ACTA PSYCHIATRICA
SCANDINAVICA

Multiple adverse outcomes over 30 years following adolescent substance misuse treatment

Hodgins S, Larm P, Molero-Samuleson Y, Tengström A, Larsson A. Multiple adverse outcomes over 30 years following adolescent substance misuse treatment.

Objective: To compare outcomes over 30 years experienced by individuals who as adolescents entered substance misuse treatment and a general population sample.
Method: All 1992 individuals seen at the only clinic for substance misusing adolescents in Stockholm from 1968 to 1971 were compared to 1992 individuals randomly selected from the Swedish population, matched for sex, age and birthplace. Death, hospitalization for physical illness related to substance misuse, hospitalization for mental illness, substance misuse, criminal convictions and poverty were documented from national registers.
Results: Relative risks of death, physical illness, mental illness, substance misuse, criminal convictions and poverty were significantly elevated in the clinic compared to the general population sample. After adjustment for substance misuse in adulthood, the risks of death, physical and mental illness, criminality and poverty remained elevated.
Conclusion: Adolescents who consult for substance misuse problems are at high risk for multiple adverse outcomes over the subsequent 30 years.

S. Hodgins[1,2], P. Larm[2], Y. Molero-Samuleson[2], A. Tengström[2], A. Larsson[2]

[1]Department of Forensic Mental Health Science, Institute of Psychiatry, King's College London, London, UK and [2]Section of Alcohol and Drug Dependence Research, Department of Clinical Neuroscience, Research Centre for Adolescents Psycho-social Health, Karolinska Institutet, Stockholm, Sweden

Significant outcomes

- Substance misuse in adolescence conferred an elevated risk of multiple adverse outcomes over 30 years.
- Adverse outcomes were not explained by continuing substance misuse.
- Multiple problems may have been present in adolescence.

Limitations

- The results of this study cannot be generalized to adolescent substance misusers generally, but only to those who seek help.
- The prevalence rates of the six adverse outcomes are likely underestimated.
- No information was available on the general population sample prior to age 21.

Introduction

Substance misuse during adolescence compromises this critical life period, negatively impacting on academic performance and career opportunities, physical and mental health, and increasing the risk of premature death (1, 2). Substance misuse accounts for 23.3% of the global burden of disease for people aged 15–29 years in economically developed countries (2). Yet, knowledge of the long-term outcomes of adolescent substance misuse is limited because studies have followed participants for only short periods of time, focused on a limited number of outcomes, and have not reported outcomes separately for women and men.

The extant literature documents elevated rates of continued substance misuse (3, 4), as well as elevations in the risks of early death, criminality, serious physical and mental health problems, and poverty in the first decade of adult life (5–13) among individuals who misused substances as adolescents. Long-term outcomes are unknown. Most previous studies have focused on only one or two outcomes, and therefore the breadth of adversity experienced by adults who as teenagers abused substances has not been established. Treatment studies have focused almost exclusively on relapse (14, 15). Generally, reduced levels of substance use are reported after treatment with participants who achieve abstinence doing better on other outcomes such as educational achievement (16–19), employment (16, 20), criminality (18, 20), psychological functioning (19, 21) and suicidal ideation (22). Most of these studies examined small samples and did not report sex differences in outcomes (15). Continued substance misuse has been reported to be less common among women than men (23, 24), and mental illness more common (25, 26). Other studies, however, report similar outcomes for women and men (7, 10, 27).

While few studies have documented the prevalence of adverse outcomes through adulthood of individuals who misused substances as teenagers, the available evidence suggested that the prevalence of death and serious physical illnesses would increase over the 30 year follow-up, while the prevalence of substance misuse and criminality would decrease (1, 2, 28). Documenting trends in prevalence is important for the development of public health interventions targeting adverse outcomes.

Aims of the study

The prevalence of six adverse outcomes over 30 years was compared in a sample who consulted a clinic for substance misuse problems when they were adolescents and a randomly selected sample matched for sex, age and place of birth. Adverse outcomes included death, hospitalization for physical illnesses related to substance misuse, hospitalization for mental illness, substance misuse, criminality and poverty.

Material and methods

Once ethical permission for the study had been granted by the Ethics Committee of the Karolinska Institute, the clinic files from 1 January 1968 to 31 December 1971, were screened to extract the person number (a unique number assigned to

each Swedish resident) of each individual who had been seen at the clinic. A request was sent to different agencies responsible for records of death, health care, crime, welfare and disability payments, describing the study, presenting a copy of the ethical approval, and requesting collaboration. As each agency agreed to provide information, the list of person numbers of individuals in the clinic sample was forwarded to them. Each agency then sent the data to Statistics Sweden. Information on participants in the clinic sample was extracted from the old clinic files and these data were also sent to Statistics Sweden. Once all data were on hand, Statistics Sweden merged the files, de-identified the data, and assigned each participant a study identification number.

