Psychiatric and psychosocial predictors of substance use disorders among adolescents

Longitudinal study*

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Background Few studies have prospectively examined psychosocial and psychiatric predictors of adolescent substance use disorders simultaneously.

Aims To identify psychosocial and psychiatric predictors of substance use disorders in adolescence.

Method School children aged 12 years (s.d.=0.3) free from any substance use disorder at grade 7 (n=428) were assessed in three consecutive years, using a standardised psychiatric interview. Their baseline psychosocial information was also collected. The outcome was the onset age of a substance use disorder. The Cox regression model was used for data analysis.

Results The most significant predictive factors for adolescent substance use disorder included male gender, attention-deficit hyperactivity disorder, conduct disorder and sibling use of tobacco. Three protective factors against such morbidity included living in a household with two parents, a good academic grade at grade 7 and objection to the use of substances.

Conclusions Early intervention for disruptive behaviour disorders and specific psychosocial risk factors might prevent substance use disorders in early adolescence.

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Substance use disorder among adolescents has become an important public health issue in most countries (Bauman & Phongsavan, 1999). Previous studies have identified attention-deficit hyperactivity disorder (ADHD) and/or conduct disorder as the most predictive mental disorders (e.g., Lynskey & Fergusson, 1995; Biederman *et al*, 1998), and male gender (Costello *et al*, 1996), family history of substance misuse (Biederman *et al*, 2000), single-parent household (Griffin *et al*, 2000), low socio-economic status (Chong *et al*, 1999), inadequate parental monitoring (Borawski *et al*, 2003), academic underachievement (Tot *et al*, 2004), inappropriate peer influence (Urberg *et al*, 2003), and disorganised neighbourhood (Lambert *et al*, 2004) as the major psychosocial predictors of such morbidity. Few studies have prospectively examined psychosocial and psychiatric predictors of adolescent substance use disorders simultaneously in the community. Little is known regarding whether the predictors for such disorders in adolescence previously identified in Western societies will also be found in other societies. Using a prospective cohort design, our study attempts to identify individual, socio-environmental, and psychiatric predictors of substance use disorders during adolescence in a non-Western society.

METHOD

Study sample and procedure

The study sample was drawn from a 3-year longitudinal study of substance use disorders among adolescents in Taiwan (Gau *et al*, 2005). This longitudinal study included a random sample of schoolchildren in grade 7, selected from two junior high schools in South Taiwan. Twenty-six out of 44 classes were randomly selected, with all their students included in the study (n=1070).

A two-stage case-finding strategy was employed. In the first year of the study (1995), 446 out of the 1070 students received a second-stage standardised psychiatric assessment conducted by staff child psychiatrists unaware of the first-stage screening results (Gau *et al*, 2005). This subsample included all of those who were screened positive (n=382) and every 1 in 10 randomly selected from those who screened negative (n=64) for any mental disorders; 6 students refused to undergo the follow-up assessments, and 12 developed a substance use disorder before grade 7. The remaining 428 students (215 boys and 213 girls) had formed the cohort for this study (Fig. 1). Their mean age at baseline was 12.5 years (s.d.=0.3). They were interviewed to provide information about psychosocial factors in the past year. The same standardised psychiatric interview was conducted among them in the following two consecutive years (grade 8 and grade 9).

The fieldwork was conducted at school following a timetable arranged by the tutors of the study classes. The review board of the Department of Health, Taiwan, approved this study as being ethical for studying adolescents. Child assent and oral informed consent were obtained respectively from study participants and their parents, after a detailed explanation of the
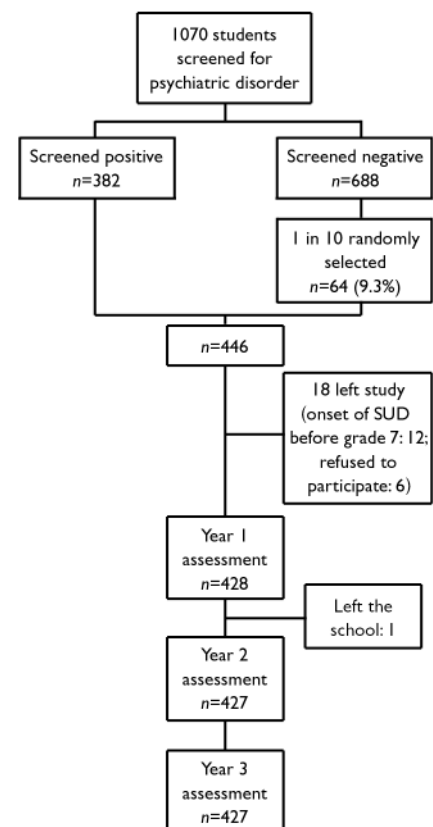

Fig. I Flow chart of recruitment and assessment (SUD, substance use disorder).

purpose and interview procedures of this study, and confidentiality about interview records and non-obligation of participating in this study were assured.

