Abstract
The study aimed to use prospective longitudinal birth cohort data to examine the association between peer aggression at 14 years and mental health and substance use problems at 17 years. A sample of 1590 participants from the Western Australian Pregnancy Cohort (Raine) study were divided into mutually exclusive categories (victims, perpetrators, victim-perpetrators and uninvolved). Involvement in any type of peer aggression as a victim (10.1%), perpetrator (21.4%), or a victim-perpetrator (8.7%) was reported by 40.2% of the sample. Being a victim of peer aggression was associated with later depression and internalising symptoms whilst perpetrators of peer aggression were found to be at increased risk of later depression and harmful alcohol use. Victim-perpetrators of peer aggression were more likely to have externalising behaviours at 17 years. Having adjusted for mental health problems at 5 and mental health and substance use problems at 14 years of age, this suggests an independent relationship between peer aggression at 14 years and mental health and substance use problems at 17 years.

Keywords
Bullying; Peer aggression; outcome; adolescent; Raine Study; mental health; substance use.

Abbreviations
Western Australian Pregnancy Cohort (Raine) study, Child Behaviour Checklist (CBCL), Beck Depression Inventory for Youth (BDI-Y), Youth Self Report (YSR), Odds Ratio (OR), Confidence Interval (CI).
Adolescent peer aggression and its association with mental health and substance use in an Australian cohort

Peer aggression is a common sub-type of aggression in children and adolescents (Ybrandt & Armelius, 2010), most prevalent between the ages of 9 and 14 (Cross et al., 2009; Due, Holstein, & Soc, 2008). There are three main groups of participants in peer aggression; the victim, the perpetrator and a third group who are both the victim and the perpetrator (victim-perpetrator) (Austin & Joseph, 1996; Haynie et al., 2001; Veenstra et al., 2005). The estimated prevalence of peer aggression (victim or perpetrator) ranges from 5% to 35% with lower prevalence (3% -13%) for those in the victim-perpetrator group (Copeland, Wolke, Angold, & Costello, 2013; Craig et al., 2009; Cross et al., 2009; Due et al., 2008; Jansen et al., 2012; Solberg & Olweus, 2003; Sourander, Jensen, Rönning, et al., 2007b). The variation in prevalence has been linked to methodological differences in definition and measurement (Griffin & Gross, 2004; Shaw, Dooley, Cross, Zubrick, & Waters, 2013) with recent studies now incorporating cyber-aggression. Irrespective of this, it is clear that a large number of children and adolescents are involved in peer aggression.

Victims of peer aggression are more likely to have fewer close friends, and are at increased risk of mental health problems, particularly internalising symptoms which are characterised by an over control of emotion expressed through behaviours such as excessive worrying and social withdrawal (Achenbach & Edelbrock, 1978; Arseneault et al., 2006; Boulton & Underwood, 1992; Nansel et al., 2001; Zeman, Cassano, Perry-Parrish, & Stegall, 2006). It has been further demonstrated that victims of peer aggression are likely to display sub-assertive behaviour which may increase their likelihood of becoming victims of peer aggression, as perpetrators of peer aggression
perceive them as easy targets that are less likely to retaliate (Fekkes, Pijpers, Fredriks, Vogels, & Verloove-Vanhorick, 2006). Longitudinal studies have consistently found strong links between victims of peer aggression as a child or adolescent and later mental health problems including depression, anxiety, suicide ideation and suicide attempts (Copeland et al., 2013; Heikkilä et al., 2013; Hemphill et al., 2011; Klomek et al., 2008; Sourander, Jensen, Rönning, et al., 2007b; Ybrandt & Armelius, 2010). The association between being a victim of peer aggression and later substance abuse problems is less clear with some studies reporting that victims of peer aggression are less likely to drink alcohol later in life (Nansel et al., 2001) whereas others suggest that being a victim of peer aggression is associated with an increased risk of later harmful alcohol use (Goebert, Else, Matsu, Chung-Do, & Chang, 2011; Tharp-Taylor, Haviland, & D'Amico, 2009). Similarly some studies have shown an association between being a victim of peer aggression and later illicit drug and tobacco use (Goebert et al., 2011; Niemela et al., 2011; Tharp-Taylor et al., 2009), whereas others have found no association at all (Copeland et al., 2013; Hemphill et al., 2011; Sourander, Jensen, Rönning, et al., 2007b).

