THE JOURNAL OF
CHILD PSYCHOLOGY AND PSYCHIATRY

Journal of Child Psychology and Psychiatry 49:10 (2008), pp 1118–1128 doi:10.1111/j.1469-7610.2008.01955.x

Pre- and postnatal influences on preschool mental health: a large-scale cohort study

Monique Robinson,[1,2] Wendy H. Oddy,[1,3] Jianghong Li,[1] Garth E. Kendall,[5] Nicholas H. de Klerk,[1] Sven R. Silburn,[4] Stephen R. Zubrick,[4] John P. Newnham,[6] Fiona J. Stanley,[1] and Eugen Mattes[1]

[1]Telethon Institute for Child Health Research, Centre for Child Health Research, The University of Western Australia, Perth, Australia; [2]School of Psychology, The University of Western Australia, Perth, Australia; [3]School of Public Health, Curtin University of Technology, Perth, Australia; [4]Centre for Developmental Health, Curtin University of Technology, Perth, Australia; [5]School of Nursing and Midwifery, Curtin University of Technology, Perth, Australia; [6]School of Women's and Infants' Health, The University of Western Australia at King Edward Memorial Hospital, Perth, Australia

Background: Methodological challenges such as confounding have made the study of the early determinants of mental health morbidity problematic. This study aims to address these challenges in investigating antenatal, perinatal and postnatal risk factors for the development of mental health problems in pre-school children in a cohort of Western Australian children. **Methods:** The Raine Study is a prospective cohort study of 2,868 live born children involving 2,979 pregnant women recruited at 18 weeks gestation. Children were followed up at age two and five years. The Child Behaviour Checklist (CBCL) was used to measure child mental health with clinical cut-points, including internalising (withdrawn/depressed) and externalising (aggressive/destructive) behaviours (n = 1707). **Results:** Multinomial logistic regression analysis showed that the significant risk factors for behaviour problems at age two were the maternal experience of multiple stress events in pregnancy (OR = 1.20, 95% CI = 1.06, 1.37), smoking during pregnancy (OR = 1.30, 95% CI = 1.06, 1.59) and maternal ethnicity (OR = 3.34, 95% CI = 1.61, 6.96). At age five the experience of multiple stress events (OR = 1.17, 95% CI = 1.08, 1.27), cigarette smoking (OR = 1.19, 95% CI = 1.03, 1.37), male gender (OR = 1.43, 95% CI = 1.02, 2.00), breastfeeding for a shorter time (OR = .97, 95% CI = .94, .99) and multiple baby blues symptoms (OR = 1.08, 95% CI = 1.02, 1.14) were significant predictors of mental health problems. **Conclusions:** Early childhood mental health is significantly affected by prenatal events in addition to the child's later environment. Interventions targeting adverse prenatal, perinatal and postnatal influences can be expected to improve mental health outcomes for children in the early years. **Keywords:** Mental health, pre-school children, behavioural development, Raine Study, CBCL.

The World Health Organization (WHO) estimates a worldwide prevalence of mental health morbidity in children and adolescents of approximately 20% and identifies mental health in the early years as a key target for intervention strategies (World Health Organization, 2001). It is well established that mental health in early childhood has a significant influence on subsequent mental health outcomes (Preski & Walker, 1997). Poor mental health in early childhood also has a negative impact on the child's physical health and school achievements (Sawyer et al., 2001). Therefore the early risk factors associated with mental health morbidity in pre-school children is a vital area of empirical enquiry both in its own right and as a prerequisite for the development of effective preventions to improve mental health in children and adults.

There is growing evidence that prenatal experiences can influence later psychological outcomes (Pennington, 2002). The pregnancy and postpartum periods have been recognised in relation to risk factors on the causal pathways for serious mental illnesses such as schizophrenia; however, these findings are complicated by methodological difficulties (Geddes & Lawrie, 1995; Kessler, 2000; Susser, Brown, & Matte, 1999). Geddes and Lawrie (1995) found in their meta-analysis that obstetric complications are potentially responsible for a two-fold increase in the later development of early-onset schizophrenia, although the authors do note possible sampling bias in existing research. Susser and colleagues (1999) also reviewed the literature linking prenatal insults with the later development of schizophrenia and noted that the study of the early determinants of mental health is potentially riddled with methodological challenges, such as confounding bias and crude measures of exposures.

There has been a lesser focus on the early determinants of adverse behavioural outcomes in children and young adults, and such research is not immune from these same methodological conundrums. Limited associations were found in a previous prospective pregnancy study that examined a variety of pre- and perinatal risk factors and child behaviour at age five (O'Callaghan, Williams, Andersen, Bor, & Najman, 1997). The authors observed that only male gender, more antenatal admissions and cigarette smoking during pregnancy

Conflict of interest statement: No conflicts declared.

Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA

were significant predictors of either externalising or internalising behaviour in the adjusted analysis; however, the use of a modified measure of child behaviour may have influenced the absence of further significant associations. Another study reviewed pre- and perinatal risk factors for child behavioural problems, specifically attention deficit hyperactivity disorder (ADHD); however, the authors of this study predominantly looked at the effects of prenatal maternal substance use and stress and did not include other types of child behavioural problems (Linnet et al., 2003). Some relevant research has used retrospective data collection. Allen, Lewinsohn, and Seeley (1998) conducted a comprehensive analysis and presented some striking findings as to the role of adverse pre- and perinatal events, such as prenatal stress and premature birth, and the development of psychopathology in adolescence. However, the analysis is based on the maternal retrospective recall of events that occurred between 14 and 18 years previously and hence the reliability of the results is called into question (Allen et al., 1998).

Putting such methodological issues aside, it is clear from the existing research that there are specific negative behavioural sequelae associated with specific pre- and perinatal events such as maternal characteristics (Fergusson & Woodward, 1999), socioeconomic hardship (Duncan, Brooks-Gunn, & Klebanov, 1994), stress experience (Rice, Jones, & Thapar, 2007), obstetric complications (O'Callaghan et al., 1997), and cigarette smoking (Martin, Dombrowski, Mullis, Wisenbaker, & Huttunen, 2006). It is also clear that risk factors for child behaviour problems, such as those listed above, do not exist within a vacuum but rather exert their influence from within a complex network of biological, socioeconomic and psychological influences.

Given the importance of these methodological considerations, it is essential to unpack the relationships between antenatal, perinatal and postnatal risk and later mental health outcomes through complex analysis of a longitudinal nature (Angold & Egger, 2007; Kessler, 2000). What is currently lacking is a comprehensive analysis that takes into account the multiple risk factors for behavioural problems in early childhood and analyses these multiple factors together within a prospective pregnancy cohort to gain a better understanding of which factors are of particular importance in terms of the development of psychopathology.

