 (0.078)	0.990	0.000 (0.012)	0.990	0
Support (any)	-0.087 (0.164)	0.596	-0.014 (0.028)	0.613	1
Remoteness	0.167 (0.035)	0.000	0.025 (0.005)	0.000	1
Constant	-0.545 (0.199)	0.008			

Predicted probability of alcohol abuse for a typical individual = 0.081

Model 9 predicts that the probability of alcohol abuse for a typical individual is 8.1%, whilst the probability of alcohol dependence, according to model 10, is 1.6%. People who were abused as children are significantly more likely to abuse alcohol and to be alcohol dependent. The marginal impact of physical abuse on the likelihood of abusing alcohol is 0.091 and the marginal effect on alcohol dependence is 0.034. Similarly, the marginal impact of sexual

abuse on the likelihood of abusing alcohol is 0.099 and the marginal effect on alcohol dependence is 0.035. Again, combined abuse has the largest marginal effect, increasing the probability of alcohol abuse by 0.186 compared to the typical case (i.e. increasing the likelihood of alcohol abuse from 8.1% to 26.7%). The impact of combined abuse on alcohol dependence is 0.102, increases the probability from 1.6% to 11.8%, on average.

Table 11: Logit estimation of the probability of alcohol dependence (model 10)

Variable	**Odds ratio (s.e.)**	***p* value**	**Marginal effect (s.e.)**	***p* value**	**X**
Physical abuse only	3.212 (0.744)	0.000	0.034 (0.011)	0.001	0
Sexual abuse only	3.290 (0.917)	0.000	0.035 (0.012)	0.004	0
Combined abuse	8.091 (2.351)	0.000	0.102 (0.034)	0.003	0
Age 30 to 44	1.148 (0.253)	0.534	0.002 (0.003)	0.518	1
Age 45 to 59	0.817 (0.216)	0.446	-0.003 (0.004)	0.407	0
Age 60 to 74	0.322 (0.076)	0.000	-0.011 (0.003)	0.000	0
Age 75 to 85	0.149 (0.081)	0.001	-0.014 (0.003)	0.000	0
Married	0.589 (0.105)	0.004	-0.011 (0.005)	0.018	1
Female	0.380 (0.070)	0.000	-0.025 (0.006)	0.000	1
SES	0.958 (0.025)	0.105	-0.001 (0.000)	0.098	9
Income missing	1.000 (0.207)	0.999	-0.000 (0.003)	0.999	0
Support (any)	0.893 (0.761)	0.895	-0.002 (0.015)	0.899	1
Remoteness	0.993 (0.117)	0.955	-0.000 (0.002)	0.955	1

Predicted probability of alcohol dependence for a typical individual = 0.016

Results Part 3: Do victims of child abuse become abusive?

This final results section looks at whether being abused as a child is significantly associated with abusing others. Model 11, reported in table 12, predicts the probability of causing accidental harm to others whilst model 12 (table 13) estimates the probability of causing purposeful harm to others. In both models sexual abuse as a child is not statistically significant, whereas physical and combined abuse are significant. The odds ratios and marginal effects of physical and combined abuse are similar. This suggests that it is the physical component of abuse which has an intergenerational impact. Only the marginal effects of physical abuse, compared to a typical case, are significant at the 5% level in both models. Having been physically abused as a child increases the likelihood of accidentally

harming others from 0.3% to 1.6% and increases the likelihood of purposefully harming others from 0.1% to 0.7%.

These results suggest that there is a small but statistically significant probability that people who are abused as children will become abusers themselves. Whether this abuse of others includes child abuse cannot be determined from the available data. It is also important to note that the relationship between being abused as a child and causing harm to others may be an indirect relationship, through variables that have been excluded from models 11 and 12. For example, abuse of others may be a consequence of alcohol or drug problems or mental illness. We will explore the pathways through which having been abused leads to harm of others in a future research paper.

Table 12: Logit estimation of the probability of accidental harm of others (model 11)

Variable	**Odds ratio (s.e.)**	***p* value**	**Marginal effect (s.e.)**	***p* value**	**X**
Physical abuse only	5.217 (1.729)	0.000	0.013 (0.006)	0.024	0
Sexual abuse only	2.233 (1.135)	0.120	0.004 (0.003)	0.201	0
Combined abuse	5.386 (2.539)	0.001	0.013 (0.008)	0.086	0
Age 30 to 44	0.689 (0.329)	0.438	-0.001 (0.002)	0.509	1
Age 45 to 59	0.999 (0.602)	0.999	-0.000 (0.002)	0.999	0
Age 60 to 74	0.756 (0.411)	0.609	-0.001 (0.001)	0.572	0
Age 75 to 85	0.712 (0.570)	0.674	-0.001 (0.002)	0.622	0
Married	0.912 (0.301)	0.782	-0.000 (0.001)	0.779	1
Female	0.355 (0.181)	0.047	-0.006 (0.003)	0.104	1
SES	1.110 (0.055)	0.039	0.000 (0.000)	0.114	9
Income missing	1.282 (1.079)	0.769	0.001 (0.004)	0.803	0
Support (any)	0.557 (0.752)	0.667	-0.002 (0.007)	0.738	1
Remoteness	1.254 (0.261)	0.280	0.001 (0.001)	0.344	1