Perpetrators of peer aggression have been consistently found to be at increased risk of mental health problems particularly externalising behaviours which are characterised by an under control of emotions and are displayed through acts such as impulsivity, defiance, swearing and aggression towards others (Achenbach & Edelbrock, 1978; Kim, Leventhal, Koh, Hubbard, & Boyce, 2006; Sourander et al., 2010; Van der Wal, De Wit, & Hirsing, 2003; Veenstra et al., 2005). Most longitudinal studies show perpetrators of peer aggression in early adolescence to be at an increased risk of later alcohol dependence and other substance abuse problems as well as
increased risk of later criminal and violent behaviour (Farrington & Ttofi, 2011; Hemphill et al., 2011; Niemela et al., 2011; Sourander, Jensen, Ronning, et al., 2007a; Sourander, Jensen, Rönning, et al., 2007b). Some studies suggest that being a perpetrator of peer aggression in childhood or adolescence increases the risk of later depression, however this is seen predominately in males (Kaltiala-Heino, Fröjd, & Marttunen, 2010; Klomek et al., 2008). Furthermore longitudinal evidence suggests that perpetrators of peer aggression are more likely at risk of anti-social personality disorder (Copeland et al., 2013; Sourander, Jensen, Rönning, et al., 2007b).

Compared to studies of victims and perpetrators of peer aggression, there is less research examining the concurrent and later mental health problems of victim-perpetrators of peer aggression. This group are more likely to display externalising behaviours similar to perpetrators of peer aggression, but also have internalising behaviours similar to victims (Ivarsson, Broberg, Arvidsson, & Gillberg, 2005). Victim-perpetrators of peer aggression have the highest risk of later psychiatric problems (Copeland et al., 2013; Kumpulainen & Rasanen, 2000; Sourander, Jensen, Rönning, et al., 2007b) and the poorest psychosocial functioning out of the three groups (Haynie et al., 2001; Veenstra et al., 2005). They have an increased risk of wide ranging adverse outcomes including anxiety, depression, suicidal ideation, substance use disorders and criminal behaviour (Copeland et al., 2013; Kim, Koh, & Leventhal, 2005; Klomek et al., 2008; Sourander, Jensen, Ronning, et al., 2007a; Sourander, Jensen, Rönning, et al., 2007b; Winsper, Lereya, Zanarini, & Wolke, 2012).

General strain theory is a framework that explains the underlying process in which peer aggression affects mental health and substance use (Agnew, 1992, 2001). This argues that those who are exposed to strain or strenuous events (i.e. peer
aggression) often develop negative emotions as a result. These negative emotions such as depression, anxiety, and anger can then lead to the individual trying to escape the strain through acts such as substance use, self-harm or suicide (Hay, Meldrum, & Mann, 2010). Although this provides a rationale for why victims or victim-perpetrators of peer aggression develop mental health and substance use problems it does not explain why perpetrators of peer aggression are at increased risk of adverse outcomes. Keeping this theoretical framework in mind it is possible that adolescents become perpetrators of peer aggression to escape strain or a strenuous event in their life. However, perpetrating peer aggression may alienate these adolescents from their peers and teachers, further exacerbating existing strain, causing these perpetrators like victims, to be at increased risk of mental health and substance use problems.

An alternative explanation for the increased risk of mental health and substance use problems after involvement in peer aggression is that early adverse experiences (i.e. peer aggression) that occur during vulnerable developmental periods can cause neurobiological changes (Anda et al., 2006; Shonkoff, Boyce, & McEwen, 2009) expressed as illnesses such as depression in later years (Shonkoff et al., 2009).

Currently there are some limitations to the existing studies examining the mental health problems of children and adolescents involved in peer aggression. Initially many studies were cross sectional (Fekkes, Pijpers, & Verloove-Vanhorick, 2004; Kaltiala-Heino, Rimpela, Rantanen, & Rimpela, 2000; Nansel, Craig, Overpeck, Saluja, & Ruan, 2004; Nansel et al., 2001; Van der Wal et al., 2003) which prevents the determination of the direction of causality (Reichenheim & Coutinho, 2010). The advantage of more recent longitudinal studies is that they may permit the direction of causality between peer aggression and mental health problems to be inferred. However, the majority of
longitudinal studies have only adjusted for mental health problems at the time peer aggression was measured and not for pre-existing mental health problems prior to the age that the peer aggression was measured (Heikkilä et al., 2013; Kaltiala-Heino et al., 2010; Kim et al., 2006; Klomek et al., 2008; Sourander, Jensen, Rönning, et al., 2007b).