In this study we aim to prospectively examine a comprehensive range of antenatal, perinatal and postnatal risk factors and their impact on problem behaviours in early childhood using complete behavioural data from the Western Australian Pregnancy Cohort (Raine) Study. This analysis is an improvement on previous research outlined above by using prospectively collected data from a large population-based sample, analysing a multitude of factors together to minimise confounding bias, and using a valid and reliable measure of child behaviour, the Child Behaviour Checklist (Achenbach, 1991). Understanding the influence of early determinants can inform the appropriate targeting of resources, especially during pregnancy, and the development of effective clinical interventions to assist in lessening the social, emotional and economic burden of child mental health problems.

Method

Study population

The study is based on data from the Western Australian Pregnancy Cohort Study, commonly known as the Raine Study. The Raine Study is a longitudinal study following women who were recruited at or around 18 weeks gestation (n = 2979) through the public antenatal clinic at King Edward Memorial Hospital (KEMH) and nearby private clinics in Perth, Western Australia, from May 1989 through to November 1991. The enrolment methods are reported elsewhere (Newnham, Evans, Michael, Stanley, & Landau, 1993). Briefly, to be eligible for enrolment, the women were required to have a gestation of between 16 and 20 weeks, sufficient English language skills, an expectation to deliver at KEMH, and an intention to reside in Western Australia to allow for future follow-up of their child. At birth, a total of 2,868 live born children (96%) were available for follow-up. All follow-ups of the study families were approved by the Human Ethics Committee at KEMH and/or Princess Margaret Hospital for Children in Perth.

Measures – Child Behaviour Checklist (CBCL)

Child mental health was measured at age two by the Child Behaviour Checklist for Ages 2–3 (CBCL/2–3). The CBCL/2–3 is a 99-item, empirically validated measure of child behaviour by parent report (Achenbach, Edelbrock, & Howell, 1987). At age five the children were assessed using the CBCL for Ages 4–18 (CBCL/4–18). The CBCL/4–18 is a 118-item commonly used dimensional measure of child behaviour during the previous six months and shows good internal reliability and validity in a number of population settings (Achenbach, 1991; Achenbach & McConaughy, 1997). A clinical calibration with Australian children demonstrated moderately high sensitivity (83% overall) and specificity (67% overall) to a clinical diagnosis, and good test–retest reliability (Zubrick et al., 1997). The three year predictive validity of the CBCL/2–3 for CBCL/4–18 outcomes across both sexes is r = .49, indicating good predictive power (Achenbach et al., 1987).

Both the CBCL/2–3 and CBCL/4–18 produce a *T*-score for total behaviour, in addition to apportioning factors into clinical domains and internalising and externalising behaviour sub-scales (Achenbach, 1991). The withdrawal, somatic and anxious/depressed domains are grouped together to determine a total score for *internalising* behaviours, which are associated with depression, anxiety, and withdrawal (Achenbach & McConaughy, 1997). The domains of delinquency and

aggression are grouped to determine a score for *externalising* behaviours, which are implicated in the psychopathology of mental health disorders such as attention deficit hyperactivity disorder (ADHD) and conduct disorder (Achenbach & McConaughy, 1997).

As recommended by the CBCL manual, we applied clinical cut-off scores to the total CBCL *T*-scores to obtain a binary variable indicative of overall mental health morbidity, and internalising and externalising morbidity (Achenbach, 1991; Drotar, Stein, & Perrin, 1995). We chose to use clinical cut-point variables rather than continuous scores as we were examining the development of mental health problems and therefore required a clinical point of definition for morbidity. In this study, a *T*-score of greater than 60 indicated mental health morbidity, consistent with CBCL norms (Achenbach & McConaughy, 1997). A variable with four levels was created to indicate the presence of mental health morbidity at age two only, age five only, and both age two and age five as an indicator of ongoing problems in comparison with the non-clinical sample.

Explanatory variables

Antenatal determinants. A number of sociodemographic influences in the antenatal period were examined, including maternal age at conception, maternal education, maternal ethnicity and maternal psychiatric history. Maternal education at the time of birth was included as a continuous variable representing the highest completed year of secondary education. Maternal ethnicity was originally recorded in the dataset as Caucasian, Aboriginal, or other (9%), which predominantly consisted of Asian mothers. Aboriginal mothers (2.2% of cohort) were excluded from the analysis due to missing CBCL data. Maternal psychiatric history (2.4% of the cohort) was also not included in the model for the same reason.

We examined maternal smoking during pregnancy with a continuous variable representing increasing cigarettes smoked per day, measured at approximately 18 weeks gestation. Preliminary analysis showed that the number of cigarettes smoked per day by 34 weeks gestation was strongly correlated with the number of cigarettes smoked at 18 weeks gestation ($r = .866$, $p < .001$). We therefore used the amount of cigarettes smoked at 18 weeks gestation to represent smoking frequency during pregnancy. Data on alcohol consumption during pregnancy was also collected at 18 and 34 weeks gestation.

Total family income during pregnancy and the presence of the child's biological father in the family home during pregnancy (yes or no) were also considered. Family income was dichotomised according to minimum household income levels, or the 'poverty line' (less than $24,000 per annum compared with $24,000 per annum or greater), defined by the Australian government and utilised in similar population studies (Sawyer et al., 2001).

Mothers were asked at 18 weeks and 34 weeks gestation whether or not they had experienced any of 10 major life stress events selected from the 67-item life stress inventory developed by Tennant and Andrews (1976). These were: pregnancy problems, death of a close friend or relative, separation or divorce, marital problems, problems with children, job loss (involuntary), partner's job loss (involuntary), money problems, residential move or other stressful event. The question on the 18 weeks gestation questionnaire asked whether any of the events had been experienced since becoming pregnant and, on the 34 weeks gestation questionnaire, whether any of the events had been experienced within the last four months, ensuring that the same event was not counted twice. We examined the number of stress events experienced at 18 weeks and 34 weeks gestation and given their near identical impact on mental health morbidity we created a variable representing the cumulative number of stressful events experienced since becoming pregnant.

Perinatal determinants. We examined gestational age at birth in weeks as a continuous variable. The gender of the child (male or female) was also included in our model, in addition to how many siblings the child had at the time of birth (continuous). Apgar scores five minutes after birth were collected.