Measures

Chinese K–SADS–E

The Chinese version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children – Epidemiologic Version (K–SADS–E) was developed by the Taiwan Child Psychiatry Research Group (Gau & Soong, 1999) and further revised to meet the DSM–IV diagnostic criteria (American Psychiatric Association, 1994) with an additional section regarding betel-nut use disorder (Chong *et al*, 1999; Gau *et al*, 2005). The interrater reliability of this instrument was examined among nine staff child psychiatrists in the research team in advance: generalised kappa coefficients ranged from 0.73 to 0.96 for all mental disorders included (Chong *et al*, 1999; Gau *et al*, 2005).

In this study all the screening items in individual sections of the Chinese K–SADS–E were grouped together to form a separate screening version for use in the first stage of case-finding. Validity of this screening version was examined among 124 randomly selected grade 8 students, and the overall sensitivity (78%) and specificity (98%) against any Chinese K–SADS–E diagnosis made by the nine child psychiatrists were satisfactory (Gau *et al*, 2005).

Teacher Report Form and academic performance

Teachers reported on the Chinese version of the Teachers' Report Form (TRF; Achenbach, 1991). The Chinese TRF has been reported to be a reliable and valid self-administered instrument for measuring child behavioural problems based on teachers' ratings (Yang *et al*, 2000). Teachers were also interviewed to provide information about the students' classroom behaviours, academic performance and peer relationships. School report cards of grade point average at primary school were provided by schools, with the participants' permission.

Interview for psychosocial variables

An interview was developed to obtain demographic and psychosocial information for the year prior to the first assessment at grade 7. The kappa statistics for a 4-week test–retest reliability among 115 junior high-school students regarding these variables were as follows: house-moving at grade 6, $\kappa = 0.41$; parent's and student's expectation of highest educational level, $\kappa = 0.48$ and $\kappa = 0.72$ respectively; allowance at grade 6, $\kappa = 0.54$; after-school curricular cram courses, $\kappa = 0.47$–0.87; company during free time, $\kappa = 0.76$; spare-time activities, $\kappa = 0.46$–0.71; and spending time in unsuitable places, $\kappa = 0.68$–0.86. The kappa statistics for reports of parents' and siblings' regular use of any substance (tobacco, alcohol, betel nut, glue, sedatives, amphetamine, central nervous system depressants or heroin) ranged from 0.58 to 1.00 and from 0.49 to 1.00 respectively.

Attitudes towards substance use

Participants' attitude towards the use of any substances was investigated with three questions:

(a) 'Do you object to the use of any substance among your family members?' (1 no objection at all, 2 slight objection, 3 some objection, 4 strong objection).

(b) 'If there were an opportunity, would you use any substance?' (0 definitely no, 1 not sure, 2 yes).

(c) 'Do you think use of the substance is harmful to your health and life?' (0 not harmful, 1 mildly harmful, 2 seriously harmful).

One question was designed to enquire about peer use of substances: 'What proportion of your friends use any substance?' (0 none, 1 no more than one in four, 2 around half, 3 no more than three in four, 4 almost all).

The Cronbach's alpha coefficients for internal consistency of these questions among a representative sample of 1291 junior-high-school students ranged from 0.76 to 0.87. The intraclass correlation coefficients for the 4-week test–retest reliability among 115 junior-high-school students ranged from 0.45 to 0.71. The internal consistency of these four questions was also satisfactory in this study ($\alpha = 0.65$–0.84).

Psychiatric diagnosis

Psychiatric diagnoses of the study participants were first made by the child psychiatrists who conducted the Chinese K–SADS–E interview, according to DSM–IV criteria. All the diagnoses were then independently reassessed by S.S.F.G. and A.T.A.C. through a systematic review of all the interview records. Psychiatric diagnoses generated from this reassessment were jointly discussed and the consensus diagnosis was taken as final. To minimise the likely underreporting of externalised disorders by the participants, information regarding behaviour syndromes gathered from the TRF data was incorporated into our diagnostic consideration for the best estimation of ADHD, oppositional defiant disorder, and conduct disorders. Diagnoses of substance use disorders included substance abuse and substance dependence.

