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ORIGINAL ARTICLE

Retrospective and prospectively assessed childhood adversity in association with major depression, alcohol consumption and painful conditions

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Background. Considerable evidence now links childhood adversity to a variety of adult health problems. Unfortunately, almost all of these studies have relied upon retrospective assessment of childhood events, creating a vulnerability to bias. In this study, we sought to examine three associations using data sources that allowed for both prospective and retrospective assessment of childhood events.

Methods. Methods. A 1994 national survey of children between the ages of 0 and 11 collected data from a 'person most knowledgeable' (usually the mother) about a child. It was possible to link data for $n = 1977$ of these respondents to data collected from the same people in a subsequent adult study. The latter survey included retrospective reports of childhood adversity. We examined three adult health outcomes in relation to prospectively and retrospectively assessed childhood adversity: major depressive episodes, excessive alcohol consumption and painful conditions.

Results. Results. A strong association between childhood adversities (as assessed by both retrospective and prospective methods) and major depression was identified although the association with retrospective assessment was stronger. Weaker associations were found for painful conditions, but these did not depend on the method of assessment. Associations were not found for excessive alcohol consumption irrespective of the method of assessment.

Conclusions. These findings help to allay concerns that associations between childhood adversities and health outcomes during adulthood are merely artefacts of recall bias. In this study, retrospective and prospective assessment strategies produced similar results.

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Key words: Alcohol consumption, back pain, epidemiological studies, longitudinal studies, major depressive episodes, migraine, painful conditions.

Introduction

Adverse childhood experiences (ACE) are believed to have a negative impact on health status later in life. Mental health outcomes, particularly depression, may occur more often in people with adverse childhood experiences. The ACE study, for example, retrospectively linked ACE to lower levels of adult mental health (Felitti *et al.* 1998; Edwards *et al.* 2003) and to probable depressive disorders (Chapman *et al.* 2004). McLaughlin *et al.* (2010) used data from the US National Epidemiological Survey of Alcohol and Related Conditions to document stress sensitisation, defined as a greater than additive effect of childhood adversity and more recent stressful events, in the aetiology of major depressive episode (MDE), posttraumatic stress disorder and anxiety disorders. A similar result for MDE was reported in two analyses arising from a Canadian longitudinal survey (Colman *et al.* 2013; Patten, 2013). In the World Mental Health (WMH) Surveys, an association between childhood adversity and almost all evaluated mental disorders, including major depression, was found (Kessler *et al.* 2010). The association between childhood adversity and adult MDE has been consistently reported in the literature.

Pain and depression may be linked at a pathophysiological level (Miller *et al.* 2009), but the association of painful conditions with childhood adversity is more tenuous than that of MDE. Epidemiologically, painful medical conditions are among those most strongly associated with MDE (Patten *et al.* 2005). Pain itself is a complex phenomenon that can be assessed along an

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affective dimension (pain unpleasantness) as well as a more conventional dimension of pain intensity, with pain sensitivity being affected by depression (Strigo *et al.* 2008). Here, pain sensitivity is defined as a qualitatively altered negative emotional response to normally non-aversive thermal stimuli (Strigo *et al.* 2008). Childhood adversity has been suspected of increasing the risk of painful conditions. A review by Raphael *et al.* (2004), however, noted that most of the evidence for this idea derives from cross-sectional studies that relied on retrospective reports of childhood adversity, whereas most prospective investigations have failed to identify an association. These authors suggested that an association may not exist, or that if it does exist it may be weak. A prospective study, however, reported that self-reported arthritis was associated with reports of childhood adversity in a community study (Keyes *et al.* 2013).

The association between self-reported alcoholism ('have you ever considered yourself an alcoholic?') and childhood adversity was reported by the ACE study (Felitti *et al.* 1998) and an association of childhood adversity with substance-use disorders was seen in the WMH surveys (Kessler *et al.* 2010). However, this literature has been inconsistent. Colman *et al.* (2013) reported an association between heavy drinking and childhood adversity in some but not all cycles of a Canadian longitudinal survey. Scott *et al.* (2012) reported that associations of alcohol use disorders with childhood maltreatment were no longer significant after adjustment for sociodemographic variables.

