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**Psychotic Symptoms in Young Adults Exposed to Childhood Trauma – a 20 Year
Follow-up Study**

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Abstract

Childhood adversity has been shown to increase the risk of psychotic symptoms in adult life. However, there are no previous studies looking at the association between experiencing a natural disaster during childhood and the development of psychotic symptoms in young adulthood.

Eight hundred and six bushfire-exposed children and 725 control children were evaluated following the 1983 South Australian bushfires. Five hundred and twenty nine (65.6%) of the bushfire group and 464 (64%) controls participated in a follow up study 20 years later. Childhood data on emotional and behavioural disorders and dysfunctional parenting was available. The adult assessment included the Australian National Health and Well-Being psychosis screen and detailed information about trauma, childhood adversity and alcohol and cannabis abuse.

5.6% of subjects responded positively to the psychosis screen and 2.6% responded positively to a further probe question. Psychotic symptoms were more common in subjects exposed to a greater number of traumas, and were associated with higher rates of childhood adversity, emotional and behavioural disturbance, dysfunctional parenting, and alcohol and cannabis abuse. Subjects exposed to bushfires as children did not have a greater risk of psychosis. Our results indicate that exposure to multiple traumas, rather than a single major trauma, increases the risk of later psychosis.

1. Introduction

There is considerable interest in the contribution of childhood trauma to the later development of psychosis (Morgan and Fisher, 2007). Recent reviews have proposed pathways by which trauma might modulate brain structure and function (Bremner, 2005; van Winkel et al., 2008), leading to greater vulnerability to psychosis. This study looks at the association between childhood exposure to a severe trauma, the 1983 Australian bushfires,

and later psychotic symptoms. The 1983 bushfires were devastating and the affected communities, which depended on agriculture and forestry, sustained major losses of homes, property and life, with far reaching consequences (McFarlane and Raphael, 1984). The impact of the bushfires on children living in these communities is described further by McFarlane et al. (1987).

A recent meta-analysis (Van Os et al., 2009) found that the median prevalence of subclinical psychotic experiences (SPE) in the general population is about 5%. In this meta-analysis, subclinical psychotic experiences were defined as symptoms or experiences of or resembling hallucinations, delusions or both, which were not associated with distress or help-seeking. Whilst most SPE are transitory, a proportion of people with these symptoms develop a chronic psychotic disorder, most commonly schizophrenia (Dominguez et al., 2009). Several recent studies have shown that exposure to physical or psychological trauma, including bullying and sexual abuse, increases the risk of later SPE (Bak et al., 2005; Bebbington et al., 2004; Janssen et al., 2004; Lataster et al., 2006). Exposure to a greater number of traumas is associated with a higher risk of psychosis (Janssen et al., 2005; Spauwen et al., 2006). Cannabis use is also associated with SPE (Miettunen et al., 2008; Dragt et al., 2010). Houston et al. (2008) found an interaction between cannabis use, childhood sexual abuse, and adult non-affective psychosis.

Several previous studies have followed the childhood survivors of natural disasters into adulthood (Green et al., 1994; Yule et al., 2000; Bolton et al., 2000; Morgan et al., 2003), but none of these studies have investigated the prevalence of SPE in the survivors when they reach adulthood. Further, none have included control subjects recruited during childhood.

The 1997 Australian Survey of Health and Well-Being used the same psychosis screening tool as the present study (Degenhardt and Hall, 2001). Their sample included adults up to the age of 50 years, and they found that 1.2% of their subjects screened positive for psychosis. The psychosis positive group were more likely to meet DSM-IV criteria for

alcohol use disorder (OR 3.93, 95% CI 2.48-6.24) and cannabis use disorder (OR 5.86, 95% CI 3.37-10.18).

Our study provides a unique opportunity to examine the association between exposure to a specific childhood trauma, the 1983 bushfires in South Australia, and the presence of SPE in young adulthood. In addition, we were able to examine associations between exposure to childhood adversity and trauma, cannabis and alcohol use, and adult psychotic symptoms. Urbanicity is often included as a risk factor for SPE (Janssen et al., 2004; Cougnard et al., 2007) but all our subjects lived a rural area, the South-Eastern region of the state of South Australia, at the time of the childhood assessments.