Postnatal determinants. Breastfeeding was examined as a continuous variable representing the total duration of breastfeeding in months after collating information from the feeding questionnaire at ages one, two and three. Postpartum mood disturbance was measured using an index of 16 postnatal feelings on the Blues Questionnaire, completed by mothers after birth and while still in hospital. These 16 items were a summation of the 22 items on the Blues Scale developed by Kennerley and Gath (1989), a robust and valid measure of 'baby blues' symptoms immediately postpartum (Henshaw, 2003). The number of blues feelings was included as a continuous variable because previous research has shown that women experiencing higher levels of 'baby blues' symptoms in the first days after birth are more likely to develop postnatal depression later (Henshaw, Foreman, & Cox, 2004).

Procedure

Informed consent to participate in the study was obtained from the mother of each child at every follow-up. Data regarding social, economic, and demographic characteristics and the experience of life stress events were collected at enrolment (18 weeks gestation) and at 34 weeks gestation. Perinatal data were collected at birth, 'baby blues' symptoms in hospital shortly after birth, and infant feeding information was collected at one, two and three years of age. The study children and their families were followed-up at two and five years of age by questionnaire, which included sociodemographic and behavioural information.

The aim of the follow-ups was to collect data as close as possible to the intended age, although the range of ages being examined increased as the study continued. All cohort studies have problems from loss to follow-up although the attrition rate in our study was likely to be non-random. At age two, 69% children participated in the follow-up (*M* age = 26 months, *SD* = 1.9) while 76% participated at age five (*M* age = 71 months, *SD* = 2.6). Teenage and young mothers, those who did not live with the child's biological father at birth, those who experienced high levels of stress and those whose child had a

lower gestational age were less likely to remain in the study at two and five years, potentially having an effect on our observed results (Li et al., 2008). However, given that the initial cohort over-represented socially-disadvantaged women, this loss to follow-up reduces the bias and may have increased the generalisability of the study.

Statistical analysis

Correlations between risk factors were calculated [see addendum] and frequency data analysed (Table 1). Univariate multinomial logistic regression analysis was initially performed to determine the relationships between explanatory variables and total mental health morbidity (Table 2), and internalising and externalising problems (not presented). The four-tiered nominal outcome was 'no mental health morbidity' and morbidity at age two only, age five only, and at both ages (all odds ratios have the children with 'no mental health morbidity' as the denominator). The preliminary univariate analysis showed no relationship between alcohol consumption in pregnancy or Apgar scores measured five minutes after birth and the CBCL outcomes, therefore these variables were not included. All explanatory variables were then block entered into a multivariable multinomial logistic regression model for total behavioural morbidity (Table 3) and internalising and externalising morbidity (Table 4). We tested for two-way interaction effects between the variables that were shown to be the most significant in the multinomial logistic regression analysis; however, there were no more significant results than would be expected by chance and therefore these interactions were not included in the final model. We used SPSS Version 15.0 in our data analysis (SPSS Inc., 2006).

Results

Prevalence

The frequency distributions of the outcome and explanatory variables are presented in Table 1 by continuous and categorical status. Eleven and a half percent of two-year-old children had CBCL *T*-scores above the clinical cut-point for total behavioural morbidity, while 20% of five-year-old children had CBCL *T*-scores above the clinical cut-point. Over 6% had a clinically significant *T*-score (≥60) at both ages, so 5% of two-year-olds and 14% of five-year-olds had one episode of morbidity (Table 1). Externalising problems were relatively more common than internalising problems at age two and at both ages, while internalising problems were more common at age five. The mean maternal age at conception was 28 years (*SD* = 5.65), and 38% of mothers had left secondary education by the completion of year 10. Almost 9% of mothers were of other ethnicity than Caucasian or Aboriginal, and 23% smoked at least one cigarette per day during pregnancy. In our cohort 27% of mothers had a total family income below the poverty line, 10% of mothers did not live with the biological father of their child, and the mean number of stress events experienced in pregnancy was two (*SD* = 1.97). The mean gestational age in weeks was 39 (*SD* = 2.09), and 52% of children born were male. In our cohort 49% of births were firstborn children, the mean length of breastfeeding was eight months (*SD* = 7.06), and the average number of 'baby blues' symptoms experienced in the immediate postpartum was three (*SD* = 2.98).

Table 1 Frequency characteristics for the cohort

Continuous variables	*N*	*M*	*SD*
Maternal Age at Conception*	1701		
years		28.41	5.65
Stress Events in Pregnancy†	1578		
number of events		2.08	1.97
Gestational Age[a]	1703		
weeks		38.84	2.09
Breastfeeding Duration[μ]	1661		
months		7.89	7.06
'Baby blues'[±]	1466		
number of blues symptoms		2.94	2.98
Maternal Education*	1702		
highest school year		10.98	1.06
Categorical variables	**N**	**n**	**%**
CBCL Year 2 Morbidity Only	1707		
Total		88	5.2
Internalising		77	4.5
Externalising		118	6.9
CBCL Year 5 Morbidity Only	1707		
Total		233	13.6
Internalising		240	14.1
Externalising		221	12.9
CBCL Year 2 & 5 Morbidity Combined	1707		
Total		107	6.3
Internalising		57	3.3
Externalising		113	6.6
Maternal Ethnicity*	1706		
other		147	8.6
Gender of Child[a]	1703		
male		889	52.2
female		814	47.8
Smoking in Pregnancy*,[b]	1707		
none		1322	77.4
1–10 daily		228	13.4
11–20 daily		132	7.7
21 +daily		25	1.5
Low Family Income in Pregnancy*	1631		
<$24,000 per annum		437	26.8
Father Living with Family*	1706		
no		163	9.6
Number of siblings[a,b]	1707		
none		835	48.9
1		516	30.2
2		262	15.4
3+		94	5.5

Missing cases not included in analysis unless stated otherwise, valid percentages used.
*Measured at 18 weeks gestation.
†Measured at 18 and 34 weeks gestation.
μMeasured at age one, two and three years.
±Measured in hospital in days immediately following birth.
[a]Measured at birth.
[b]Included in regression analyses as continuous variable.