Most studies have assessed childhood adversity retrospectively. For example, in the ACE study a questionnaire about adverse childhood events was administered to adults attending a health care organisation (Felitti *et al.* 1998). Measurement errors resulting from inaccurate recall may inflate associations if respondents having poor health in adulthood are more likely to recall childhood adversities (differential misclassification bias) or may dilute those associations if inaccuracies in recall occur at the same rate irrespective of adult health status (Kleinbaum *et al.* 1982). Misclassification may arise through several mechanisms, one of which is retrospective amplification. The perceived level of threat associated with a traumatic experience, for example, was found in one study to be subject to retrospective amplification among those with more persistent post-traumatic symptoms (Heir *et al.* 2009). One review on the other hand emphasised the frequent occurrence of false negative reports in the literature concerned with accuracy of recall of adverse childhood events (Hardt & Rutter, 2004).

Interestingly, Raphael *et al.* reported that court-documented child abuse or neglect failed to predict pain in young adulthood but that young adults with pain complaints were more likely to retrospectively report childhood victimisation. These authors suggested that recall of such events may actually be a more salient factor than their actual historical occurrence (Raphael *et al.* 2001).

In the present study, we sought to evaluate epidemiological associations between childhood adversities, as assessed in 1994 in a study called the National Longitudinal Study of Children and Youth (NLSCY) and adult health outcomes. Outcomes were assessed later during a partially linked study called the National Population Health Survey (NPHS). In the NLSCY, the adversities were reported by the person most knowledgeable about the child (PMK), usually the mother. The NPHS assessed childhood adversity using a series of retrospective interview items. The goal was to examine whether these two types of assessment similarly associated with the three outcomes, or not. We hypothesised that stronger associations would specifically occur with retrospective assessment in situations where differential recall bias might increase the recollection of past adversities, specifically MDE, and that in other circumstances retrospective assessment would cause non-differential misclassification and tend to dilute the associations, such that weaker associations would be observed with retrospective assessment. We focused on three health outcomes discussed above: MDE, painful medical conditions and alcohol consumption.

Method

Data sources

The NLSCY (Statistics Canada, 2010) and the NPHS (Statistics Canada, 2012) were both population-based studies conducted by Statistics Canada. The NLSCY targeted children and the NPHS targeted adults. Both were longitudinal in their design and both began data collection in 1994. The NPHS collected follow-up data for 16 years. The target population in each study was the national household-dwelling population. A feature of these studies is that they employed a linked sampling methodology. Some children between the ages of 0 and 12 surveyed for the 1994 NLSCY study were subsequently followed-up by the NPHS. These respondents were interviewed as part of the NPHS cohort when they reached age of 12 but were not included in the NLSCY longitudinal cohort. The NPHS interviewed its cohort every 2 years until 2010 (Swain *et al.* 1999). An 11-year-old NLSCY respondent sampled in 1994 with complete data collection would have been followed approximately to age 27 in the NPHS, whereas an infant in the 1994

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NLSCY with complete follow-up would have been interviewed with the adult NPHS interview in the two final NPHS cycles at the ages of 14 and 16. The shared component of the sample was a random sample representative of the target population.

Measures

The NLSCY included a series of questions directed towards the PMK about each child. We selected a set of 14 adversities that most closely resembled those asked later in the NPHS. These 14 adversities were: death of parent, death of family member, parents separated, number of moves, a stay in foster care, other separation from parents, change in household membership, alcohol/mental health issues, injury/illness of family member, abuse, hospital stay, injury/illness of child, conflict between parents and other trauma.

The NPHS included a series of retrospective questions inquiring about childhood adversities, all of which were asked directly of the study participants. The questions were preceded by: 'The next few questions ask about some things that may have happened to you while you were a child or teenager, before you moved out of the house. Please tell me if any of these things have happened.' This was followed by individual items referring to the following events: spending 2 weeks in hospital, parental divorce, long-term parental unemployment, 'something that scared you so much you thought about it for years after', being sent away from home for doing something wrong, parental drinking or drug use that 'caused problems for the family', 'physical abuse by someone close to you.' Childhood stressful experiences were again classified as occurring when there were one or more positive responses to these items.

The NPHS interview included the Composite International Diagnostic Interview Short Form for Major Depression (CIDI-SF) (Kessler *et al.* 1998) to assess past year MDE. The CIDI-SF was developed using data from the National Comorbidity Survey (Kessler *et al.* 1994), which used the DSM-IIIR classification. The CIDI-SF is scored using an algorithm that produces a predictive probability of past year MDE. For the current analysis, the 90% predictive cut-point was used in scoring. This scoring procedure requires endorsement of five symptom-based criteria (at least one of which must be depressed mood or loss of interest), providing face validity in relation both to the DSM-IIIR and DSM-IV definitions of MDE.