We hypothesised that the bushfire-exposed group would be more likely to manifest SPE as adults. We anticipated that parent and teacher assessments indicating emotional and behavioural problems during childhood would be associated with later SPE. We expected that subjects reporting childhood adversity would be more likely to experience SPE. Finally, we predicted that alcohol and cannabis abuse would be more common in young people with SPE.

2. Methods

The method is described in more detail in McFarlane and Van Hooff (2009).

2.1 Participants

2.1.1 Bushfire-exposed subjects

Participants (n=806) were recruited as children during the two-year period after they had been exposed to an Australian bushfire disaster in 1983 (McFarlane et al., 1987). Five hundred and twenty nine (65.6%) completed the follow-up study (Table 1).

2.1.2 Control Subjects

In 1985, 725 primary school children from a neighbouring region that was not directly affected by the fires were recruited as a comparison sample (McFarlane et al., 1987). Four hundred and sixty four control subjects (64%) participated in the follow-up study (Table 1).

Table 1 about here

2.2 Measures

At the childhood assessment, parents and teachers completed the Measure of Parenting Style (MOPS; Parker et al., 1997), the Rutter Parent Scale (Rutter et al., 1970) and the Rutter Teacher Scale (Rutter, 1967).

At follow-up, the presence of SPE was determined using the psychosis screen from the Australian National Survey of Health and Well-Being (Degenhardt and Hall, 2001). There are four screening questions, and three of these questions have probes that are asked if there is a positive response to the question. The instrument addresses delusions of control, thought interference and passivity, delusions of reference or persecution, and grandiose delusions. It also asks whether the person has ever received a possible diagnosis of schizophrenia. Psychosis screen-negative subjects (PSN) did not endorse any of the screen items. Psychosis screen-positive subjects (PSP) answered yes to at least one screen item. Psychosis probe-positive subjects (PPP) answered yes to at least one screen item and at least one probe question.

Lifetime exposure to traumatic events was assessed using the standard list of ten Criterion-A events from the Composite International Diagnostic Interview (CIDI; World Health Organisation, 1997). These were direct combat, life-threatening accident, fire, flood or natural disaster, witnessed someone being badly injured or killed, rape, sexual molestation, serious physical attack or assault, threatened with a weapon/held captive/kidnapped, tortured or victim of terrorists, and any other stressful event. In addition, we included seven

other types of events (domestic violence, witnessed domestic violence, threatened/harassed without a weapon, finding a dead body, witnessing someone suicide or attempt suicide, child physical abuse, child emotional abuse). These events were based on a systematic recoding of the “other” trauma category in a random community sample (Goldney et al., 2000). The Adverse Childhood Experiences Scale (ACE; Dube et al., 2003) measured exposure to childhood adversity and trauma up to the age of 16 years (see Table 3).

Alcohol use was assessed with the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993). The CIDI section on substance abuse and dependence was used to determine the number of cannabis-related symptoms, and whether the subject met criteria for cannabis dependence.

2.3 Statistical Analyses

Results are presented as means and standard deviations. Separate analyses were carried out for psychosis screen-positive subjects (PSP) and psychosis probe-positive subjects (PPP). The rationale for this was that the screen-positive group met a minimal threshold for SPE, whilst the probe-positive group had more pronounced psychotic symptoms. It was expected that any association between risk factors and later SPE would be strongest for the probe-positive group. Chi-square tests were used to determine the associations between the presence of psychotic symptoms and the other measures. Odds ratios and confidence intervals are reported. Multivariate Logistic Regressions were used to determine the relative contribution of the total number of lifetime traumas, alcohol abuse, cannabis abuse, childhood behavioural problems and childhood adversity to the prediction of screen-positive (PSP) and probe-positive (PPP) symptoms. P values of <0.05 were taken as significant. Analyses were performed using PASW Statistics (Version 18.0).

3. Results

Sociodemographic data describing the entire sample (N=993) is presented in Table 1. The age of the participants at baseline is their age at the time of the bushfire (in 1983) not their age at recruitment. A comparison between responders and non-responders to the follow up study has been published previously (McFarlane and Van Hooff 2009). There were few differences; non-responders were more likely to be younger and to be male. Further descriptive data for study participants has been published in McFarlane and Van Hooff (2009).