Statistics Sweden created a comparison sample by randomly selecting for each individual in the clinic sample, an individual in the general population with the same sex, month and year of birth and birth place (city, outside city, outside Sweden). Information from each of the registers was then requested and added. The data were de-identified, individuals were assigned a study identification number by Statistics Sweden, and the data files were forwarded to the research team.

Participants

Two thousand and eighty-eight individuals consulted the only clinic for adolescents with substance use problems in a large urban area in Sweden between 1 January 1968 and 31 December 1971. Ninety-six were excluded as information could not be retrieved. The final clinic and general population samples each included 1660 men and 332 women. Individuals who died before the end of the age period or who were outside the country for more than 6-months were excluded from the analyses for the age period.

Adult outcomes

Adult outcomes were documented until 31 December, 2002. In Sweden, national registers are annually updated and recorded information has been shown to be valid (29). Information on the date of death was extracted from the register maintained by the Swedish National Board of Health and Welfare for all of Sweden since 1961.

Physical illness was defined as: i) having been admitted to hospital for a physical disease that previous research had related to alcohol or drug use; and/or ii) having received a disability pension because of a physical illness related to alcohol or drug use (30–32). Physical illness related to alcohol

and/or drug use was defined as in the Global Burden of Disease Study (33) with the addition of HIV/AIDS, hepatitis B, and hepatitis C, and included other sexually transmitted diseases, neoplasms, cardiovascular diseases, digestive diseases, unintentional and intentional injuries. Information was extracted from the Swedish hospital discharge register maintained by the Swedish National Board of Health and Welfare. From 1969 to 1971, this register contained information about all hospital admissions in the county excluding the municipality where the clinic was situated; from 1972 to 1986 this register covered admissions to all hospitals in the county and the municipality where the clinic was situated; and from 1987 to 2002 all admissions to every hospital in Sweden.

Mental illness was defined as: i) having been admitted to a psychiatric ward with a diagnosis for a mental disorder, and/or ii) having received a disability pension because of a mental disorder. Information was extracted from the Swedish hospital discharge register and from the National Insurance Board.

Substance misuse was defined as: i) having been admitted to hospital with a diagnosis of a substance use disorder, e.g. substance dependence; and/or ii) having been admitted to hospital with a diagnosis of a substance-related condition, e.g. alcohol liver disease, alcoholic myopathy, degeneration of nervous system because of alcohol; and/or iii) having been convicted of an alcohol or drug related crime.

Information on criminal convictions was extracted from official files, Lagfördaregistret.

Poverty was defined as having received social welfare payments because of low income. This information was available from 1990 onwards from Statistics Sweden.

Statistical analyses

Proportions of women and men in the clinic and general population samples with varying numbers of adverse outcomes were compared using chi-squared tests. The prevalence of each outcome, for the entire period and for each 5-year age period, was estimated using generalized linear models, log link function and assuming binomial outcomes. Model parameters were maximum likelihood-estimated by the Newton–Raphson algorithm and the variance–covariance matrix by the robust sandwich estimator. This procedure yielded estimates of relative risk (RR), comparing different values of the variable included in the model, that is sample (clinic or general population) and sex. First the clinic and the general population samples were compared within sex, giving the risk ratios presented in Table 2. To examine differences in risk ratios for women and men, a sex × group interaction was included in the model and tested for statistical significance using Wald statistics. The risk ratios were again calculated taking account of problems in adulthood. To examine the number of adverse outcomes experienced by participants, continuous variables were created each with values from 0 to 6, indicating the presence (1) or absence (0) of substance misuse, physical illness, mental illness, criminality and poverty in any 5-year age period. To examine the co-occurrence of adverse outcomes, dichotomous variables indicating the presence or absence of each adverse outcome during the 30-year follow-up period were created. To assess age-wise trends in prevalence of the adverse outcomes, observed outcomes for all age periods were simultaneously analysed in models as described above, with the addition of an age period variable. Interactions among period, age and sample were then added, step-wise, to the model. To account for the fact that each participant contributed several observations, correlated outcomes within subjects were explicitly allowed in the model specification.

Results

Characteristics of the clinic sample in adolescence

Information was extracted from the old clinic files to describe the clinic sample as adolescents. Table 1 presents characteristics of the clinic sample prior to age 20.

Ten per cent of the files were rated independently by two research assistants. Intra-class correlations for each variable presented in Table 1 exceeded 0.80.