It has been previously shown that children exhibiting emotional and behavioural problems including aggression from as early as 17 months are at an increased risk of becoming a victim or perpetrator of peer aggression in later life (Barker et al., 2008; Jansen, Veenstra, Ormel, Verhulst, & Reijneveld, 2011). This aggression in very young children is not necessarily directed towards another child but may consist of behaviours such as destroying toys or temper tantrums (Reebye, 2005).

Fisher et al. (2012) suggests that there are individual characteristics such as pre-existing mental health problems that make certain children and adolescents more vulnerable to becoming victims of peer aggression. Incorporating this into their methodology, Fisher et al. (2012) found that after controlling for early internalising and externalising problems at age 5 the association remained between being a victim of peer aggression (at 7 and 10 years) and later self-harm (at 12 years). This current study builds on this premise by additionally controlling for co-existing mental health problems at the age peer aggression was measured and including a broader range of outcomes. By adjusting for pre-existing and co-existing mental health problems, any association between peer aggression and later mental health and substance use problems provides strong evidence of a temporal relationship. The presence of a temporal relationship is one of the required criteria to show that a relationship is causal (Hill, 1965).
The aim of the present study was to examine the association between peer aggression (victim, perpetrator, victim-perpetrator) at 14 years and mental health and substance use problems at 17 years using a large prospective longitudinal birth cohort after adjusting for pre-existing mental health problems at 5 years of age, and co-existing mental health and substance use problems at 14 years.

Methods

Study Population

This study utilised population based data from the Western Australian Pregnancy Cohort (Raine) study, a prospective birth cohort study of 2868 children born in Western Australia between September 1989 and April 1992. Initial recruitment was from the sole tertiary maternity hospital in Perth, Western Australia and consisted of pregnant women who were between 16-20 weeks gestation. These women were followed up at 24, 28 and 38 weeks (Newnham, Evans, Michael, Stanley, & Landau, 1993). Data used in this study were collected when the participants were 5 (78.0% retention), 10 (71.4% retention), 14 (64.9% retention) and 17 (61.2% retention) years of age. At 17 years, 1754 of the original cohort participated, of whom 1590 (90.6%) completed the peer aggression questionnaire at 14 years. Ethical approval for this study was granted by the Human Research Ethics Committees from the Princess Margaret Hospital for Children and King Edward Memorial Hospital in Western Australia and consent was obtained at each follow up stage from the participants’ guardians.

Measures and Procedure

Peer Aggression. This study categorised participants into four mutually exclusive groups; victims of peer aggression, perpetrators of peer aggression, victim-perpetrators of peer aggression and the reference group of participants who were
uninvolved in any type of peer aggression. At 14 years peer aggression was assessed through a self-reported questionnaire designed for the Raine study. The questionnaire begins with the following statement, “Bullying is when someone is picked on by another person, or a group of people say nasty things to him or her. It is also when someone is hit, kicked, threatened, sent nasty notes or when no one talks to them.” Although the Raine questionnaire used the term ‘bullying’ to describe these behaviours, ‘peer aggression’ is a better term as the definition provided to the participants does not refer to a power differential or repetition of the behaviour, two key components of bullying (Olweus, 1993). ‘Victims of peer aggression’ were those participants who endorsed having been bullied at school in the previous three months. ‘Perpetrators of peer aggression’ were those participants who endorsed having bullied other children at school. ‘Victim-perpetrators of peer aggression’ were those participants who endorsed having been bullied in the past three months and also having bullied other children at school.

**Outcomes.** Depression was assessed at 17 years using the Beck Depression Inventory for Youth (BDI-Y). The BDI-Y is a reliable and valid self-reported scale which assesses the intensity of depression in adolescents and has excellent test-retest reliability (Beck, Beck, & Jolly, 2001). The BDI-Y includes 20 items that relate to depressive symptoms and feelings that the participant may have experienced over the past two weeks. Each item has four possible answers (never=0, sometimes=1, often=2, always=3) and the participant’s final score can range from 0 to 60, with higher scores indicating a greater degree of depression. In order to obtain a binary variable participants were either categorised as not having depression (normal) or mild-severe
depression, these categories were based on clinical cut-offs (normal <13; mild-severe depression >14) (Beck et al., 2001).