Statistical analysis

Survival analysis using the Cox proportional hazard regression analysis with time-dependent variable was employed to examine the psychiatric predictors and baseline psychosocial predictors for substance use disorders. Psychiatric predictors included ADHD, conduct disorder, oppositional defiant disorder, depressive disorders and anxiety disorders. Substance use disorders included misuse of and dependence on nicotine, alcohol, betel nut and illicit drugs.

The outcome (survival time) was age at onset of the substance use disorder. If the student was diagnosed with such a disorder, then an event was recorded and this participant's data were not censored. If the participant had more than one substance use disorder, the earliest age at onset for any disorder was taken as the age at onset. Under this condition, the age at onset of the substance use disorder was the survival time for a non-censored case. In contrast, if the substance use disorder was not diagnosed by the end of the study, then no event was recorded and the participant's data were censored; under this condition, the age at the last observation for this censored case was the survival time. Thus, censored individuals were those who either had no diagnosis of a substance use disorder by the end of the study, or were lost to follow-up during the course of the study with no prior diagnosis of a substance use disorder.

For survival analysis, participants with any psychiatric predictor (disorder) but who did not develop a substance use disorder by the end of the study, or with an onset of substance use disorder later than that of the predictor, belonged to the positive psychiatric group. Participants with a substance use disorder but without any

psychiatric predictor, or with an onset of the disorder preceding that of the predictor, belonged to the negative psychiatric group. Psychosocial predictors included measures in family, school and peer domains in the year preceding the baseline psychiatric assessment.

Statistical analyses were performed using SAS version 9.1 (SAS Institute Inc., Cary, North Carolina, USA). The preselected alpha value was 0.05. The PROC PHREG procedure was used to create time-dependent variables in order to generate a Cox regression model with time-dependent variables. Hazard ratios and their 95% confidence intervals were computed using this model.

RESULTS

Sample characteristics

The mean age at onset for participants with ADHD (7.2 years, s.d.=1.1) diagnosed across the three waves of follow-up in this cohort was younger than that of any of the other diagnostic groups. The corresponding ages were 9.5 years (s.d.=2.6), 11.3 years (s.d.=1.5), 11.7 years (s.d.=1.1), 12.8 years (s.d.=1.5), and 13.0 years (s.d.=0.8) for anxiety disorders, oppositional defiant disorder, conduct disorders, depressive disorders and substance use disorders, respectively. There was no gender difference in age at onset for all the mental disorders. There was no difference in onset age of substance use disorders between participants with and without ADHD (P=0.806), oppositional defiant disorder (P=0.927), conduct disorder (P=0.261), anxiety disorders (P=0.964) and depressive disorders (P=0.508).

Thirty-five (16.3%) boys and 7 (3.3%) girls were newly diagnosed with substance use disorders. Among them, there were 16 (38%) primary cases (individuals who had had no previous mental health disorders). All of them had nicotine use disorder (19 for nicotine abuse and 23 for nicotine dependence), and 18 (43%) and 13 (31%) also had betel use disorder (15 for betel abuse and 3 for betel dependence) and alcohol use disorder (12 for alcohol abuse and 1 for alcohol dependence) respectively. Only one participant misused amphetamines.

Socio-demographic predictors

Table 1 displays the effect of socio-demographic factors assessed at baseline on the risk of substance use disorder. Participants with such a disorder were more likely to be male and to have fathers and mothers with lower educational attainments. There was no significant difference in family structure, birth order or household status on such risk.

Psychosocial predictors

Table 2 presents the individual effect of psychosocial factors on the risk of substance use disorder. In family domains, participants who had a lower expectation of their highest educational attainment had a significantly higher risk of subsequent onset of substance use disorder. The same trend was observed for participants whose parents had the same expectation. A higher risk of disorder was found among participants whose siblings had regular use of tobacco or any substance before the baseline assessment. No such trend was observed for parents' regular use of tobacco or any substance or for monthly allowances at grade 6. In terms of school performance, those who had higher grades at primary school and attended curriculum-related cram courses after school were less likely to develop a substance use disorder.

Regarding peer influences, those who preferred to be with their friends rather than their family during their spare time and those who passed their time in unsuitable places were more likely to develop substance use disorders. An increased proportion of friends using substances and number of unsuitable places where participants spent time also increased the risk of disorder. In contrast, an increase in the variety of appropriate and healthy spare-time activities decreased the risk of disorder.

Regarding attitudes towards substance use, a response indicating that the student would use substances given the opportunity significantly predicted substance use disorder, whereas objection to substance use and recognising substance use as harmful to physical health significantly decreased the likelihood of developing this disorder.