Relative risks of adverse outcomes in the clinic sample as compared to the general population sample over 30 years

Table 2 presents the percentages of men and women in the clinic and general population samples with adverse outcomes during the entire 30-year follow-up period and for each 5-year period from ages 21 to 50, and RR ratios estimating risk in the clinic sample compared to the general population sample, within sex. Over three decades, the risks for all six adverse outcomes were elevated among both women and men in the clinic sample compared to the general population sample. Relative risk estimates were generally higher among the women than the men, and these differences reached statistical significance for death (Wald

Table 1. Characteristics of the clinic sample up to age 20

	Total	Women (n = 332)	Men (n = 1660)
Mean age at first contact (SD)	17.64 (1.78)	16.78 (1.83)	17.84 (1.70)
Severity of alcohol use			
Light use	9.2% (183)	19.6% (65)	7.1% (118)
Moderate use	53.5% (1065)	51.5% (171)	53.9% (894)
Severe use	37.3% (744)	28.9% (96)	39.0% (648)
Severity of illicit drug use			
Abstainers	52.8% (1052)	37.7% (125)	55.8% (927)
Experimental use	25.2% (501)	25.0% (415)	25.9% (86)
Severe use	22.0% (439)	19.2% (318)	36.4% (121)
Types of substances used			
Alcohol	94.9% (1890)	86.1% (286)	96.6% (1604)
Cannabis	37.6% (749)	47.9% (159)	35.5% (590)
Stimulants	18.3% (364)	33.7% (112)	15.2% (252)
Opiates	5.5% (109)	8.1% (27)	4.9% (82)
Hallucinogens	5.4% (107)	9.6% (32)	4.5% (75)
Benzodiazepines/barbiturates	1.3% (25)	2.4% (8)	1.0% (17)
Inhalants	19.4% (386)	21.4% (71)	19.0% (315)
Other illicit drugs	6.1% (122)	12.3% (81)	4.9% (81)
Severity of delinquency			
No offending	39.2% (780)	55.7% (185)	35.8% (595)
Minor offending	20.8% (414)	22.9% (76)	20.4% (338)
Serious offending	40.1% (798)	21.4% (71)	43.8% (727)
Type of treatment			
Detoxification only	51.7% (1029)	43.7% (145)	53.3% (884)
In-patient treatment	10.8% (216)	24.1% (80)	8.2% (136)
Out-patient treatment	26.3% (524)	24.7% (82)	26.6% (442)
No treatment	2.3% (45)	1.2% (4)	2.5% (41)
No information	8.9% (178)	6.3% (21)	9.5% (157)
Mean length of in-patient and out-patient treatment in months	4.52 (8.91)	7.19 (11.37)	3.77 (7.94)

$\chi^2(N = 3797) = 4.66$, $P = 0.031$), substance misuse (Wald $\chi^2(N = 3763) = 8.68$, $P = 0.003$) and criminality (Wald $\chi^2(N = 3763) = 13.68$, $P = 0.000$).

Table 3 presents RR ratios of adverse outcomes over 30 years adjusted for the presence of substance misuse, hospitalization for mental illness, substance misuse co-morbid with hospitalization for mental illness, and poverty in any 5-year period. After adjusting for the presence of one or more adverse outcomes, the RR of the other adverse outcomes remained significantly elevated among the clinic sample women and men. The adjusted risk ratios for each 5-year period for each outcome are presented in Tables S1–S4.

As shown in Table 3, the RR ratios adjusted for substance misuse in adulthood for all five adverse outcomes and among both women and men were significantly elevated for the clinic compared to the population sample. In addition, as presented in Table S1, the risk ratios adjusted for the presence of substance misuse in adulthood for the five adverse outcomes were significantly elevated for the majority of 5-year age periods. To further explore this finding, RR ratios were re-calculated excluding all subjects with substance misuse in one or more 5-year age periods of adulthood. For the

clinic compared to the general population sample, the RR were significantly elevated for criminality (women: RR = 3.10, 1.92–5.00; men: RR = 1.92,1.68–2.20), physical illness (women: RR = 1.40, 1,13–1.73; men: RR = 1.18, 1.05–1.33), mental illness (women: RR = 4.70, 2.35–9.37; men: RR = 1.78, 1.26–2.54) and poverty (women: RR = 2.58, 1.82–3.66; men: RR = 1.54, 1.23–1.92). By contrast, the risk of death was not elevated in the clinic sample relative to the general population sample after adjustment for the presence of substance misuse in adulthood.