The NPHS also included a variety of self-report items on alcohol consumption. These included a 7-day consumption diary. Canadian 'low risk' drinking guidelines in place at the time of the study (14 per week and men and 9 per week in women) were used to identify excess consumption this analysis. Due to limitations of the data source we were unable to assess alcohol dependence – this was assessed in only one NPHS cycle by the relevant CIDI-SF module.

A set of painful chronic conditions were identified based on a series of items asking about 'long-term' (defined as 'expected to last' longer than 6 months) medical conditions. The items employed in this part of the survey resembled those of the US Behavioral Risk Factor Surveillance system questionnaires (Centers for Disease Control and Prevention, 2013) and asked about professionally diagnosed long-term conditions. Three conditions were classified as painful conditions in these analyses: migraine, back pain and 'arthritis or rheumatism.' A self-reported professional diagnosis of any one of these conditions was taken to mean that the respondent had a painful condition. These conditions were also examined individually when the sample size was adequate.

Data linkage

The linkage of the two survey datasets was carried out by Statistics Canada and the linked data were forwarded to the Prairie Regional Data Centre at the University of Calgary, where it was analysed using Stata (Stata Corporation, 2012).

Analysis

In order to maximise the use of the follow-up data, we selected a method of analysis that could incorporate repeated observations from each respondent: generalised estimating equations (GEE). As the outcome variables were binary, logistic regression was used. We employed an unstructured correlation structure after determining that this produced better goodness of fit statistics than two alternatives: independent and exchangeable. Robust standard errors were used in all analyses. The three outcomes were modelled in the same way in relation to adversities in the linked sample, and from the self-reported adversities in the entire NPHS longitudinal cohort. We produced sex-adjusted models within the linked data file (all respondents entered into the NPHS follow-up at age 12 such that, barring a cohort effect, age adjustment was not relevant) and age and sex adjusted estimates for the NPHS longitudinal file. Whereas the painful conditions category consisted of respondents with any one of the three specified painful conditions, we also examined each of those conditions individually. This resulted in 12 tests of significance, leading to a concern about Type I error. To address this, the Benjamini–Hochberg procedure was used to control the false

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discovery rate in this part of the analysis. The procedure was implemented using spreadsheet-based method (Thiessen *et al.* 2002). The datasets from these population surveys are each associated with a set of replicate bootstrap weights designed to account for design effects and to ensure representation of the target population. In analyses where one dataset was used the estimates were weighted. Most of the analyses, however, were not weighted since they were based on a linked sample from two different surveys.

Results

There were $n = 1977$ respondents in the linked sample. Of these subjects 95.9% provided outcome data during at least one follow-up assessment and could therefore be included in the GEE analysis. Complete follow-up was achieved for 66.0% of the sample over the entire interval (up to 16 years, for some of the participants), 0.7% left the sampling frame because of death or institutionalisation during follow-up and 0.9% provided partial responses. The proportion lost to follow-up during NPHS follow-up of the linked sample was 32.5%. Table 1 presents demographic features of the sample and Table 2 reports the frequency of experiencing any one or more childhood adversity in the NLSCY cross-tabulated against the NPHS data. In the NLSCY, one or more adversity was reported by 25.1% (95% confidence intervals (CI) 22.6–27.6) of the sample whereas in the NPHS 54.3% (95% CI 50.1–58.5) reported one or more of the targeted adversities. Respondents with missing data on one or both of the adversity measures could not be included in the cross-tabulation, so the row totals are not exactly the same as the frequencies reported above. There was approximately 60% agreement between the two sets of reports, which was significantly greater than chance ($z = 7.26$, $p < 0.001$) but (not unexpectedly since different adversities were assessed) the Kappa was only 0.21, indicating a low degree of chance-corrected agreement. When this comparison was restricted to a subset of adversities that were somewhat consistently assessed: parental divorce, physical abuse and being sent away from home/placed in foster care (examples of where the two surveys assessed similar concepts, although different items were employed), the Kappa was somewhat higher at 0.43.