Psychiatric predictors

Oppositional defiant disorder, ADHD and conduct disorder, but not depressive disorders or anxiety disorders, significantly predicted the risk of substance use disorder among study participants (Table 3). The significant predictive effect of ADHD on the risk of such disorder was maintained after controlling for effects of other mental

Table 1 Socio-demographic predictors of substance use disorders among adolescents

Socio-demographic predictors	Substance use disorders		Cox model[1]	
	Event, n	Censored, n	HR	(96% CI)
Gender				
Male	35	180	5.15	(2.29–11.59)
Female	7	206	1.00	
Father's education				
Senior high school and below	36	251	3.02	(1.27–7.16)
College and above	6	135	1.00	
Mother's education				
Junior high school and below	31	170	3.27	(1.64–6.50)
Senior high school and above	11	216	1.00	
Household				
With both parents	35	350	0.61	(0.26–1.44)
Other	6	36	1.00	
Family structure				
Nuclear family	30	291	1.10	(0.55–2.20)
Other	11	95	1.00	
Birth order				
Eldest or single child	12	147	0.58	(0.29–1.17)
Middle	7	81	0.62	(0.27–1.44)
Youngest	23	158	1.00	

HR, hazard ratio.
1. Cox proportional hazards regression analysis.

Table 2 Psychosocial predictors of substance use disorders among adolescents

Psychosocial predictors	Substance use disorders		Cox model[1]	
	Event, n	Censored, n	HR	(96% CI)
Familial domains				
Parent's expectation of highest education				
Junior collect and below	25	113	3.21	(1.73–5.94)
College and above	17	273	1.00	
Self-expectation of highest education				
Junior college and below	32	148	4.58	(2.25–9.31)
College and above	10	238	1.00	
Allowance per month at grade 6				
⩾US$15	20	150	1.40	(0.77–2.57)
<US$15	22	236	1.00	
Parents smoke regularly				
Yes	31	252	1.61	(0.79–3.29)
No	10	134	1.00	
Siblings smoke regularly				
Yes	11	31	3.91	(1.92–7.94)
No	25	318	1.00	
Parents use any substance				
Yes	34	306	1.27	(0.56–2.87)
No	7	80	1.00	
Siblings use any substance				
Yes	11	38	3.23	(1.59–6.56)
No	25	311	1.00	
School performance				
Attending curricular cram courses				
Yes	27	320	0.43	(0.23–0.82)
No	14	66	1.00	
GPA (1–5) at primary school			0.41	(0.32–0.53)
GPA (1–5) at grade 7			0.39	(0.28–0.55)
Peer influences				
Company during spare time				
Friends or alone	26	152	2.37	(1.27–4.42)
Family	16	234	1.00	
Spending time in unsuitable places				
Yes	10	49	2.05	(1.01–4.17)
No	32	337	1.00	
Number of spare-time activities (0–9)[2]			0.69	(0.50–0.93)
Number of unsuitable places (0–5)[2]			1.72	(1.08–2.77)
Proportion of friends using substances (0–36)[3]			10.59	(5.58–20.10)
Attitude towards substance use				
Attempt to use substance (0–16)[3]			36.65	(13.72–97.90)
Objection to substance use (8–32)[3]			0.35	(0.24–0.51)
Recognise substance as harmful to health (0–16)[3]			0.36	(0.15–0.83)

GPA, grade point average; HR, hazard ratio.
1. Cox proportional hazards regression analysis.
2. Range of number in parentheses.
3. Range of score in parentheses.

disorders, except that conduct disorders partially explained the pathway from ADHD to substance use disorders. Similarly, the significant predictive effect of conduct disorder on the risk of substance use disorder remained after controlling for effects of other mental disorders, except that ADHD partially explained the pathway from conduct disorder to substance use disorder. Although the significant effect of oppositional defiant disorder on the risk of substance use disorder remained the same after controlling for depressive and anxiety disorders, such effect disappeared after controlling for ADHD or conduct disorder, suggesting that comorbidity of oppositional defiant disorder with ADHD and/or conduct disorder might explain the prediction by oppositional defiant disorder of substance use disorder.

Final model for the predictors of substance use disorders

Table 4 shows the final model of predictors of substance use disorder using multivariate analysis with stepwise selection. All the demographic, psychosocial and psychiatric predictors ($P<0.1$ in univariate analysis) were included in the model selection, except for five factors significantly associated with conduct disorder. These included proportion of peers using substances, spending time in unsuitable places, attempt to use a substance, grade point average at primary school, and company during spare time. The final model shows that the most predictive factors were male gender, ADHD, conduct disorder, and sibling using tobacco. On the other hand, the risk of substance use disorder was significantly lower for students with a household of two parents, better academic grade at grade 7, and objection to use of a substance.