3.1 Psychosis Screen Positive Subjects

Fifty six subjects (5.6% of the total sample; Table 2) endorsed at least one psychosis screening item. Subjects who responded positively to at least one screening question (Psychosis Screen Positive, PSP) were compared to those who did not endorse any of the screening items (Psychosis Screen Negative, PSN) on the following demographic variables: age at the time of the bushfire, age at the time of follow-up, gender, marital status, completion of year 12, and employment status. A higher proportion of PSN participants were married (34.6%) compared to PSP participants (16%) ($\chi^2= 8.12, p=0.004$). All other comparisons were not significant.

Table 2 about here.

Thirty two (6.0%) of the bushfire-exposed group and 24 (5.2%) of the control group responded positively to the psychosis screen (ns). However, the PSP group reported a mean of 4.25 (± 2.78) lifetime CIDI traumatic events whilst PSN subjects had a mean of 2.17 (± 1.91) (OR 1.41, CI 1.28-1.56, $p < 0.001$). Besides the bushfires, the most common traumas were being in a life threatening accident, having a family member or friend in a life threatening accident, and witnessing someone being badly injured or killed. There was no relationship between any specific type of traumatic event and PSP status.

The PSP group had more emotional and behavioural problems as children. The mean Rutter parent score was 8.89 (± 7.16) for PSP subjects and 6.10 (± 5.17) for PSN subjects (OR 1.081; CI 1.02-1.13, $p=0.005$). The mean Rutter teacher scores were 4.31 (± 5.39) for PSP subjects and 2.75 (± 3.77) for PSN subjects (ns). PSP subjects were significantly more likely to report childhood adversity according to the ACE Questionnaire and dysfunctional parenting using the MOPS (Tables 3,4).

Tables 3,4 about here

PSP subjects had higher total AUDIT scores (OR 1.12; CI 1.07-1.18, $p<0.001$) and were more likely to be alcohol dependent (OR 3.91; CI 1.87-8.16, $p<0.001$) than PSN subjects. Forty one (4.1%) of the total study population met criteria for cannabis dependence, and they were more likely to report SPE (OR 3.15; CI 1.26-7.84, $p=0.014$). The mean number of cannabis symptoms was 2.00 (± 2.49) for the PSP group and 0.72 (± 1.52) for the PSN subjects (OR 1.38; CI 1.23 – 1.56; $p < 0.001$).

Logistic regression, with a positive response to the psychosis screen as the dependant variable and the number of childhood traumatic events, the AUDIT total score, the total number of lifetime traumas, the number of cannabis symptoms, and the Rutter parent total score as the independent variables, demonstrated that a greater number of lifetime traumas and a higher AUDIT score predicted a positive psychosis screen. These variables remained significant after controlling for age and gender. The number of cannabis symptoms, childhood behavioural problems and childhood trauma were not significant predictors (Table 5).

Table 5 about here

3.2 Psychosis Probe Positive Subjects

Twenty six subjects (2.6% of the total study population) responded positively to a probe question (Psychosis Probe Positive, PPP). The majority (n=18) were male (ns). They were compared to the (Psychosis Probe Negative, PPN) group.

Again, there was no specific association with bushfire exposure. Sixteen bushfire-exposed subjects (2.2%) and 10 control subjects (3.3%) responded positively to a psychosis probe. The mean number of lifetime traumas for the PPP group was 5.35 (\pm 2.95) compared to 2.21 (\pm 1.91) for the PPN subjects (OR 1.55; 1.36–1.77, $p < 0.001$). There was no significant difference between groups on the Rutter scales, but PPP subjects had significantly higher scores on nearly all ACE and MOPS items (Table 3 and 4).

The PPP group had a higher total AUDIT score (OR 1.12; CI 1.05–1.20, $p < 0.001$) and were more likely to be alcohol dependent (OR 4.04; CI 1.33–12.29, $p = 0.014$). They endorsed a higher total number of cannabis symptoms (OR 1.47; CI 1.26–1.72, $p < 0.001$).

Logistic regression showed that a greater number of lifetime traumas and the AUDIT score also predicted PPP status. These variables remained significant after controlling for age and gender. The number of cannabis symptoms, childhood behavioural problems and childhood trauma were not significant predictors (Table 5).

4. Discussion

We found an overall rate of SPE of 5.6%, which is comparable with that reported by van Os et al. (2009) in their recent meta-analysis. The response rates to the follow up study were similar in both groups and we were fortunate that about two thirds of each group participated. Our hypothesis that the bushfire-exposed group would be more likely to have SPE as young adults was not supported. We did replicate previous findings that a greater number of traumas were associated with an increased risk of SPE. These young people had

been exposed to a surprising number of severe traumas, with the PPP group reporting they had experienced more than five significant lifetime traumas.