Table 2 Univariate multinomial logistic regression analysis

Variables	Morbidity Year 2 Only OR# (95% CI)	Morbidity Year 5 Only OR# (95% CI)	Morbidity Year 2 & Year 5 OR# (95% CI)
Antenatal determinants			
Maternal Age at Conception (years)	.93** (.90, .97)	.95** (.92, .97)	.93** (.90, .96)
Maternal Education (highest school year)	.77* (.63, .94)	.89 (.78, 1.02)	.73** (.61, .88)
Maternal Ethnicity (other)	2.54** (1.42, 4.51)	.84 (.49, 1.45)	1.56 (.84, 2.87)
Smoking in Pregnancy (cigarettes per day)	1.30** (1.18, 1.52)	1.23** (1.10, 1.37)	1.19* (1.02, 1.39)
Low Family Income in Pregnancy (<$24,000pa)	2.00** (1.27, 3.16)	1.67** (1.23, 2.26)	3.65** (2.42, 5.51)
Father Living with Family (no)	1.68 (.84, 3.35)	2.62** (1.75, 3.92)	4.53** (2.81, 7.31)
Stress Events in Pregnancy (number of events)	1.23** (1.11, 1.37)	1.23** (1.15, 1.32)	1.41** (1.29, 1.55)
Perinatal determinants			
Gestational Age (weeks)	.96 (.88, 1.06)	1.04 (.97, 1.12)	.89** (.83, .96)
Gender of Child (male)	1.60* (1.03, 2.48)	1.26 (.95, 1.67)	1.18 (.80, 1.75)
Number of siblings (total at birth)	.86 (.68, 1.09)	.82* (.70, .95)	.69** (.54, .89)
Postnatal determinants			
Breastfeeding Duration (months)	.97 (.94, 1.01)	.96** (.94, .98)	.96* (.90, .99)
'Baby blues' (number of symptoms)	1.05 (.97, 1.14)	1.08** (1.03, 1.14)	1.20** (1.13, 1.28)

* significant at .05 level.
** significant at .005 level.
# odds ratio and 95% confidence intervals.

Table 3 Multivariable multinomial logistic regression analysis

Variables	Morbidity Year 2 Only OR# (95% CI)	Morbidity Year 5 Only OR# (95% CI)	Morbidity Year 2 & Year 5 OR# (95% CI)
Antenatal determinants			
Maternal Age at Conception (years)	.95 (.90–1.01)	.98 (.95–1.02)	.97 (.92–1.02)
Maternal Education (highest school year)	.94 (.72–1.23)	1.05 (.88, 1.25)	1.06 (.80–1.39)
Maternal Ethnicity (other)	3.34** (1.61–6.96)	.97 (.51–1.86)	1.98 (.90–4.40)
Smoking in Pregnancy (cigarettes per day)	1.30* (1.06–1.59)	1.19* (1.03–1.37)	1.02 (.82–1.27)
Low Family Income in Pregnancy (<$24,000pa)	1.64 (.89–2.99)	1.12 (.74–1.70)	2.68** (1.47–4.88)
Father Living with Family (no)	.64 (.23–1.78)	1.61 (.89–2.89)	2.07 (1.20–5.13)
Stress Events in Pregnancy (number of events)	1.20** (1.06–1.37)	1.17** (1.08–1.27)	1.29** (1.15–1.45)
Perinatal determinants			
Gestational Age (weeks)	.89 (.77–1.03)	1.03 (.93–1.14)	.82** (.72–.94)
Gender of Child (male)	1.59 (.93–2.70)	1.43* (1.02–1.2.00)	.90 (.54–1.50)
Number of siblings (total at birth)	.88 (.65, 1.19)	.91 (.75, 1.10)	.69* (.50, .97)
Postnatal determinants			
Breastfeeding Duration (months)	.99 (.95–1.03)	.97* (.94–.99)	1.00 (.96–1.04)
'Baby blues' (number of symptoms)	.98 (.90–1.08)	1.08** (1.02–1.14)	1.15** (1.06–1.23)

* significant at .05 level.
** significant at .005 level.
# odds ratio and 95% confidence intervals.

Multinomial logistic regression analysis

Antenatal determinants. A younger maternal age (years) was significantly associated with an increase in child mental health morbidity in all outcome categories in the univariate analysis (Table 2). However, these results were not significant in the adjusted analysis (Table 3) except for externalising behaviour (Table 4) at age two (OR = .95, $p < .05$). Similarly, the univariate relationship between increasing years of maternal secondary education and fewer behavioural problems was no longer significant in the multivariable analysis for any of the behavioural outcomes. Mothers from non-Caucasian backgrounds showed a strong relationship with mental health morbidity at age two in the univariate regression analysis (OR = 2.54, $p < .005$), and this odds ratio increased in the adjusted analysis (OR = 3.34, $p < .005$), and was significant for internalising behaviours rather than externalising behaviours. Increasing numbers of cigarettes smoked per day during pregnancy was significantly predictive of mental health morbidity for all outcomes in the unadjusted results, and was significant at age two (OR = 1.30, $p < .05$) and age five years (OR = 1.19, $p < .05$) in the multivariable results for total behaviour, for both internalising and externalising behaviour at age two years, and externalising behaviour only at age five years. A family income below the poverty line during pregnancy was strongly linked with the development of child mental health problems in the univariate analysis; however, it was significant for total behavioural morbidity only at both ages in the multivariable results (OR = 2.68,

Table 4 Multivariable multinomial logistic regression analysis – internalising and externalising morbidity