DISCUSSION

Few studies have simultaneously investigated psychiatric predictors (Costello *et al*, 2003) and psychosocial predictors (Tot *et al*, 2004) of substance use disorders among adolescents in the community prospectively. In this paper we report such a study conducted in a non-Western society. Our findings demonstrate broadly similar patterns of predictions of the risk of adolescent substance use disorders previously reported in Western societies. There are, however, some exceptions.

Psychiatric predictors

Although earlier studies have reported that disruptive behaviour disorders – notably conduct disorder and ADHD – were the most important psychiatric predictors of adolescent substance use disorder, some differences in their findings can be

Table 3 Psychiatric predictors of substance use disorders among adolescents

Psychiatric predictors		Substance use disorders		Cox model[1]	
		Event, n	Censored, n	HR	(95% CI)
ADHD	Yes	17	48	4.09	(2.21–7.58)
	No	25	338	1.00	
Oppositional defiant disorder	Yes	7	19	3.41	(1.51–7.67)
	No	35	367	1.00	
Conduct disorder	Yes	15	16	9.34	(4.96–17.58)
	No	27	370	1.00	
Depressive disorder	Yes	2	26	1.18	(0.28–4.90)
	No	40	360	1.00	
Anxiety disorder	Yes	6	80	0.69	(0.29–1.65)
	No	36	306	1.00	

ADHD, attention-deficit hyperactivity disorder; HR, hazard ratio.
1. Cox proportional hazards regression analysis.

observed. Several studies have shown that conduct disorder most strongly predicted substance use disorder (e.g. Lynskey & Fergusson, 1995; Clark & Cornelius, 2004), and partially explained the predictive effect of ADHD on such disorders (e.g. Flory & Lynam, 2003). Other studies reported that the effect of ADHD remained significant after controlling for other psychiatric comorbidity (e.g. Biederman *et al*, 1998). However, the study by Lynskey & Fergusson (1995) suggested that when due allowance was made for early conduct problems, early attentional problems were not related to later substance use. Findings in this study lend support to independent effects of ADHD and conduct disorder on substance misuse.

Findings regarding the relationships between depression and anxiety disorders and substance use disorders have been inconsistent in previous studies (Miller-Johnson *et al*, 1998; Rao *et al*, 2000; Costello *et al*,

2003; Goodwin *et al*, 2004). Although our study did not find that depression or anxiety disorders predicted substance use disorders, the relatively short duration of follow-up did not allow us to confirm Goodwin *et al*'s (2004) finding that they strongly predicted substance use disorders in late adolescence or young adulthood. Nevertheless, the evidence gathered here tends to suggest that disruptive behaviour disorders (notably ADHD and conduct disorder) may act as psychiatric antecedents of substance misuse in early adolescence, and anxiety and depressive disorders might have such a role in late adolescence and adulthood.

Psychosocial predictors

Individual factors

As in earlier studies (Costello *et al*, 1996; Chong *et al*, 1999; Tot *et al*, 2004), our cohort showed that the risk of substance use disorders was greater in boys and in

adolescents with academic underachievement. However, our study was unable to assess the predictive role of substance use disorders for poor academic achievement. It is likely that school failure might cause an adolescent to be vulnerable to substance use, which might in turn lead to further downgrading of academic performance. This study is superior to most previous studies (e.g. Tot *et al*, 2004) in that participants' grades were based on school report cards rather than on self-perceived academic performance.

The duration of compulsory education in Taiwan is 9 years. Owing to the keen academic competition for senior high-school (Gau & Soong, 1995), it is common for junior-high-school students to take curriculum-related cram courses after school. These courses are related to the subjects included in the joint entrance examinations for senior high school. Taking these cram courses represents a higher expectation of future academic achievement held by both students and parents, which was found to have a significantly reduced risk of adolescents' substance misuse in previous work (Chassin *et al*, 1992) and in this study. Such a higher academic expectation from adolescents and their parents also represents their shared values and philosophy of life, which has been reported to be one of the protective factors against adolescent substance use (Bogenschneider *et al*, 1998).

Familial factors

Our results have lent strong support to the notion that substance use disorders are associated with low socio-economic status, indicated by low parental educational attainment (Chassin *et al*, 1992; Costello *et al*, 1996; Chong *et al*, 1999; Ho & Gee, 2002), and with broken family, indicated by either a single-parent or no-parent household (Griffin *et al*, 2000). Although the educational attainments of both fathers and mothers predicted adolescent substance use disorder in the univariate analysis, only that of mothers remained in the multivariate model. This might be explained by the fact that mothers in Taiwan play a major part in child-rearing and child education. Our findings did not support the association between family structure and the risk of adolescent substance misuse previously reported (Farrington & Loeber, 2000). Like other studies, we found no significant association between birth order and the risk of adolescent substance use disorder.