Given that these traumas occurred during childhood, adolescence and early adulthood, factors such as the nature of the trauma, the age or developmental stage of the child and the presence of family and other support, may influence the impact of the trauma (Salmon and Bryant, 2000). We have previously examined the interaction between age at exposure to the bushfires and the incidence of Post-Traumatic Stress Disorder (PTSD) and other psychiatric diagnoses, and did not find an effect. The experience of other traumas, at other ages, by many of the subjects may have obscured any direct relationship between the age at the time of the bushfires and the impact of this event.

Bremner (2005) describes the pathological effects of stress on the hippocampus. Possible mechanisms include stress-induced elevation of cortisol and excitatory amino acids, and reduction in brain-derived neurotrophic factor (BDNF). People with schizophrenia have been shown to have hippocampal volume reduction (Velakoulis et al., 2006), hypothalamic-adrenal-pituitary (HPA) axis dysfunction (Walker et al., 2008), low levels of BDNF (Jindal et al., 2010) and an inverse relationship between cortisol and BDNF in the prefrontal cortex (Issa et al., in press). Taken together, these findings suggest that in a vulnerable individual, trauma may exacerbate changes in brain structure and function leading to increased risk of psychosis.

Our results support previous findings of an association between childhood adversity and SPE in early adulthood. Our study has the advantage of including assessments undertaken during childhood. The Rutter parent scores indicate that PSP subjects had signs of behavioural and emotional disturbance in childhood. Dysfunctional parenting, assessed during childhood, also increases the risk of SPE twenty years later. Similarly, higher levels of childhood adversity are associated with a greater risk of psychosis. This effect is not associated with particular types of parenting or adversity, but seems to indicate a more general effect of an inadequate family environment. There is some overlap with the trauma

data in that some forms of childhood adversity, for example, severe domestic violence and sexual abuse, can also be included as traumatic events.

Animal studies have shown that disruptions to the mother-infant relationship have chronic deleterious effects on both the mesolimbic dopamine system and the HPA axis (Liu et al., 1997; Hall et al., 1999). Human subjects who have grown up with poor parental care show greater release of dopamine in the ventral striatum and higher levels of salivary cortisol in response to a psychosocial stress than subjects who have experienced good parental care. These results are consistent with the notion that a deprived childhood environment is associated with increased reactivity of the dopamine system, possibly mediated by or associated with HPA axis dysfunction.

Cannabis use is known to be a risk factor for SPE (Miettunen et al., 2008; Dragt et al., 2010). Alcohol abuse has received less attention, despite comparable rates of cannabis and alcohol abuse in people with schizophrenia (Cantor-Graae et al., 2001). In our sample, alcohol abuse was more strongly associated with SPE than cannabis abuse. There has been considerable interest in the effects of cannabis on brain function (Müller-Vahl and Emrich, 2008) but alcohol has received much less attention. Alcohol interacts with the GABA and endocannabinoid receptor systems (Guan, 2010), both of which are implicated in psychosis (Thompson et al., 2009; Müller-Vahl and Emrich, 2008), and can precipitate alcohol-induced psychotic disorder (Soyka, 2008; Joordan et al., 2009). It is possible that cannabis and alcohol abuse are a reaction to earlier trauma, and certainly high rates of comorbid substance abuse are found in people with PTSD (Leeies et al., in press). The alcohol and cannabis abuse might act synergistically with the preceding trauma to increase vulnerability to SPE.

Our subjects were still quite young at follow up and were only part way through the period of greatest risk for psychosis. The incidence of psychotic symptoms might be higher if they were followed for another decade. Another limitation of our study was the lack of information about family history of psychosis.

In conclusion, this study confirms previous research demonstrating an association between trauma and later SPE. The total number of traumas was more important than exposure to a single devastating natural disaster. Childhood adversity was shown to increase the risk of SPE, and this study identifies dysfunctional parenting as a specific risk factor. Whilst both cannabis and alcohol were associated with SPE, alcohol had a greater effect. The goal of prevention or mitigation of psychotic disorders requires that further research is undertaken to identify the pathways by which trauma, childhood adversity, dysfunctional parenting and substance abuse increase individual vulnerability to psychosis.

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