Table 3 presents sex adjusted odds ratios (ORs) and associated 95% CI for each of the three outcomes evaluated in the linked sample. In the right-hand column, the estimates for NLSCY adversities are recalculated with exclusion of those subjects reporting adversities in the NPHS. This is a group of respondents who apparently had adversities but did not report them in the later survey. Major depression was consistently

Table 1. *Features of the linked sample in 1994 (NLSCY) and 2010 (NPHS)*

Characteristics	Categories	Weighted percentage*	95% CI
Characteristics of the linked sample as reported by the PMK in 1994 (age 0–11)			
Sex	Male	51.7	48.8–54.7
	Female	48.3	45.3–51.2
Raised by lone mother	Yes	16.3	14.2–18.5
	No	83.7	81.5–85.8
PMK depressed†	Yes	3.0	1.9–4.2
	No	97.0	95.8–98.1
Demographic context	Urban	84.3	82.5–86.1
	Rural	15.7	13.9–17.5
Immigrated to Canada	PMK	21.3	18.6–23.9
	Spouse	19.6	17.0–22.2
	Both	27.3	24.5–30.1
Characteristics of the linked sample in the final NPHS Cycle, 2010 (age 16–24)			
Marital status	Married/common law	5.3	4.0–6.7
	Not married	94.7	93.3–96.0
Education	No post-secondary	37.4	33.9–40.9
	At least some post-secondary	62.6	59.1–66.1
Employment	Currently working	67.7	64.2–71.1
	Not currently working	32.3	28.9–35.8

*Analyses based on the linked sample are not weighted in this paper, but the frequencies in table are weighted using NLSCY (top section, childhood demographics) or NPHS (bottom section, adult demographics) weights to help ensure representativeness.
†Score of 21 or greater on a modified version of the CES-D scale (Poulin *et al.* 2005).

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Table 2. *Frequency of any reported childhood adversities in the NLSCY and NPHS cohorts*

		NLSCY	
		Yes	No
NPHS	Yes	22.8%	30.0%
	No	10.0%	37.2%

associated with reports of adversity, with the stronger association being seen in the NPHS. Weaker, but still significant associations were seen for painful conditions, again, these were consistently seen in both NLSCY-linked and NPHS-based analyses. No association specifically of adversity with 'arthritis or rheumatism' was observed. Excessive alcohol consumption was not associated with adversity irrespective of method of assessment. Table 3 reports *p*-values arising from the sex-adjusted models. Identification of critical values for assessing statistical significance in each test with the Benjamini–Hochberg procedure did not alter the pattern of statistical significance. All of the *p*-values <0.05 remained significant when assessed against Benjamini–Hochberg critical values while all of the *p*-values >0.05 remained non-significant. The largest of the *p*-values that was <0.05 was that for arthritis in the NLSCY ($p = 0.008$) which was the eighth ranked *p*-value and was judged against a critical value of 0.01.

Discussion

These results support the idea that childhood adversity is associated with MDE and, less strongly, with painful conditions, a pattern consistent with prior literature. No association with excessive drinking was observed. A prior analysis of NPHS data (Colman *et al.* 2013) did report an association between childhood adversity and excessive drinking, but only when ≥2 adversities were reported and, as noted above, negative results for this association have also been reported by other studies (Scott *et al.* 2012). Identification of a strong association of childhood adversity with MDE, a weaker one with painful conditions and none for alcohol consumption seems broadly consistent with prior literature. The ORs for alcohol consumption (see Table 3) were slightly elevated, a situation that could lead to the pattern of weak and inconsistent association being observed in prior studies since only large studies would have sufficient power to reliably detect weak effects. Notably, the ACE study used 'alcoholism' as an outcome, which is a different concept than that of excessive

Table 3. *Sex-adjusted ORs for childhood adversity assessed during childhood (NLSCY) or adulthood (NPHS)*

Outcomes (NPHS)	NLSCY OR 95% CI *p*-value	NPHS OR 95% CI *p*-value	NLSCY, excluding those reporting adversities in the NPHS OR 95% CI *p*-value
MDE	2.0 1.5–2.5 <0.001	5.5 3.2–9.4 <0.001	2.7 2.0–3.6 <0.001
Migraine	1.6 1.2–2.1 0.004	1.4 0.9–2.1 0.152	1.7 1.2–2.2 0.001
Arthritis	2.3 1.2–4.3 0.008	1.0 0.7–1.6 0.842	–*
Back pain	1.5 1.1–2.0 0.006	1.9 1.3–2.8 <0.001	1.4 1.1–1.9 0.022
Painful conditions	1.9 1.5–2.4 <0.001	1.5 1.1–2.0 0.007	1.8 1.4–2.2 <0.001
Alcohol above weekly guidelines	1.2 0.9–1.5 0.132	1.3 0.9–1.7 0.107	1.1 0.9–1.4 <0.001

*Due to small cell sizes, the estimate could not be released.

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consumption that that used here. Also, the ACE study had a very large sample size.