After adjusting for the presence of hospitalization for mental illness, for five adverse outcomes and all six age periods among both women and men, only one RR fell below significance. After adjusting for the presence of substance misuse co-morbid with hospitalization for mental illness, the RR of the clinic vs. the general population sample for hospitalization because of a physical illness, a criminal conviction, and poverty were significantly increased in each 5-year age period among both women and men.

Co-occurrence of adverse outcomes

The numbers of adverse outcomes experienced by the women and men in the clinic and general population samples are presented in Table 4. Among the women, 19.4% of the clinic sample and 53.9% of the general population sample experienced none of the adverse outcomes, while among the men this was also true of 20.7% of the clinic sample and 45.7% of the general population sample. Among the women and men in the clinic sample, 39.8% experienced three or more adverse outcomes, while this was true of only 3.4% of the women and 9.8% of the men in the comparison group.

Table 5 presents comparisons of the prevalence of co-morbid conditions in the clinic and general population samples. As can be seen, the prevalence of only substance misuse and only mental illness is similar in the clinic and general population samples among both women and men. By contrast, substance misuse combined with criminality, substance misuse plus criminality and physical illness, substance misuse and mental illness, and substance misuse and mental illness and crime are significantly more common among both women and men in the clinic than the general population sample.

Trends in the prevalence of adverse outcomes over time

The trends over time of the prevalence of the six adverse outcomes are presented in Fig. 1. The

	Women				Men			
	Percentage		Risk ratio	95% CI	Percentage		Risk ratio	95% CI
	Clinic	Comparison			Clinic	Comparison		
Death	11.4	1.6	6.97	2.77–17.4	15.1	6.1	2.45	1.95–3.07
Ages 21–25	1.5	0.3	4.71	0.55–40.06	1.9	0.9	2.05	1.09–3.84
Ages 26–30	2.8	0.3	8.58	1.09–67.29	3.2	0.9	3.52	1.96–6.33
Ages 31–35	1.6	0.3	4.94	0.58–41.99	1.7	1.1	1.52	0.83–2.80
Ages 36–40	2.7	0.3	8.03	1.01–63.78	3.1	1.0	3.10	1.74–5.52
Ages 41–45	2.8	0.3	8.25	1.04–65.57	4.6	1.4	3.21	1.97–5.22
Ages 46–50	1.9	0	–		3.2	1.6	1.99	1.05–3.78
Physical illness	60.4	34.2	1.77	1.48–2.11	48.8	32.1	1.52	1.39–1.66
Ages 21–25	22.7	9.4	2.42	1.55–3.80	17.2	8.5	2.03	1.58–2.61
Ages 26–30	25.8	8.6	3.00	1.98–4.54	17.8	8.2	2.16	1.77–2.65
Ages 31–35	22.8	7.0	3.25	2.05–5.16	15.2	8.3	1.83	1.49–2.25
Ages 36–40	21.4	9.1	2.35	1.54–3.59	15.1	8.4	1.8	1.46–2.23
Ages 41–45	20.8	9.5	2.20	1.43–3.37	16.1	8.8	1.83	1.49–2.25
Ages 46–50	22.7	10.8	2.10	1.13–3.89	19.2	12.8	1.50	1.20–1.88
Mental illness	23.4	4.1	5.69	3.22–10.05	17.6	5.3	3.32	2.63–4.20
Ages 21–25	12.0	1.1	11.40	2.73–47.58	5.1	1.6	3.28	1.63–6.62
Ages 26–30	10.5	2.6	3.95	1.85–8.43	5.8	1.7	3.34	2.17–5.15
Ages 31–35	8.1	2.3	3.44	1.50–7.86	6.3	2.0	3.21	2.13–4.84
Ages 36–40	9.7	2.0	4.78	2.01–11.3	7.8	1.7	4.55	2.97–6.98
Ages 41–45	6.9	1.4	4.94	1.70–14.34	6.8	1.9	3.49	2.30–5.30
Ages 46–50	8.2	2.5	3.27	0.91–11.78	7.1	1.4	5.07	2.74–9.38
Substance misuse	35.3	3.2	11.14	5.94–20.88	43.0	10.2	4.21	3.60–4.93
Ages 21–25	22.0	1.1	20.90	5.14–85.0	27.2	5.4	5.0	3.54–7.09
Ages 26–30	17.0	1.0	17.11	5.40–54.18	24.3	4.2	5.73	4.44–7.40
Ages 31–35	17.8	0.7	26.59	6.54–108.11	21.2	3.6	5.93	4.47–7.86
Ages 36–40	15.5	1.3	11.52	4.20–31.63	18.4	3.5	5.26	3.94–7.04
Ages 41–45	11.7	1.4	8.32	2.98–23.22	16.7	3.3	5.12	3.77–6.95
Ages 46–50	7.3	1.7	4.36	0.95–20.11	12.4	2.4	5.07	3.20–8.04
Criminality	43.3	9.2	4.71	3.26–6.82	61.7	26.8	2.30	2.10–2.51
Ages 21–25	29.5	4.2	7.01	3.44–14.27	51.3	16.5	3.12	2.58–3.77
Ages 26–30	20.9	4.0	5.26	2.90–9.55	39.6	10.9	3.62	3.10–4.28
Ages 31–35	15.1	2.3	6.45	2.96–14.07	29.4	8.1	3.63	3.00–4.38
Ages 36–40	17.2	2.7	6.40	3.09–13.26	23.9	6.9	3.49	2.83–4.31
Ages 41–45	16.4	2.8	5.85	2.81–12.18	21.7	9.1	2.39	1.97–2.90
Ages 46–50	12.7	2.5	5.09	1.37–2.38	14.9	8.3	1.80	1.37–2.38
Poverty	47.6	14.8	3.22	2.39–4.34	33.7	13.2	2.56	2.20–2.97
Ages 36–40	46.8	10.1	4.63	2.48–8.67	36.2	12.7	2.85	1.95–4.15
Ages 41–45	42.1	12.1	3.47	2.45–4.93	30.2	10.4	2.89	2.41–3.48
Ages 46–50	31.8	9.2	3.47	1.86–6.49	24.1	9.7	2.50	1.97–3.17