Adolescent internalising and externalising problems were measured at 17 years through the Youth Self Report (YSR/11-18) (Achenbach, 1991b). The YSR is composed of 118 items and is an empirically validated and reliable measure of emotional and behavioural problems in adolescents (Achenbach & McConaughy, 1997). Responses to YSR are scored on a three point scale with statements either being, not true (0); somewhat/sometimes true (1) or very true (2). The raw scores were converted to standardised T-scores for internalising (withdrawn, somatic complaints, anxious/depressed) and externalising problems (aggressive/delinquent). In order to obtain a binary variable a cut-off (T-score ≥ 60) was used to indicate clinically significant internalising and externalising problems (Achenbach, 1991b).

Harmful alcohol use was assessed at 17 years through a self-reported questionnaire designed for the Raine study. Participants were asked, “Have you ever drunk 6 or more alcoholic drinks at one time or drunk so much alcohol that you vomited?” In order to obtain a binary variable those who endorsed this question by responding “yes, more than once” were categorised as harmful alcohol users and those who reported “never” or “only once” were categorised as non-harmful alcohol users.

Harmful cannabis use was assessed at 17 years through a self-reported questionnaire designed for the Raine study. The participants were asked, “How often do you use cannabis (marijuana) for non-medical purposes?” In order to obtain a binary variable those participants who responded to using cannabis monthly, weekly or daily were categorised as harmful users of cannabis and those participants who responded to using cannabis less than monthly, once a year or never were categorised as non-harmful
users/abstainers. Congruent with previous studies which have shown an association between monthly use of cannabis in adolescence and increased risk of depression, suicide ideation and attempts and the use of other illicit drugs (Fergusson, Horwood, & Ridder, 2005; Moore et al., 2007), this study classified monthly use of cannabis as harmful.

Current cigarette smoking was assessed at 17 years through a self-report questionnaire of their smoking habits in the past week. Those participants who reported smoking more than one cigarette in the past week were categorised as current cigarette smokers. Non-smokers were those either reported smoking one or less cigarettes in the past week or never smoking.

**Confounding Variables.** Socioeconomic status was assessed by asking the parent, “What is your total family income before tax per year?” This study divided the income into low (<$25 000), middle and high (> $60 000) categories based on the Australian Taxation Office cut offs in that time period. Family structure was assessed by asking the child’s parent “Is the father/mother of your child living with you?” If the answer was “No” the parent was asked, “Do you have another partner who lives with you?” This study divided family structure into three categories: lives with biological parents, lives with single parent or lives in a blended family. Maternal mental health problems were assessed by asking the child’s mother, “Have you ever been treated for an emotional or mental health problem?”

Pre-existing mental health problems were measured at 5 years through the use of The Child Behaviour Check List (CBCL/4-18) (Achenbach, 1991a). The CBCL is a parent report measure which has 118 items consistent with the YSR. The CBCL was chosen to be used in the Raine study due to its extensive use in Australia and in various
other settings (Hensley, 1988; Sawyer et al., 2001; Verhulst et al., 2003). It has been well validated and widely used in research in studies of childhood mental health problems, with Australian studies finding an eight week test-retest reliability of the parent CBCL to be 0.87 and six month test-retest reliability 0.75 (Garton, Zubrick, & Silburn, 1995; Zubrick et al., 1997).

Co-existing mental health problems, at the same time involvement in peer aggression was assessed (14 years), were measured through the YSR and BDI-Y. Prior use of substances (alcohol, cigarettes, cannabis) was also measured at 14 years. The same self-report questionnaires to assess substance use were used at 14 and 17 years of age.

**Statistical Analysis**

Using STATA 12.0 (StataCorp., 2011) descriptive statistics were obtained for all variables. Logistic regression models with binary outcomes were used to investigate the association between exposure to peer aggression (victims, perpetrators, victim-perpetrators) at 14 years and mental health (depression, internalising, externalising behaviour) and substance use (alcohol, cigarettes. cannabis) problems at 17 years. Firstly, univariate logistic regression was used to calculate the unadjusted odds ratios. If peer aggression contributed significantly (p<0.05) to an outcome these associations were then further investigated through multivariate logistic regression. Model 1 controlled for the effects of sex, family income, maternal mental health problems and family structure. Model 2 included all variables in model 1 plus pre-existing substance use problems at 14 years and model 3 included all variables in model 2 plus pre-existing (5 years) and co-existing mental health problems (14 years).