The literature linking childhood adversity to adult pain has been inconsistent. As noted above, based on a literature review, Raphael *et al.* reported that the association may be weak, or may not exist at all. In this study, we observed a significantly elevated risk of painful conditions in association with childhood adversity but the association was indeed weak compared to that for MDE, consistent with the prior report (Raphael *et al.* 2004). Most importantly for the goals of this study, the pattern was comparable irrespective of the method of assessment employed.

Unlike a prior study (Scott *et al.* 2012), we were unable to directly compare different methods of assessment of adversity. There are many explanations for the differing responses. It is likely that some children experienced adversities at a time after the time of reporting in the NLSCY, such that the record of exposure to adversity in the NPHS, which only began at age 18 might pick up problems not identified at the earlier survey. A major limitation of this investigation is that the specific adversities assessed in two surveys were not the same, such that differential reporting cannot be assumed to be due to recall issues at all. Studies having an opportunity to compare identical sets of adversities with prospective and retrospective recall are needed to decisively determine the impact of recall on estimated associations. Despite these methodological uncertainties, the results reported here are in line with those reported previously (Scott *et al.* 2012): there was a considerable degree of consistency of estimated associations across the different assessment methods. While there is a tendency to consider self-report as merely representing an error prone proxy assessment of actual historical events, the likelihood of recollecting and reporting of such events may be related to their personal salience and health-impact. In turn, this may mean that retrospective assessments are more useful than expected despite their likely vulnerability to error. However, the hypothesis put forward by Raphael *et al.* (2001) that recall of adversities may actually be a more salient factor than their actual historical occurrence was not confirmed by these results, since a similar pattern of association with prospectively reported adversities was seen even when adversities were not reported retrospectively, see the right-hand column in Table 3.

Since misclassification of risk factor exposures tends to be a source of bias in epidemiologic research (Kleinbaum *et al.* 1982), expectation holds that systematic differences should be introduced when misclassification is substantial. For example, in a hypothetical population with 1100 people that are non-depressed and 120 depressed members one may imagine a scenario in which 20 of the 120 depressed and 100 of the 1100 non-depressed have experienced an adverse event during their childhood, leading to an OR of 2. However, if there is a 35% false negative rate for the reporting of adversity in the non-depressed respondents an OR of 3.2 would be expected. Similar inflation of the association would be seen if false positives occurred selectively in the depressed subjects. On the other hand, if there was an equivalent 35% false negative rate in both depressed and non-depressed subjects (non-differential misclassification), a slightly reduced OR of 1.9 would be expected. Most of the existing literature would suggest that false negative classification among respondents whose mental health is good is likely to be the main problem with retrospective reports (Fergusson *et al.* 2000; Hardt & Rutter, 2004; Heir *et al.* 2009) and one may therefore expect to see an overestimation of the association when retrospective reports are used. This is a potential explanation for the very strong association (OR = 5.5) seen for MDE when retrospective reports were used in the classification of exposure, but the same effect was apparently not seen for the other outcomes examined. By way of emphasising this point, it may be noted that the OR for MDE when adversity was defined in terms of the retrospective NPHS reports was approximately twice as large as that seen when adversity was defined using the NLSCY data and the lower bounds of the 95% CI for the NPHS-based estimate exceeded the upper bound of that for NLSCY-defined adversity. A tendency for differential misclassification to inflate estimates might be offset by aspects of inaccuracy that are not related to health status at the time of measurement (non-differential misclassification), such that the theoretical direction of bias is difficult to anticipate. Empirical observations are therefore important and the ones reported here are reassuring. However, it is worth noting that in the case of painful conditions, which might not be associated with differential recall in the same way that depression may be, did show a slightly stronger association with childhood adversity in the NLSCY data, which is consistent with the hypothesis that retrospective misclassification of adversity may be non-differential with respect to adult pain.

Important limitations of this study include attrition, which could have distorted the associations observed, and the limited sample size. The cross-tabulation required to estimate the ORs could not generally be further stratified to detect effect modification or explore issues of confounding. Also, the analysis would have been more decisive if the assessment of adversity were more consistent across the studies. The employment of validated instruments to assess adversity and its severity would be superior to the sorts of items included, which allow only a rough determination that an adversity occurred.

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In totality, these results concur with the conclusions of prior studies (Hardt & Rutter, 2004; Scott *et al.* 2012) that retrospective assessment of adversity, despite an obvious vulnerability to inaccuracy, cannot be assumed *de facto* to invalidate epidemiological estimates. Such measures appear to perform more favourably than, based on epidemiologic theory, one might expect.

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Conflict of Interest

None.

Ethical Standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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