Table 2. Percentages and unadjusted relative risk ratios (95% confidence intervals) for six adverse outcomes over 30 years comparing individuals who as adolescents were treated for substance misuse and a matched general population sample

prevalence of death increased over the 30-year follow-up period with no significant sample or sex differences. The prevalence of physical illnesses related to substance misuse remained stable over time. A significant sample effect indicated that the trend differed in the clinic and general population samples, while no sex differences were detected. The prevalence of hospitalization for mental illness was also stable over time. The trends differed by sex with the prevalence decreasing among women and increasing among men. The prevalence of substance misuse significantly declined over time, similarly for each sample and sex. The prevalence of criminal convictions also decreased over time, with significant sample and sex effects indicating steeper declines among the clinic than general population sample, and among men than women. There was a significant decrease in poverty from ages 37 to 50, which was similar for each sample and sex. There were no significant sex differences in sample effect on trends for any of the six outcomes.

Discussion

The prevalence of multiple adverse outcomes was elevated over three decades of adult life among individuals who as adolescents entered treatment for substance misuse. Results concurred with previous findings showing continuity of substance misuse and elevated rates of criminality, mental and physical health problems through the first decade of adult life. This study extended these findings by showing elevated rates of death, criminality, substance misuse, physical and mental illnesses requiring hospitalization, and poverty to age 50. One-third of the females and 56% of the

Table 3. Relative risk ratios for adverse outcomes adjusted for substance misuse, mental illness, substance misuse co-morbid with mental illness, and poverty among the clinic women and men compared to the women and men in the general population sample over the 30-year follow-up period

	Crude RR (95% confidence interval)		RR adjusted for substance misuse (95% confidence interval)		RR adjusted for mental illness (95% confidence interval)		RR adjusted for substance misuse co-morbid with mental illness (95% confidence interval)		RR adjusted for poverty (95% confidence interval)	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Death	6.97 (2.77–17.4)	2.45 (1.95–3.07)	5.18 (1.82–14.8)	1.90 (1.43–2.52)	5.99 (2.12–16.9)	2.44 (1.87–3.19)	5.83 (2.06–16.6)	2.33 (1.78–3.06)	1.48 (1.22–1.80)	1.74 (0.93–3.23)
Physical illness	1.77 (1.48–2.11)	1.52 (1.39–1.66)	1.51 (1.25–1.83)	1.23 (1.12–1.35)	1.69 (1.41–2.03)	1.46 (1.34–1.60)	1.69 (1.42–2.03)	1.45 (1.32–1.58)		1.34 (1.22–1.48)
Mental illness	5.69 (3.22–10.05)	3.32 (2.63–4.20)	3.96 (2.18–7.20)	1.88 (1.46–2.41)					3.84 (2.08–7.08)	2.34 (1.82–3.02)
Substance misuse	11.14 (5.94–20.88)	4.21 (3.60–4.93)			3.56 (2.17–5.85)	1.97 (1.57–2.48)			7.26 (3.63–14.5)	3.12 (2.63–3.71)
Crime	4.71 (3.26–6.82)	2.30 (2.10–2.51)	3.18 (2.17–4.66)	1.75 (1.60–1.92)	4.45 (3.05–6.48)	2.21 (2.01–2.42)	4.30 (2.96–6.24)	2.19 (2.00–2.40)	3.13 (2.09–4.69)	1.92 (1.74–2.11)
Poverty	3.22 (2.39–4.34)	2.56 (2.20–2.97)	2.56 (1.88–3.50)	1.61 (1.38–1.89)	2.98 (2.21–4.04)	2.32 (1.99–2.70)	3.04 (2.25–4.11)	2.32 (1.99–2.71)		