Variables	Internalising Morbidity			Externalising Morbidity		
	Morbidity Year 2 Only OR# (95% CI)	Morbidity Year 5 Only OR# (95% CI)	Morbidity Year 2 & Year 5 OR# (95% CI)	Morbidity Year 2 Only OR# (95% CI)	Morbidity Year 5 Only OR# (95% CI)	Morbidity Year 2 & Year5 OR# (95% CI)
Antenatal determinants						
Maternal Age at Conception (years)	.96 (.90, 1.02)	1.01 (.97, 1.04)	.99 (.93, 1.06)	.95* (.91–.99)	.97 (.93–1.00)	.95* (.90–1.00)
Maternal Education (highest school year)	.85 (.63, 1.14)	1.10 (.92, 1.32)	.73 (.53, 1.02)	1.08 (.85–1.37)	.92 (.77–1.10)	.91 (.70–1.18)
Maternal Ethnicity (other)	2.55* (1.06, 6.14)	1.05 (.57, 1.93)	4.47** (1.97, 1.18)	1.78 (.88–3.58)	.84 (.42–1.69)	.98 (.37–2.58)
Smoking in Pregnancy (cigarettes per day)	1.26* (1.02, 1.55)	.97 (.83, 1.14)	1.03 (.77, 1.38)	1.23* (1.02–1.49)	1.34** (1.17–1.54)	1.07 (.87–1.31)
Low Family Income in Pregnancy (<$24,000pa)	2.43* (1.26, 4.68)	1.21 (.79, 1.84)	2.10 (.98–4.51)	2.09** (1.28–3.43)	1.32 (.86, 2.02)	1.87* (1.05–3.33)
Father Living with Family (no)	.90 (.35, 2.31)	1.83* (1.04, 3.23)	.53 (.14–2.05)	.56 (.22–1.41)	.94 (.49–1.78)	1.84 (.91–3.72)
Stress Events in Pregnancy (number of events)	1.08 (.94, 1.24)	1.15** (1.06, 1.25)	1.16 (.99–1.35)	1.11 (.99–1.24)	1.08 (.98–1.18)	1.23** (1.10–1.38)
Perinatal determinants						
Gestational Age (weeks)	.93 (.79, 1.10)	.99 (.90, 1.09)	.88 (.74–1.04)	.94 (.82–1.08)	1.02 (.92–1.14)	.84** (.74–.95)
Gender of Child (male)	1.08 (.61, 1.92)	1.81** (1.29, 2.54)	.68 (.35–1.34)	1.60* (1.01–2.54)	1.29 (.91–1.82)	1.14 (.70–1.87)
Number of siblings (total at birth)	.79 (.56, 1.12)	.77* (.63, .95)	.75 (.50, 1.11)	.97 (.75, 1.25)	.87 (.71, 1.07)	.85 (.63, 1.14)
Postnatal determinants						
Breastfeeding Duration (months)	1.02 (.98, 1.06)	.98 (.96, 1.01)	1.04 (.99–1.08)	.98 (.94–1.01)	1.00 (.98–1.03)	.98 (.94–1.02)
'Baby blues' (number of symptoms)	1.04 (.95, 1.15)	1.09** (1.03, 1.14)	1.20** (1.10–1.32)	1.00 (.92–1.08)	1.05 (1.00–1.11)	1.08* (1.00–1.16)

*significant at .05 level, **significant at .005 level, #odds ratio and 95% confidence intervals.

$p < .005$). A low family income was predictive of internalising morbidity at two years (OR = 2.43, $p < .05$) and externalising morbidity at two years (OR = 2.09, $p < .005$) and at both ages combined (OR = 1.87, $p < .05$). The absence of the biological father in the family home showed some relationships with total behavioural morbidity in the univariate results, though was significant only for internalising morbidity at age five in the adjusted analysis. Increasing numbers of stressful events experienced during pregnancy was significantly predictive of mental health morbidity at age two (OR = 1.20, $p < .005$), age five (OR = 1.17, $p < .005$), and at both ages (OR = 1.29, $p < .005$) in both the adjusted analysis (reported) and the unadjusted analysis. More stress experience was associated with internalising morbidity at age five years (OR = 1.15, $p < .005$), and externalising morbidity at both ages two and five years (OR = 1.23, $p < .005$).

Perinatal determinants. Within the perinatal period, a low gestational age in weeks at birth was a significant risk factor for total behavioural morbidity at both ages two and five years prior to (OR = .89, $p < .005$) and following inclusion in the multivariable model (OR = .82, $p < .005$). The analysis of internalising and externalising outcomes showed that lower gestational age at birth was associated with externalising problems rather than internalising problems. Male children were more likely to show clinically significant overall behaviour at age two in the univariate analysis (OR = 1.60, $p < .05$), and at age five in the multivariable model (OR = 1.43, $p < .05$). Male children also had clinically significant internalising behaviour at age five years (OR = 1.81, $p < .005$) and externalising behaviour at age two years (OR = 1.60, $p < .05$). The more siblings in the family at birth, the less likely a child was to exhibit behavioural problems at age five and at both ages in the univariate analysis, while this result existed only for the both ages category in the adjusted model (OR = .69, $p < .05$). Having more siblings was protective for internalising morbidity at age five (OR = .77, $p < .05$).

Postnatal determinants. A longer duration of breastfeeding (in months) was significantly related to fewer child mental health problems at age five (OR = .96, $p < .005$) and at both ages (OR = .96, $p < .05$) in the unadjusted results. When breastfeeding length was included in the multivariate analysis, it remained protective for child mental health problems at age five only (OR = .97, $p < .05$) and was not significant for internalising or externalising behaviour. An increasing number of 'baby blues' symptoms in the immediate postpartum was a risk factor for child mental health morbidity at age five (OR = 1.08, $p < .005$) and at both ages (OR = 1.15, $p < .005$) for both the adjusted (reported) and unadjusted analysis. More 'baby blues' symptoms

were also predictive of increased internalising morbidity at age five (OR = 1.09, $p < .005$) and both ages (OR = 1.20, $p < .005$) and externalising morbidity at age five only (OR = 1.08, $p < .05$).

Discussion

Our study aimed to comprehensively examine the antenatal, perinatal and postnatal determinants of mental health morbidity in the pre-school years. In this analysis we have looked at multiple risk factors for mental health morbidity in one model to minimise the effects of confounding bias that have limited previous research. We have also used an empirically validated outcome measure to examine child mental health, and we have conducted our analyses within a large prospective pregnancy cohort to enhance the reliability of the findings and eliminate problems associated with retrospective recall.

In all three outcome categories the experience of multiple stress events in pregnancy was predictive of a clinically significant *T*-score for total behaviour after adjustment for multiple other risk factors, and the effects were equally balanced across internalising and externalising sub-scales. This finding supports the link between stress experience in pregnancy and fetal neuro-development that has been previously found (Rice et al., 2007; Wadhwa et al., 2001), but adds to the literature in revealing that the strength of this relationship persists even in the light of other major influences on child mental health morbidity. Clearly this factor is of great significance in establishing the epidemiology of behavioural morbidity in early childhood. One hypothesis suggests that this relationship is mediated by premature exposure to cortisol, which may prepare the fetus for a world the mother perceives as difficult and hence inattention and externalising behaviour may represent the child's behavioural adaptation to a stressful world (Crowther et al., 2007; French, Hagan, Evans, Mullan, & Newnham, 2004). Reporting a greater incidence of stress may also reflect maternal mental health status. The Avon Longitudinal Study of Parents and Children (ALSPAC), a large-scale prospective cohort study, examined the influence of clinically significant maternal anxiety during pregnancy on child mental health outcomes at age four and found a significant relationship between high levels of prenatal anxiety and poorer mental health outcomes in the early years (O'Connor, Heron, Golding, Beveridge, & Glover, 2002).