Table 4 Final model of predictors of substance use disorders among adolescents

Predictor factor	HR	(95% CI)[1]	P
ADHD	2.64	(1.21–5.76)	0.015
Conduct disorder	4.16	(1.86–9.27)	<0.001
Male gender	3.65	(1.25–10.70)	0.018
Household with two parents	0.15	(0.04–0.64)	0.011
GPA 1–5 at grade 7	0.45	(0.30–0.69)	<0.001
Objection to the use of substances	0.44	(0.24–0.82)	0.010
Siblings using tobacco	2.49	(1.05–5.89)	0.038

ADHD, attention-deficit hyperactivity disorder; GPA, grade point average.
1. Multivariate Cox proportional hazards regression analysis.

Parental use of substances has been documented to be one of the predictors of substance use disorder among adolescents in Western societies (e.g. Biederman *et al*, 2000). Our study supports this finding only for betel nut chewing, which was reported to have a family aggregation (Ho & Gee, 2002). As in some Western studies (e.g. Tot *et al*, 2004), tobacco and alcohol use in siblings predicted nicotine and alcohol use disorders among adolescents in our study. These findings partially support the notion of greater influence by siblings than by parents on the use of tobacco and alcohol among adolescents, and also suggest an important role of common environmental factors in the risk of substance use. Increased substance use among parents and siblings may imply not only a potential genetic contribution but also an environmental contribution to the problem, because parental substance use may create a relaxed environment for substance use by the children.

Peer influences

Consistent with other studies (e.g. Distefan *et al*, 1998; Beal *et al*, 2001; Urberg *et al*, 2003; Tot *et al*, 2004), our study demonstrated that peer use of substances is a significant predictor of adolescent substance use, with a stronger effect than that of use by siblings and parents (e.g. Beal *et al*, 2001). Previous studies (e.g. Distefan *et al*, 1998) have shown that increased communication with parents about various serious problems has a protective role in preventing adolescent use of tobacco and alcohol. Our findings have shown that a preference for staying with friends rather than parents increased the risk of substance use disorder. Moreover, our finding also indicates that adolescents less interested in spending time with their parents might be more apt than others to choose friends who smoke cigarettes or use other substances (Distefan *et al*, 1998). In general, the less parents are involved in their children's daily life, the greater is the risk of their children developing substance use disorders (Griffin *et al*, 2000; Borawski *et al*, 2003).

Like other researchers (e.g., Beal *et al*, 2001; Urberg *et al*, 2003), we found that adolescents who spent time in places considered inappropriate for students under grade 9 in Taiwan tended to have a higher access to substances through peers, leading to subsequent development of substance use disorders. Conversely, adolescents who often spent their free time in places considered suitable were less likely to develop such disorders. Visits to places such as libraries and bookshops may indicate that these adolescents were interested in study, had a good home and school connection, and had healthy leisure activities such as going to the gym, scenic resorts and parks.

Attitudes towards substance use

Our findings support the notion that a view of substance use as harmful to health (Lambert *et al*, 2004) and an attitude of objection to substance use (Lambert *et al*, 2004) are preventive for adolescent substance use disorder. Our study also supports the potential contribution of novelty- or stimulus-seeking behaviour (such as attempting to use a substance whenever there is a chance or the substance is present) to a higher risk of adolescent substance use disorder (Gerra *et al*, 2004). Hence, differential inner drives and values may lead an adolescent either to initiate and maintain, or to stay away from, the use of a substance (Gerra *et al*, 2004).

Strengths and limitations of the study

Strengths of our study include its longitudinal design; the conduct of the psychiatric assessment by child mental health professionals, using a standardised Chinese version of the well-recognised K–SADS–E with cross-cultural validation and satisfactory interrater reliability; the use of consensus psychiatric diagnoses from independent assessments, supplemented by independent TRF reports; the use of structured interviews for psychosocial factors with satisfactory psychometric properties; and the satisfactory response rate.