males in the clinic sample had not used illicit drugs when they consulted the clinic and two-thirds of the females and 50% of the males used alcohol only experimentally or not at all. Sixty-one per cent of the females and 41% of the males in the clinic sample had no record of delinquency. In a previous paper, we have shown that the severity of the substance misuse and delinquency in the clinic sample were positively associated with all six adverse outcomes over 30 years (34). Yet, the breadth and severity of adversity that was experienced through adult life by the clinic compared to the general population sample was dramatic. Given the breadth and severity of the adverse outcomes experienced through adult life by the clinic sample, it would be important to know if difficulties in similar domains were already present in adolescence.

Importantly, the elevations in risk of the adverse outcomes among both the women and men in the clinic sample remained significant after taking account of substance misuse in adulthood defined strictly as having received treatment for substance misuse or for a related physical illness, or having been convicted for an alcohol or drug related crime in any 5-year period. This finding suggests that the adversity that plagued the clinic sample through adult life was not simply the result of continued substance misuse. Nor was it the result of serious mental illness, substance misuse co-morbid with mental illness, or poverty. The elevations in risk of all six adverse outcomes for the clinic compared to the general population sample are not easily explained by problems that we documented from age 21 onwards. The findings may be interpreted to suggest that factors operating earlier in life were driving the negative life trajectories and limiting movement from a pathway of maladjustment to one characterized by health and positive social functioning.

Our hypothesis that the clinic women and men would show elevated rates of multiple adverse outcomes was confirmed with 40% experiencing three or more adverse outcomes. The elevations in risk of the six adverse outcomes for the clinic sample were evident for each 5-year period from age 21 to 50 suggesting that the individuals who had misused substances as teenagers presented multiple problems as they began their adult lives and that these problems persisted throughout adulthood. Notably, the clinic sample differed from the general population sample not in the prevalence of either substance misuse or mental illness in adulthood, but in the prevalence of various combinations of substance misuse, criminality, mental and physical health problems, and

Table 4. Percentages of clinic and general population sample women and men who experienced varying numbers of adverse outcomes

Number of adverse outcomes	Females (%)			Males (%)		
	Clinic	General population sample	χ^2	Clinic	General population sample	χ^2
0	19.4	53.9	$\chi^2(6,\ N = 647) = 160.9$***	20.7	45.7	$\chi^2(6,\ N = 3242) = 495.5$***
1	24.7	32.8		24.2	33.4	
2	16.0	9.9		15.3	11.7	
3	14.5	2.2		15.7	6.4	
4	17.3	0.6		15.8	2.5	
5	7.7	0.6		7.8	0.7	
6	0.3.	0		0.5	0.2	

***$P = 0.000$.

Table 5. Comparisons of the prevalence of co-morbid conditions among women and men in the clinic and general population samples

	Women			Men		
	General population sample	Clinic sample	χ^2	General population sample	Clinic sample	χ^2
Substance misuse only	0	0	–	0.2% (4)	0.2% (4)	0.000 ($n = 3219$)
Substance misuse and crime	2.2% (7)	28.8% (90)	85.2*** ($n = 628$)	9.4% (149)	40.5% (627)	405.7*** ($n = 3135$)
Substance misuse and crime and physical illness	0.9% (3)	24.7% (77)	79.5*** ($n = 628$)	5.3% (84)	27.2% (423)	278.1*** ($n = 3142$)
Mental illness only	0.6% (2)	0.9% (3)	0.19 ($n = 639$)	1.1% (17)	0.9% (14)	0.29 ($n = 3219$)
Mental illness and substance misuse	0.9% (3)	13.5% (42)	36.9*** ($n = 628$)	1.8% (28)	13.6% (211)	156.2*** ($n = 3135$)
Mental illness and substance misuse and crime	0.6% (2)	10.9% (34)	30.6*** ($n = 628$)	1.5% (23)	13.0% (201)	156.7*** ($n = 3135$)

***$P = 0.000$.

poverty. Thus, seeking help for substance misuse problems in adolescence predicted multiple mental health and psychosocial problems in early adulthood, through middle adulthood, and that were still evident among the men from age 45 to 50 and among the women until age 45. Among the clinic women from age 45 to 50 elevations in risk were observed for physical illness, criminal offending and poverty. The results of this study support the recent conclusion that research should aim to investigate risk factors common to the spectrum of externalizing disorders rather than continuing to study each externalizing disorder separately (35, 36). This is similar to conclusions from older longitudinal studies that showed that the accumulation of problems was a better predictor of poor outcome than any one problem (37).