Maternal smoking during pregnancy was a significant risk factor for later child behavioural problems at age two and at age five, in particular externalising behaviour which is consistent with the existing literature (Button, Maughan, & McGuffin, 2007; Maughan, Taylor, Caspi, & Moffitt, 2004). In terms of general health outcomes, prenatal smoking may be the single most preventable cause of child health problems (Logan & Spencer, 1996). Smoking behaviours are closely linked with sociodemographic status, including low income, and have been suspected as a proximal risk factor reflecting the larger influence of socioeconomic status on mental health outcomes (Logan & Spencer, 1996). However, we did not find significant interaction effects in our study for antenatal maternal smoking, indicating that smoking is not primarily influencing child mental health status in a proxy capacity. As recently noted by Button et al. (2007), it is clear that a direct influence is present between smoking in pregnancy and psychological problems, but what remains unknown is the mechanism through which this influence operates.

Maternal ethnicity (non-Caucasian) was significantly associated with overall child mental health at age two in the adjusted analysis, in particular for internalising problems where significant odds ratios were evident at age two and at both ages two and five. This may reflect the barriers faced by women from minority ethnic groups in accessing support for preschool children. Mothers from culturally and linguistically diverse backgrounds also face barriers other than socioeconomic resources, such as language, lack of social capital and discrimination, and these factors in turn may affect child mental wellbeing in the early years (Wen, 2007). The majority of the sample of 'other' ethnicity was comprised by Asian mothers and previous research has found that Asian populations are usually *less* likely to experience the same disparities related to child outcomes as other ethnic groups, though our finding would suggest that some difficulties or disparities do indeed exist (Wen, 2007).

For the remaining antenatal risk factors, we found a number of significant results. Early childhood has been identified as the developmental stage where family income has the greatest effect on child development (Duncan & Brooks-Gunn, 2000). Our study showed that economic hardship in pregnancy was a strong predictor of total mental health morbidity at both ages two and five, and also had a significant effect on internalising behaviour at age two and externalising behaviour at age two and at both ages. A younger maternal age was a significant predictor of externalising morbidity at age two and at both ages two and five; however, maternal age was not significant in the multivariable model. The correlations between maternal age and other variables are likely to explain this result, with maternal age significantly correlated with all other variables except the gender of the child.

We saw a protective effect of increasing years of high school education experienced by the mother; however, this disappeared probably due to co-action of other predictors such as stress, smoking and low income. Specifically, the absence of the biological father in the family home in pregnancy was predictive of internalising morbidity at age five in the

adjusted analysis, though not significant in the adjusted models for overall behaviour. It is suggested that being a single parent is associated with poorer child mental health outcomes and that the younger a child is when their parents separate, the worse the mental health outcome – with children whose parents have been separated since birth or before to be at the greatest risk (Clarke-Stewart, Vandell, McCartney, Owen, & Booth, 2000). However, numerous factors, such as antisocial behaviour of the father, mediate this relationship (see Jaffee, Moffitt, Caspi, & Taylor, 2003) and may be responsible for the opposing directions of effect seen in the multivariable model.

Three perinatal risk factors were explored within this study. A lower gestational age in weeks at birth was predictive of the continuity of mental health morbidity in early childhood, particularly externalising morbidity, at ages two and five and is congruent with retrospective findings that children born preterm are more likely to experience early mental health morbidity (Zubrick et al., 2000). Our results show that babies of a younger gestational age at birth may face significant mental health challenges throughout the pre-school years in addition to known physical health challenges (Aday, 1994). In our study, male children showed more behavioural morbidity than female children, with significant results for overall behaviour and internalising behaviour at age five, and significantly more externalising behaviour at age two. Other studies have found male children to be more at risk of externalising behaviour than female children (Baillargeon et al., 2007; O'Callaghan et al., 1997), and it is thought that externalising behaviour in boys is more salient to mothers than in girls (Najman et al., 2001).

Having more siblings was related to better overall mental health status in our study at both ages two and five, and was significantly predictive of less internalising morbidity at age five only. The important role that siblings play in a child's social environment has been noted previously (Leventhal & Brooks-Gunn, 2000), and having siblings at the time of birth has been associated with externalising behaviour such as physical aggression (Tremblay et al., 2004). The results from this study show that having more siblings is protective for mental health status, although more so for internalising behaviour than for externalising behaviour.

Finally, we examined two risk factors from the postnatal period. Breastfeeding for a longer period showed a significant protective effect initially in the univariate analysis which remained for total behaviour *T*-scores above the clinical cut-point at age five only but otherwise was overshadowed by other sociodemographic risk factors.

The link between maternal depressive symptoms immediately postpartum and later child psychopathology has long been recognised (Phillips & O'Hara, 1991). We found the presence of multiple 'baby blues' symptoms in the immediate postnatal period to be highly predictive of persistent mental health morbidity in the pre-school years, and strongest with later internalising morbidity but still influential with externalising behaviour at both ages. This suggests that withdrawal and anxious/depressed symptomatology are the specific behavioural consequences of maternal postpartum blues. Given the positive association between multiple 'baby blues' symptoms and clinical postpartum depression (Henshaw et al., 2004), our findings suggest that early intervention with mothers experiencing multiple 'baby blues' symptoms may be a strategy to prevent the later development of mental health problems in offspring.

Strengths and limitations

The main strength of our study was the use of a large pregnancy cohort followed to age five years that provided information relating to a wide range of biomedical, sociodemographic and psychosocial factors collected from 18 weeks gestation and prospectively throughout early childhood, thus allowing for multiple risk factor analysis at several critical developmental stages. The large sample size enabled rigorous analysis and generalisability for other populations of mothers and children showing similar characteristics. Research on the risk factors associated with poor child mental health outcomes to date has predominantly been cross-sectional in nature, or based on retrospective recall of data, both potentially unreliable strategies that can dilute the potency of findings (Allen et al., 1998; Kraemer et al., 1997).

Our use of the CBCL, a well-established measure of mental health morbidity, is a particular strength of the study, as the CBCL has shown good internal consistency in the diagnosis of child psychopathology in many previous reports (Bird, Gould, Rubio-Stipec, & Staghezza, 1991). The CBCL was shown to be comparable to the DISC diagnostic schedule (based on DSM-III), suggesting that the CBCL is as good at identifying children with psychiatric morbidity as a time-consuming diagnostic interview (Jensen et al., 1996). Similar results have been found with Western Australian children (Zubrick et al., 1995). Thus the use of the CBCL allows our findings to be compared with those of other studies describing trajectories of childhood mental health problems and behavioural psychopathology.