**Results**
Prevalence and sex differences in peer aggression

Involvement in any peer aggression was reported by 40.2% of the sample, with 10.1% (N=121) of the participants reporting that they had been victims of peer aggression. Of the 121 participants that reported being victims of peer aggression, 44.6% (N=54) were male (OR and 95% CI: 0.91, 0.62-1.33). One in five adolescents (21.4%, N=293) reported that they were perpetrators of peer aggression. Being male was associated with a doubling of the odds of being a perpetrator of peer aggression compared to females (OR and 95% CI: 2.20, 1.69 –2.89). Victim-perpetrators accounted for 8.7% (N=102) of whom males were more prevalent (59.8%) than females (OR and 95% CI: 1.68, 1.11 –2.53). Two significant sex differences were observed between the outcome variables reported. Females were twice as likely to report depression than males (OR and 95% CI: 2.55, 1.94 –3.35). Females were also more likely to report externalising problems than males (OR and 95% CI: 1.47, 1.11 –1.95) (Table 1).

Peer aggression at 14 years and mental health problems at 17 years

After controlling for sociodemographic covariates, mental health problems at 5 and co-existing mental health and substance use problems at 14 years (Model 3), those participants who were victims or perpetrators of peer aggression at 14 years were significantly more likely to be depressed at 17 years (OR and 95% CI: 2.12, 1.22- 3.69 and 1.81, 1.19-2.76 respectively). Only those participants who were victims of peer aggression had significantly increased odds of being in the clinical range for internalising problems at 17 years (OR and 95% CI: 2.34, 1.25-4.37). With respect to externalising problems, only those participants who were victim-perpetrator of peer aggression at 14 years were significantly more likely to have externalising symptoms in the clinical range at 17 years (OR and 95% CI: 2.23, 1.08- 4.64) (Table 2).
Peer aggression at 14 years and substance use problems at 17 years

Being a perpetrator of peer aggression at 14 years was associated with an increased risk of harmful alcohol use at 17 years even after controlling for mental health problems at 5 and co-existing mental health and substance use problems at 14 years (OR and 95% CI: 1.76, 1.23-2.53). Those who were victims of peer aggression at 14 years were significantly less likely to drink alcohol at 17 years (OR and 95% CI: 0.48, 0.26-0.88). After adjusting for all confounding variables (Model 3), no significant associations were observed between any types of peer aggression at 14 years and harmful cannabis use or cigarette smoking at 17 years (Table 3).

Discussion

The prevalence of peer aggression at 14 years reported in this study was consistent with previous research which reports perpetration is the most common form of peer aggression followed by victimisation and then engaging in both (Cross et al., 2009; Kim et al., 2006). Similarly, previous research shows males are more likely to be the perpetrators and victim-perpetrators of peer aggression (Copeland et al., 2013; Craig et al., 2009; Veenstra et al., 2005).

This study demonstrates that peer aggression at 14 years is associated with a variety of mental health and substance use problems at 17 years. These outcomes of the groups diverge with victims of peer aggression being at increased risk of future internalising symptoms whilst victim-perpetrators of peer aggression were found to be at increased risk of developing later externalising problems such as aggressive and delinquent behaviours. Other studies report similar findings (Arseneault et al., 2006; Kim et al., 2006; Kumpulainen et al., 1998; Veenstra et al., 2005; Ybrandt & Armelius, 2010). Those in the victim-perpetrator group are sometimes known as ‘aggressive
victims’ as they react to victimisation by either becoming perpetrators of peer aggression themselves or developing other externalising problems including delinquent and disruptive behaviours (Olweus, 1978; Pellegrini, Bartini, & Brooks, 1999; Schwartz, Dodge, Pettit, & Bates, 1997).