The analyses of trends demonstrated significant change over the 30-year follow-up period in the prevalence of all outcomes except physical and mental illness. The prevalence of death increased, while the prevalence of substance misuse, criminality and poverty declined over time. As expected, the decrease in criminality was greater among the clinic than the general population sample. The general population sample, however, showed a greater increase in serious physical illnesses related

to substance misuse than the clinic sample. Only two sex differences in trends were detected, a greater decline in criminality among men than women and a greater decline in hospitalization for serious mental illness among women than men.

The elevations in risk of serious physical and mental illness and poverty observed among the clinic sample compared to the general population sample were similar among women and men. The elevations in risk of death among the clinic sample were even higher among the women than the men, beginning in the early twenties and persisting to age 45. The elevations in risk of substance misuse and criminality among the clinic women were higher than those observed among the clinic men. The elevations in risk of all adverse outcomes among the clinic females are especially noteworthy as these women were giving birth and rearing children during the period under study.

A number of methodological features affect the interpretation of the results. This is the first study to assess multiple adverse outcomes over three decades of adult life comparing a sample of individuals who engaged in substance misuse while adolescents and a sample drawn randomly from the general Swedish population matched for sex, age and region of birth. The samples were relatively large and information was available
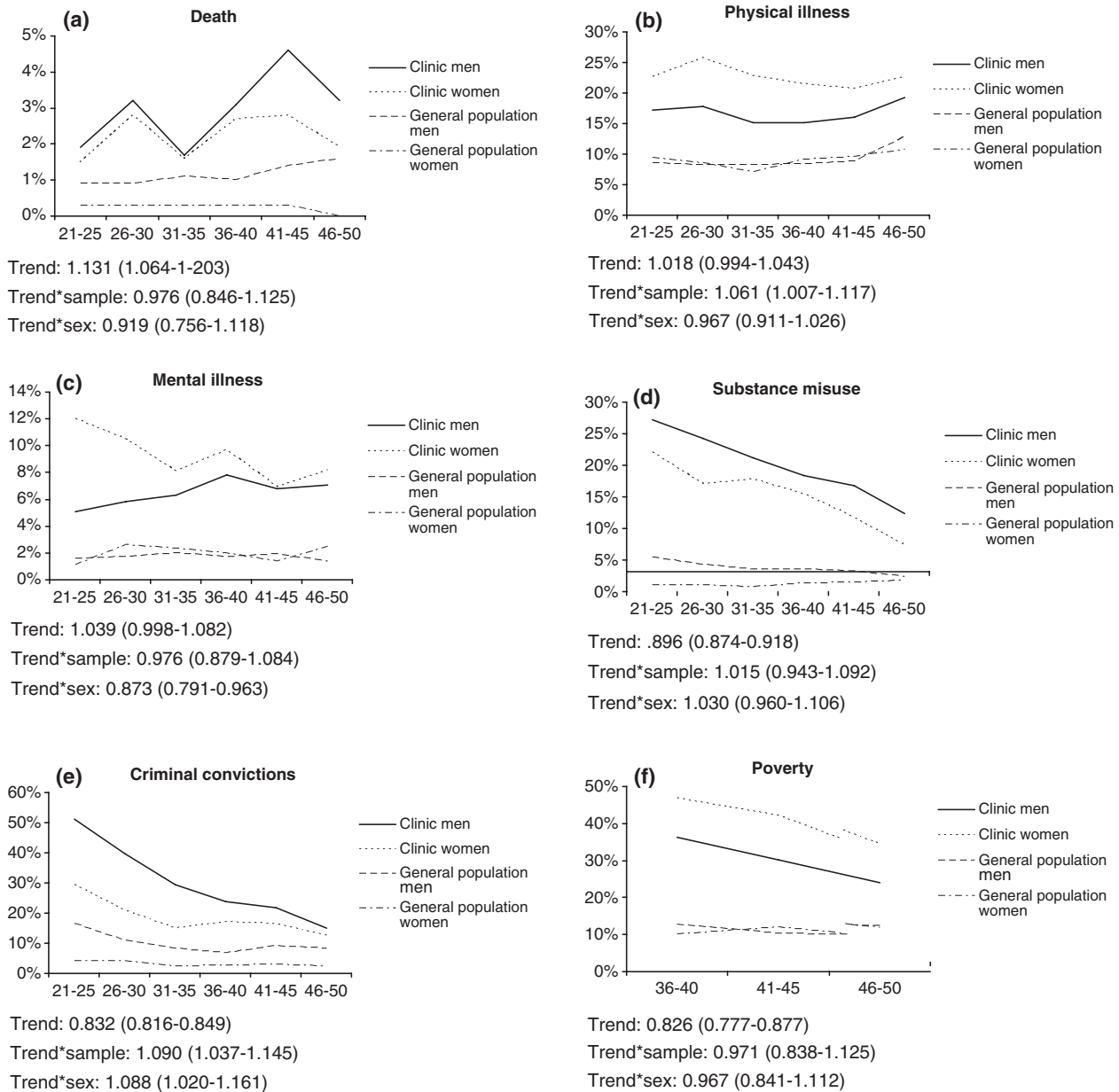
(a) Death