The use of maternal self-report for the CBCL as our primary outcome measure has been validated (Warnick, Bracken, & Kasl, 2007), although child behaviour ratings may have been affected by the mother's own experience of stress and depressive symptomatology postnatally (Najman et al., 2001). Our use of mothers' ratings of 'baby blues' symptoms in the immediate postpartum period (within days) and measures of child behaviour at age two and age five make it problematic to presume any inverse

causal relationship between earlier maternal mood and later CBCL responses.

Conclusion

Our study addresses the major methodological problems experienced by previous research into the early determinants of mental health morbidity in early childhood. We have shown that particular risks present in the ante-, peri- and postnatal periods have a significant independent influence on preschool child mental health, particularly stress, smoking, low income in pregnancy and multiple 'baby blues' symptoms immediately after birth. Our study contributes to a more complete understanding of the extent to which early determinants account for the population prevalence and continuity of mental health morbidity, as well as their potential as targets for prevention.

Supporting information

Additional supporting information may be found in the online version of this article:

Table 1 Univariate multinomial logistic regression analysis of stress events at 18 and 34 weeks gestation and total morbidity

Table 2 Univariate multinomial logistic regression analysis of stress events at 18 and 34 weeks gestation and internalising and externalising morbidity

Table 3 Correlations between explanatory variables using Pearson's r

Table 4 Significant two-way interaction effects as a result of testing for interactions between explanatory variables in the multivariable model

Please note: Wiley-Blackwell are not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

Acknowledgements

The Western Australian Pregnancy Cohort Study is funded by the Raine Medical Research Foundation, the National Health and Medical Research Council (NHMRC) of Australia, the Telstra Foundation and the Western Australian Health Promotion Foundation. Dr W.H. Oddy is funded as an NHMRC Population Health Research Fellow. Dr E. Mattes was funded by an NHMRC General Practice Fellowship and a Capacity Building Grant in Population Health Research. We would like to acknowledge Peter Jacoby for statistical advice, the research assistants for their ongoing commitment to data collection, and the study families for their continuing participation in the study.

Correspondence to

Monique Robinson, Telethon Institute for Child Health Research, PO Box 855, West Perth, WA 6872 Australia; Tel: +61 8 9489 7913; Fax: +61 8 9489 7700; Email: moniquer@ichr.uwa.edu.au

References

Achenbach, T.M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 Profile*. Burlington: University of Vermont, Department of Psychiatry.

Achenbach, T.M., Edelbrock, C., & Howell, C.T. (1987). Empirically based assessment of the behavioural/emotional problems of 2- and 3-year-old children. *Journal of Abnormal Child Psychology*, *15*, 629–650.

Achenbach, T.M., & McConaughy, S.H. (1997). *Empirically based assessment of child and adolescent psychopathology* (2nd edn). Thousand Oaks, CA: Sage Publications.

Aday, L.A. (1994). Health status of vulnerable populations. *Annual Review of Public Health*, *15*, 487–509.

Allen, N.B., Lewinsohn, P.M., & Seeley, J.R. (1998). Prenatal and perinatal influences on risk for psychopathology in childhood and adolescence. *Development and Psychopathology*, *10*, 513–529.

Angold, A., & Egger, H.L. (2007). Preschool psychopathology: Lessons for the lifespan. *Journal of Child Psychology and Psychiatry*, *48*, 961–966.

Baillargeon, R.H., Normand, C.L., Séguin, J.R., Zoccolillo, M., Japel, C., Pérusse, D., et al. (2007). The evolution of problem and social competence behaviors during toddlerhood: A prospective population-based cohort survey. *Infant Mental Health Journal*, *28*, 12–38.

Bird, H.R., Gould, M.S., Rubio-Stipec, M., & Staghezza, B.M. (1991). Screening for childhood psychopathology in the community using the Child Behavior Checklist. *Journal of the American Academy of Child and Adolescent Psychiatry*, *30*, 116–123.

Button, T.M., Maughan, B., & McGuffin, P. (2007). The relationship of maternal smoking to psychological problems in the offspring. *Early Human Development*, *83*, 727–732.

Clarke-Stewart, K., Vandell, D.L., McCartney, K., Owen, M.T., & Booth, C. (2000). Effects of parental separation and divorce on very young children. *Journal of Family Psychology*, *14*, 304–326.

Crowther, C.A., Doyle, L.W., Haslam, R.R., Hiller, J.E., Harding, J.E., & Robinson, J.S. (2007). Outcomes at 2 years of age after repeat doses of antenatal corticosteroids. *New England Journal of Medicine*, *357*, 1179–1189.

Drotar, D., Stein, R.E., & Perrin, E.C. (1995). Methodological issues in using the Child Behavior Checklist and its related instruments in clinical child psychology research. *Journal of Clinical Child Psychology*, *24*, 184–192.

Duncan, G.J., & Brooks-Gunn, J. (2000). Family poverty, welfare reform, and child development. *Child Development*, *71*, 188–196.

Duncan, G.J., Brooks-Gunn, J., & Klebanov, P.K. (1994). Economic deprivation and early childhood development. *Child Development*, *65*, 296–318.

Fergusson, D., & Woodward, L. (1999). Maternal age and educational and psychosocial outcomes in early adulthood. *Journal of Child Psychology and Psychiatry*, *40*, 479–489.

French, N.P., Hagan, R., Evans, S.F., Mullan, A., & Newnham, J.P. (2004). Repeated antenatal corticosteroids: Effects on cerebral palsy and childhood behavior.[see comment]. *American Journal of Obstetrics and Gynecology*, *190*, 588–595.

Geddes, J.R., & Lawrie, S.M. (1995). Obstetric complications and schizophrenia: A meta-analysis. *British Journal of Psychiatry*, *167*, 786–793.

Henshaw, C. (2003). Mood disturbance in the early puerperium: A review. *Archives of Women's Mental Health*, *6*(Suppl. 2), s33–s42.

Henshaw, C., Foreman, D., & Cox, J. (2004). Postnatal blues: A risk factor for postnatal depression. *Journal of Psychosomatic Obstetrics and Gynecology*, *25*, 267–272.

Jaffee, S.R., Moffitt, T.E., Caspi, A., & Taylor, A. (2003). Life with (or without) father: The benefits of living with two biological parents depend on the father's antisocial behavior. *Child Development*, *74*, 109–126.

Jensen, P.S., Watanabe, H.K., Richters, J.E., Roper, M., Hibbs, E.D., Salzberg, A.D., et al. (1996). Scales, diagnoses, and child psychopathology: II. Comparing the CBCL and the DISC against external validators. *Journal of Abnormal Child Psychology*, *24*, 151–168.