Despite all these strengths, some limitations require careful consideration in the interpretation of the findings. First, owing to the purposeful sampling of study schools for this cohort, its external validity for the Taiwanese adolescent population needs to be examined. Second, psychiatric diagnoses were mainly based on student interviews and teachers' reports, without an interviewing of the participants' parents. Previous studies have shown low agreement among child, parent and teacher informants in reporting children's emotional and behavioural problems (Mitsis *et al*, 2000), and the agreement between parent and child increased with age (Jensen *et al*, 1999). In general, adolescents are superior to the other two informants in reporting their internalising symptoms, but may under-report their externalising behaviours (Jensen *et al*, 1999). Since the literature has documented the importance of teachers' contributions to the identification of externalising disorders (Mitsis *et al*, 2000), we have included the TRF assessment to make the best estimates of psychiatric diagnoses of ADHD, conduct disorder and oppositional defiant disorder. Third, despite the employment of a wealth of measures, this study did not include any biological measures for the prediction of substance use disorder. Fourth, we applied the DSM–IV diagnostic criteria for substance use disorder in this study. It is likely that we have excluded some respondents with one or two symptoms for dependence not meeting the diagnostic criteria for abuse and dependence – 'diagnostic orphans' (e.g. Hasin & Paykin, 1998; Pollock & Martin, 1999). Lastly, the follow-up period was not long enough to have a greater incidence of cases of substance use disorders and other psychiatric disorders, enabling a more powerful examination of psychiatric and psychosocial predictors. A follow-up study of this cohort in young adulthood is in preparation.

Implications

Our findings imply that early intervention for specific psychosocial risk factors and psychiatric disorders, particularly ADHD and conduct disorder, may prevent substance misuse in adolescents through the creation of a protective psychosocial environment. Such measures should include the attenuation of factors contributing to the aggravation of cognitive–behavioural deficit in ADHD. Further investigations may focus on the elucidation of pathways from ADHD to substance misuse, so that specific targets for primary prevention among different vulnerable groups can be identified.

REFERENCES

Achenbach, T. M. (1991) *Manual for the Cross-informant Program for the CBCL/4-18, YSR and TRF.* Department of Psychiatry, University of Vermont.

American Psychiatric Association (1994) *Diagnostic and Statistical Manual of Mental Disorders* (4th edn) (DSM–IV). APA.

Bauman, A. & Phongsavan, P. (1999) Epidemiology of substance use in adolescence: prevalence, trends and policy implications. *Drug and Alcohol Dependence*, **55**, 187–207.

Beal, A. C., Ausiello, J. & Perrin, J. M. (2001) Social influences on health-risk behaviors among minority middle school students. *Journal of Adolescent Health*, **28**, 474–480.

Biederman, J., Wilens, T. E., Mick, E., et al (1998) Does attention-deficit hyperactivity disorder impact the developmental course of drug and alcohol abuse and dependence? *Biological Psychiatry*, **44**, 269–273.

Biederman, J., Faraone, S. V., Monuteaux, M. C., et al (2000) Patterns of alcohol and drug use in adolescents can be predicted by parental substance use disorders. *Pediatrics*, **106**, 792–797.

Bogenschneider, K., Wu, M. Y., Raffaelli, M., et al (1998) Parent influences on adolescent peer orientation and substance use: the interface of parenting practices and values. *Child Development*, **69**, 1672–1688.

Borawski, E. A., Ievers-Landis, C. E., Lovegreen, L. D., et al (2003) Parental monitoring, negotiated unsupervised time, and parental trust: the role of perceived parenting practices in adolescent health risk behaviors. *Journal of Adolescent Health*, **33**, 60–70.

Chassin, L., Presson, C. C., Sherman, S. J., et al (1992) Parent educational attainment and adolescent cigarette smoking. *Journal of Substance Abuse*, **4**, 219–234.

Chong, M. Y., Chan, K. W. & Cheng, A. T. (1999) Substance use disorders among adolescents in Taiwan: prevalence, sociodemographic correlates and psychiatric co-morbidity. *Psychological Medicine*, **29**, 1387–1396.

Clark, D. B. & Cornelius, J. (2004) Childhood psychopathology and adolescent cigarette smoking: a prospective survival analysis in children at high risk for substance use disorders. *Addictive Behaviors*, **29**, 837–841.

Costello, E. J., Angold, A., Burns, B. J., et al (1996) The Great Smoky Mountains Study of Youth. Goals, design, methods, and the prevalence of DSM–III–R disorders. *Archives of General Psychiatry*, **53**, 1129–1136.

Costello, E. J., Mustillo, S., Erkanli, A., et al (2003) Prevalence and development of psychiatric disorders in childhood and adolescence. *Archives of General Psychiatry*, **60**, 837–844.