In relation to future alcohol use, those who were victims of peer aggression were less likely to engage in later harmful alcohol use, whilst perpetrators of peer aggression were at an increased risk of later harmful alcohol use. This might be attributed to the differences in social interaction between victims and perpetrators of peer aggression. During adolescent years, alcohol is often consumed in group situations (Cooper, 1994). Since research has shown that victims of peer aggression are often socially isolated individuals (Nansel et al., 2001), they may avoid social pressures that lead to alcohol misuse. Harmful drinking is associated with externalising behaviours in adolescents (Laukkanen, Shemeikka, Notkola, Koivumaa-Honkanen, & Nissinen, 2002). The increased risk of future harmful alcohol use by those who perpetrate peer aggression may in part be due to their social networks but also part of the spectrum of externalising problems in which they are more likely to engage.

Similar to another Australian study (Hemphill et al., 2011), there was no association between any type of peer aggression and later cannabis use. Other studies however have shown that perpetrators of peer aggression are at increased risk of later cannabis use (Farhat, Simons-Morton, & Luk, 2011; Kim, Catalano, Haggerty, & Abbott, 2011). The lack of association between perpetrators of peer aggression and cannabis use in this study may be due to inadequate power. Consistent with other studies, there was no association between victims of peer aggression and later cannabis use (Farhat et al., 2011; Hemphill et al., 2011). Similar to alcohol use, as these
individuals are less socially connected (Nansel et al., 2001) this in turn may limit their access to cannabis. Bond et al. (2007) found that good social connectedness at school increased the risk of cannabis use in adolescence. Further research is needed to better establish the reasons for the presence or absence of associations between involvement in various aspects of peer aggression and later substance use. Unlike a previous study (Niemela et al. 2011), this study found no association between cigarette smoking and peer aggression after adjusting for mental health. It is likely that any association between peer aggression and smoking is mediated by pre-existing and co-existing mental health problems.

This study extends current knowledge of the outcomes associated with peer aggression. Previous longitudinal studies have either adjusted for co-existing mental health problems at the same age as when the peer aggression was measured (Kaltiala-Heino et al., 2010; Kim et al., 2006; Klomek et al., 2008; Sourander, Jensen, Rönning, et al., 2007b) or controlled for early childhood mental health problems that preceded the peer aggression (Fisher et al., 2012). To the best of our knowledge this is the first study to control for both pre-existing and co-existing mental health problems. These results provide strong evidence of a temporal relationship between peer aggression and later mental health problems suggesting that this outcome is not simply a continuation of pre-existing psychopathology. This study shows that whilst some forms of peer aggression are associated with later outcomes independent of pre-existing emotional and behavioural problems (e.g. victims of peer aggression at 14 years and internalising symptoms at 17 years), other outcomes are no longer significant (e.g. perpetrators of peer aggression at 14 years and externalising behaviours at 17 years).
With an urgent need to address the persistently high prevalence of mental health problems in adolescents, widespread uses of effective interventions in educational settings are needed. A review of interventions by Vreeman and Carroll (2007) found the multidisciplinary whole school approach, an approach which involves the entire school community (i.e. both staff and students) to be an effective intervention.

Strengths of this study include the prospective longitudinal methodology and the use of well validated measures for depression (BDI-Y) and internalising and externalising problems (CBCL/YSR). However, like all research, this study has limitations. The measures used to assess peer aggression and substance use were questionnaires designed specifically for the Raine study and therefore not widely used measures. Additionally, the questionnaire did not collect information about the severity or type of peer aggression (Shaw et al., 2013; Griffin & Gross, 2004) or the different roles of adolescents in this behaviour such as reinforcing the victim or perpetrator or bystanding (Gini, Albiero, Benelli, & Altoè, 2008; Salmivalli, Lagerspetz, Björkqvist, Österman, & Kaukiainen, 1996). Although the study asked participants if they had been victims of aggression in the previous three months, there was no measurement of when the perpetration of aggression took place. Therefore, some of the participants who endorsed that they had perpetrated aggression may have only engaged in that behaviour when they were much younger.

Another limitation is that this study did not assess cyber aggression independently of traditional forms of peer aggression. Little is known about the differences between cyber aggression and traditional peer aggression in terms of long-term impacts although several studies have linked cyber aggression (victim and
perpetrator) to mental health problems and suicidal behaviour (Dooley, Pyżalski, & Cross, 2009; Hinduja & Patchin, 2010; Schneider, O'Donnell, Stueve, & Coulter, 2012).