Kennerley, H., & Gath, D. (1989). Maternity blues. I. Detection and measurement by questionnaire. *British Journal of Psychiatry*, *155*, 356–362.

Kessler, R.C. (2000). Psychiatric epidemiology: Selected recent advances and future directions. *Bulletin of the World Health Organization*, *78*, 464–474.

Kraemer, H.C., Kazdin, A.E., Offord, D.R., Kessler, R.C., Jensen, P.S., & Kupfer, D.J. (1997). Coming to terms with the terms of risk. *Archives of General Psychiatry*, *54*, 337–343.

Leventhal, T., & Brooks-Gunn, J. (2000). The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. *Psychological Bulletin*, *126*, 309–337.

Li, J., Kendall, G.E., Henderson, S., Downie, J., Landsborough, L., & Oddy, W.H. (2008). Maternal psychosocial wellbeing in pregnancy and breastfeeding duration. *Acta Paediatrica*, *97*, 221–225.

Linnet, K.M., Dalsgaard, S., Obel, C., Wisborg, K., Henriksen, T.B., Rodriquez, A., et al. (2003). Maternal lifestyle factors in pregnancy risk of attention deficit hyperactivity disorder and associated behaviors: review of the current evidence. *American Journal of Psychiatry*, *160*, 1028–1040.

Logan, S., & Spencer, N. (1996). Smoking and other health related behaviour in the social and environmental context. *Archives of Disease in Childhood*, *74*, 176–179.

Martin, R.P., Dombrowski, S.C., Mullis, C., Wisenbaker, J., & Huttunen, M.O. (2006). Smoking during pregnancy: Association with childhood temperament, behavior, and academic performance. *Journal of Pediatric Psychology*, *31*, 490–500.

Maughan, B., Taylor, A., Caspi, A., & Moffitt, T.E. (2004). Prenatal smoking and early childhood conduct problems: Testing genetic and environmental explanations of the association. *Archives of General Psychiatry*, *61*, 836–843.

Najman, J., Williams, G., Nikles, J., Spence, S., Bor, W., O'Callaghan, M., et al. (2001). Bias influencing maternal reports of child behaviour and emotional state. *Social Psychiatry and Psychiatric Epidemiology*, *36*, 186–194.

Newnham, J.P., Evans, S.F., Michael, C.A., Stanley, F.J., & Landau, L.I. (1993). Effects of frequent ultrasound during pregnancy: A randomised controlled trial. *Lancet*, *342*, 887–891.

O'Callaghan, M.J., Williams, G.M., Andersen, M.J., Bor, W., & Najman, J.M. (1997). Obstetric and perinatal factors as predictors of child behaviour at 5 years. *Journal of Paediatrics and Child Health*, *33*, 497–503.

O'Connor, T., Heron, J., Golding, J., Beveridge, M., & Glover, V. (2002). Maternal antenatal anxiety and children's behavioural/emotional problems at 4 years: Report from the Avon Longitudinal Study of Parents and Children. *British Journal of Psychiatry*, *180*, 502–508.

Pennington, B.F. (2002). *The development of psychopathology: Nature and nurture*. New York: The Guilford Press.

Phillips, L.H., & O'Hara, M.W. (1991). Prospective study of postpartum depression: 4½ year follow-up of women and children. *Journal of Abnormal Psychology*, *100*, 151–155.

Preski, S., & Walker, L.O. (1997). Contributions of maternal identity and lifestyle to young children's adjustment. *Research in Nursing & Health*, *20*, 107–117.

Rice, F., Jones, I., & Thapar, A. (2007). The impact of gestational stress and prenatal growth on emotional problems in offspring: A review. *Acta Psychiatrica Scandinavica*, *115*, 171–183.

Sawyer, M.G., Arney, F.M., Baghurst, P.A., Clark, J.J., Graetz, B.W., Kosky, R.J., et al. (2001). The mental health of young people in Australia: Key findings from the Child and Adolescent Component of the National Survey of Mental Health and Well-Being. *Australian and New Zealand Journal of Psychiatry*, *35*, 806–814.

SPSS Inc. (2006). *SPSS 15.0 for Windows*. Chicago.

Susser, E.B., Brown, A., & Matte, T.D. (1999). Prenatal factors and adult mental and physical health. *Canadian Journal of Psychiatry*, *44*, 326–334.

Tennant, C., & Andrews, G. (1976). A scale to measure the stress of life events. *Australian and New Zealand Journal of Psychiatry*, *10*, 27–32.

Tremblay, R.E., Nagin, D.S., Seguin, J.R., Zoccolillo, M., Zelazo, P.D., Boivin, M., et al. (2004). Physical aggression during early childhood: Trajectories and predictors. *Pediatrics*, *114*, E43–E50.

Wadhwa, P.D., Culhane, J.F., Rauh, V., Barve, S.S., Hogan, V., Sandman, C.A., et al. (2001). Stress, infection and preterm birth: A biobehavioural perspective. *Paediatric and Perinatal Epidemiology*, *15*(Suppl. 2), 17–29.

Warnick, E.M., Bracken, M.B., & Kasl, S. (2007). Screening efficiency of the Child Behavior Checklist and Strengths and Difficulties Questionnaire:

A systematic review. *Child and Adolescent Mental Health, Online Early Articles*.

Wen, M. (2007). Racial and ethnic differences in general health status and limiting health conditions among American children: Parental reports in the 1999 national survey of America's families. *Ethnicity and Health*, *12*, 401–422.

World Health Organization. (2001). *World health report: 2001: Mental health: New understanding, new hope*. Geneva: World Health Organization.

Zubrick, S., Kurinczuk, J., McDermott, B., McKelvey, R., Silburn, S., & Davies, L. (2000). Fetal growth and subsequent mental health problems in children aged 4 to 13 years. *Developmental Medicine and Child Neurology*, *42*, 14–20.

Zubrick, S., Silburn, S., Garton, A.F., Burton, P.R., Dalby, R., Carlton, J., et al. (1995). *Western Australian Child Health Survey: Developing health and well-being in the nineties. Perth*, Western Australia: Australian Bureau of Statistics and the Telethon Institute for Child Health Research (ISBN 0 642 20754 2).

Zubrick, S., Silburn, S., Gurrin, L., Teoh, H., Shepherd, C., Carlton, J., et al. (1997). *Western Australian Child Health Survey: Education, health and competence. Perth*, Western Australia: Australian Bureau of Statistics and the Telethon Institute for Child Health Research (ISBN 0 642 17239 0).

Manuscript accepted 14 April 2008