Predicted probability of accidental harm of others for a typical individual = 0.003

Table 13: Logit estimation of the probability of purposeful harm of others (model 12)

Variable	**Odds ratio (s.e.)**	***p* value**	**Marginal effect (s.e.)**	***p* value**	**X**
Physical abuse only	6.643 (2.386)	0.000	0.006 (0.003)	0.047	0
Sexual abuse only	1.572 (1.036)	0.495	0.001 (0.001)	0.563	0
Combined abuse	6.837 (3.214)	0.000	0.007 (0.004)	0.099	0
Age 30 to 44	0.906 (0.430)	0.836	-0.000 (0.001)	0.843	1
Age 45 to 59	0.580 (0.389)	0.420	-0.000 (0.000)	0.305	0
Age 60 to 74	0.572 (0.303)	0.296	-0.000 (0.000)	0.285	0
Age 75 to 85	0.545 (0.403)	0.415	-0.001 (0.001)	0.332	0
Married	0.748 (0.272)	0.426	-0.000 (0.001)	0.471	1
Female	0.094 (0.034)	0.000	-0.011 (0.004)	0.009	1
SES	0.976 (0.041)	0.566	-0.000 (0.000)	0.586	9
Income missing	0.527 (0.253)	0.187	-0.001 (0.000)	0.174	0
Support (any)	0.250 (0.210)	0.104	-0.003(0.004)	0.363	1
Remoteness	1.290 (0.249)	0.191	0.000 (0.000)	0.162	1

Predicted probability of purposeful harm of others for a typical individual = 0.001

In order to test whether the probability of transfer of abusive behaviour depends on the relationship between the perpetrator and victim, models 11 and 12 were respecified. SMHW includes data on whether childhood beatings were committed by a parent/guardian. This information was used to disaggregate the *physical abuse* and *combined abuse* variables into separate *parent* and *non-parent* variables. Sexual abuse cannot be disaggregated in this manner because details of the perpetrator are not available in the data for sexual abuse. The derived variable *parent combined abuse* therefore indicates that someone was both physically and sexually abused as a child and that the physical part of that abuse was by a parent or guardian. When the analyses were rerun there was no statistically significant difference between coefficients of abuse disaggregated by parent/non-parent perpetrator. Consequently, the results are not reported. There is no evidence to support the hypothesis that the probability of the abused becoming abusive depends on the relationship between perpetrator and victim.

Conclusions

This paper investigates long run impacts of child abuse in Australia. Part 1, demonstrates that child abuse is significantly associated with increased numbers of physical and mental health

conditions which in turn increase annual adult health care costs. Whilst the impact of physical abuse on long run health care costs is completely mediated by physical and mental health conditions, sexual and combined abuse have direct as well as indirect effects on health care costs. The results are consistent with Tang et al's (2006) findings for female child abuse in Ontario, in which combined abuse almost doubled health care costs with approximately half of this impact occurring indirectly through physical and mental health problems. Further analysis offers little evidence that the impact of child abuse on adult health care costs reduces with age, suggesting that the long run health care costs persist over the lifetime of the victim.

Parts 2 and 3 extend the analyses to other indicators of wellbeing and indicate that physical and combined abuse of children increase the probability of incarceration and the likelihood of the victims of abuse harming others. The analyses reveal that physical, sexual and combined abuse are all associated with greater rates of self harm, whether indicated by suicide attempts or drug and alcohol problems. Combined abuse has the greatest impact on all indicators.

These findings have important consequences for evaluating the expected benefit of interventions aimed at preventing child abuse in Australia. Child abuse has both direct and indirect effects on health care costs, which will not be captured by top down approaches to estimate the long run cost of child abuse via disease rates. In addition, the evidence indicates that the size of impacts of child abuse depend on the type of abuse. Moreover, the results highlight the magnitude of the costs of child abuse which, in addition to immediate costs to the victim, include long term consequences and externalities. These external effects include costs to the health care system and criminal justice system and their associated tax burden, as well as the cyclical effect of victims of abuse becoming abusers themselves. Whilst the results are derived from Australian data, the consistency of models 1 to 4 with Tang's (2006) results suggests that these outcomes may be generalisable to other OECD countries.

Further research is required to determine the pathways through which having been abused as a child leads to harm of others. Similarly the pathways to incarceration are yet to be explored. In addition, there may be age specific differences in the type and impact of abuse depending on the sex of the victim. Finally, there are a variety of alternative econometric techniques that may be appropriate to estimating the models in this paper, including generalised linear models and two part estimation techniques. These issues form the basis of our ongoing research into the long run impacts of child abuse.

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