However, it has been suggested that individuals may be engaged in both forms of peer aggression. Therefore some of the consequences associated with traditional forms of peer aggression observed in this analysis may be the result of an overlap with unmeasured cyber forms of aggression. In addition, some participants reporting no involvement in traditional forms of peer aggression may have engaged in cyber aggression. A recent study has shown cyber aggression (victim or perpetrator) to be a unique predictor of depressive symptoms and suicidal ideation after controlling for sex and traditional peer aggression (Bonanno & Hymel, 2013). It is therefore important that future peer aggression instruments measure involvement in cyber aggression along with traditional forms of peer aggression, to enable comparisons and assess independent and combined effects. Given the increasing accessibility to, and reliance on, technology, cyber aggression should be addressed as a unique risk factor both in terms of interventions and research (Bonanno & Hymel, 2013).

Although this study used clinical cut-offs, dichotomization of emotional and behavioural problems that were measured on a continuum may have resulted in a loss of information about individual differences and reduced the effect size and power of statistical tests (MacCallum, Zhang, Preacher, & Rucker, 2002). Furthermore the absence of an association between the victim-perpetrators and alcohol or cannabis use is likely a result of lack of power due to the relatively small number of participants in this group. A study with greater power may well have yielded a significant association. Additionally the externalising subscale of the YSR has one item (of 28) that asks about ‘use alcohol and drugs for non-medical purposes.’ A decision was made to retain this
item in the YSR even though other outcomes measured alcohol and cannabis use. Retention of this item enables the well validated clinical cut offs to be used in the study.

The final limitation of this current study was the attrition rate which varied across follow-up periods and among measured variables. Attrition is expected amongst large cohort studies and this attrition rate is similar to other large Australian birth cohort studies (Najman et al., 2005). Multiple imputation could not be used in this study to address the attrition rate. Only baseline information is available for a large proportion of those lost-to-follow-up with no early measurement of our main variables of interest (peer aggression - victim, perpetrator, and victim-perpetrator and mental health and substance use problems) for these participants. The variables available at baseline are not strong predictors of the missing process and therefore imputing based on these baseline variables would not give our study a more accurate result (Enders, 2010; Spratt et al., 2010).

It is possible however that the selective attrition among socially disadvantaged families may have impacted on the current results as previous studies have shown that children or adolescents who come from socially disadvantaged families are at an increased risk of involvement in peer aggression as either the victim or perpetrator (Jansen et al., 2011; Kim et al., 2006). Selective attrition among social disadvantaged families has been consistently reported in studies utilising Raine cohort data (Whitehouse et al., 2010). The loss of participants from socially disadvantaged families may have led to an underestimation of the prevalence of peer aggression in this sample and therefore an attenuation of the associations between peer aggression and the outcome. Selective attrition in a similar longitudinal study, however, did not invalidate regression models used to predict behavioural outcomes (Wolke et al., 2009). While the
loss of these participants may have affected the results of this study, the original cohort over-represented socially-disadvantaged women (Li et al., 2008), and therefore this pattern of attrition may have increased the extent to which the findings can be generalised.

This study provides strong evidence that peer aggression is independently associated with adverse mental health and alcohol problems and that there is a temporal relationship with the peer aggression preceding the later mental health and alcohol problems. Mental health problems continue to rank highly as causes of global morbidity (Murray et al., 2012). There is robust evidence strongly supported by this current study that peer aggression is associated with both co-existing and future mental health problems. The causes of mental health problems are complex and many aetiological factors such as genetic disposition, poverty and child maltreatment are difficult to modify (Norman et al., 2012; Scott, Varghese, & McGrath, 2010). Peer aggression is considered a modifiable risk factor for mental health problems (Scott, Moore, Sly, & Norman et al. 2013) with school wide interventions found to be effective in reducing the prevalence of peer aggression (Vreeman & Carroll, 2007). This highlights the need for schools to implement effective interventions to reduce the high prevalence of children and adolescents engaging in peer aggression.
References


Murray, C. J. L., Vos, T., Lozano, R., Naghavi, M., Flaxman, A. D., Michaud, C., . . . Lopez, A. D. (2012). Disability-adjusted life years (DALYs) for 291 diseases


are bullied in childhood? The Finnish “From a Boy to a Man” study. Pediatrics, 120(2), 397-404.


StataCorp. (2011) Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.