Distefan, J. M., Gilpin, E. A., Choi, W. S., et al (1998) Parental influences predict adolescent smoking in the United States, 1989–1993. *Journal of Adolescent Health*, **22**, 466–474.

Farrington, D. P. & Loeber, R. (2000) Epidemiology of juvenile violence. *Child and Adolescent Psychiatric Clinics of North America*, **9**, 733–748.

Flory, K. & Lynam, D. R. (2003) The relation between attention deficit hyperactivity disorder and substance abuse: what role does conduct disorder play? *Clinical Child and Family Psychology Review*, **6**, 1–16.

Gau, S. F. & Soong, W. T. (1995) Sleep problems of junior high school students in Taipei. *Sleep*, **18**, 667–673.

Gau, S. F. & Soong, W. T. (1999) Psychiatric comorbidity of adolescents with sleep terrors or sleepwalking: a case–control study. *Australian and New Zealand Journal of Psychiatry*, **33**, 734–739.

Gau, S. S. F., Chong, M. Y., Chen, T. H., et al (2005) A three-year panel study of mental disorders among adolescents in Taiwan. *American Journal of Psychiatry*, **162**, 1344–1350.

Gerra, G., Angioni, L., Zaimovic, A., et al (2004) Substance use among high-school students: relationships with temperament, personality traits, and parental care perception. *Substance Use and Misuse*, **39**, 345–367.

Goodwin, R. D., Fergusson, D. M. & Horwood, L. J. (2004) Association between anxiety disorders and substance use disorders among young persons: results of a 21-year longitudinal study. *Journal of Psychiatric Research*, **38**, 295–304.

Griffin, K. W., Botvin, G. J., Scheier, L. M., et al (2000) Parenting practices as predictors of substance use, delinquency, and aggression among urban minority youth: moderating effects of family structure and gender. *Psychology of Addictive Behaviors*, **14**, 174–184.

Hasin, D. & Paykin, A. (1998) Dependence symptoms but no diagnosis: diagnostic 'orphans' in a community sample. *Drug and Alcohol Dependence*, **50**, 19–26.

Ho, C. S. & Gee, M. J. (2002) The parental influence of betel-chewing behavior among junior high school students in Taiwan. *Substance Abuse*, **23**, 183–189.

Jensen, P. S., Rubio-Stipec, M., Canino, G., et al (1999) Parent and child contributions to diagnosis of mental disorder: are both informants always necessary? *Journal of the American Academy of Child and Adolescent Psychiatry*, **38**, 1569–1579.

Lambert, S. F., Brown, T. L., Phillips, C. M., et al (2004) The relationship between perceptions of neighborhood characteristics and substance use among urban African American adolescents. *American Journal of Community Psychology*, **34**, 205–218.

Lynskey, M. T. & Fergusson, D. M. (1995) Childhood conduct problems, attention deficit behaviors, and adolescent alcohol, tobacco, and illicit drug use. *Journal of Abnormal Child Psychology*, **23**, 281–302.

Miller-Johnson, S., Lochman, J. E., Coie, J. D., et al (1998) Comorbidity of conduct and depressive problems at sixth grade: substance use outcomes across adolescence. *Journal of Abnormal Child Psychology*, **26**, 221–232.

Mitsis, E. M., McKay, K. E., Schulz, K. P., et al (2000) Parent–teacher concordance for DSM–IV attention-deficit/hyperactivity disorder in a clinic-referred sample. *Journal of the American Academy of Child and Adolescent Psychiatry*, **39**, 308–313.

Pollock, N. K. & Martin, C. S. (1999) Diagnostic orphans: adolescents with alcohol symptoms who do not qualify for DSM–IV abuse or dependence diagnoses. *American Journal of Psychiatry*, **156**, 897–901.

Rao, U., Daley, S. E. & Hammen, C. (2000) Relationship between depression and substance use disorders in adolescent women during the transition to adulthood. *Journal of the American Academy of Child and Adolescent Psychiatry*, **39**, 215–222.

Tot, S., Yazici, K., Yazici, A., et al (2004) Psychosocial correlates of substance use among adolescents in Mersin, Turkey. *Public Health*, **118**, 588–593.

Urberg, K. A., Luo, Q., Pilgrim, C., et al (2003) A two-stage model of peer influence in adolescent substance use: individual and relationship-specific differences in susceptibility to influence. *Addictive Behaviors*, **28**, 1243–1256.

Yang, H. J., Soong, W. T., Chiang, C. N., et al (2000) Competence and behavioral/emotional problems among Taiwanese adolescents as reported by parents and teachers. *Journal of the American Academy of Child and Adolescent Psychiatry*, **39**, 232–239.

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