Trend: 1.131 (1.064-1-203)

Trend*sample: 0.976 (0.846-1.125)

Trend*sex: 0.919 (0.756-1.118)

(b) Physical illness

Trend: 1.018 (0.994-1.043)

Trend*sample: 1.061 (1.007-1.117)

Trend*sex: 0.967 (0.911-1.026)

(c) Mental illness

Trend: 1.039 (0.998-1.082)

Trend*sample: 0.976 (0.879-1.084)

Trend*sex: 0.873 (0.791-0.963)

(d) Substance misuse

Trend: .896 (0.874-0.918)

Trend*sample: 1.015 (0.943-1.092)

Trend*sex: 1.030 (0.960-1.106)

(e) Criminal convictions

Trend: 0.832 (0.816-0.849)

Trend*sample: 1.090 (1.037-1.145)

Trend*sex: 1.088 (1.020-1.161)

(f) Poverty

Trend: 0.826 (0.777-0.877)

Trend*sample: 0.971 (0.838-1.125)

Trend*sex: 0.967 (0.841-1.112)

Fig. 1. (a–f) The prevalence of the six adverse outcomes over 30 years of women and men in the clinic and general population.

through three decades on all but the few who had emigrated from Sweden or died. The length of the follow-up period and the breadth of outcomes that were assessed contribute to providing a valid indicator of the sequelae of adolescent substance misuse. The information on adverse outcomes was extracted from national registers that have been shown to be accurate and up-to-date and that were unbiased by subjects' substance misuse in adolescence. Both the strict definitions of the six adverse outcomes and the information available from the national registers would, in most cases, provide underestimations of the prevalence of adverse outcomes. For example, official criminal convic-

tions underestimate illegal activities, physical and mental illnesses were limited to those that led to hospitalization, and as noted in the Method section, coverage of all regions of the country for various time periods was incomplete, and information on poverty was available for only the last 13 years of the follow-up. A further limitation of the study is the lack of information about the general population sample in adolescence. While we know that none were treated at the clinic from 1968 to 1971, we do not know if they received treatment at another time.

The results of this study document the stability of multiple, probably inter-related problems,

491

across the life-span that follow from substance misuse in adolescence. If replicated, the challenge will be to uncover the contributing factors (38). In a general sense, the results concur with findings from longitudinal prospective investigations demonstrating poor physical and mental health and persistent criminality among substantial proportions of individuals who presented externalizing problems in adolescence (39) and that persistence of multiple psychosocial problems was greater than that of individual problems (37). Recent studies suggest that among the majority of adolescent substance misusers both externalizing and internalizing disorders onset in childhood prior to substance misuse (40). From the data available from the old clinic files, we were unable to assess the presence of mental disorders in adolescence. We have recently assessed a random sample of adolescents who consulted the same clinic in 2004. As in studies from North America, the great majority presented mental disorders that had onset prior to the substance misuse (41). Adolescent substance misuse has been shown to be associated with poor academic performance, and unemployment and a lack of financial autonomy (8, 9). Making the transition from adolescence to adulthood without work and life skills would be a difficult challenge, even in the absence of mental disorders. Having a criminal record may further limit employment opportunities.

The results of this study highlight the importance of assessing and treating the multiplicity of problems presented by adolescents who are misusing alcohol and/or illicit drugs to prevent continuation of current problems and the emergence of new ones. Relegating adolescent substance misuse to social services or the criminal justice system, as is done in many countries, fails to acknowledge the array of associated problems presented by adolescents who misuse substances and the likelihood of multiple adverse outcomes through adulthood. While evidence-based treatments do exist for many disorders that emerge in childhood and adolescence (42, 43), availability remains limited. Yet, given the findings from this study on the multiplicity of problems that co-occurred over three decades of adult life following adolescent substance misuse, it would be reasonable to propose that effective treatment when disorders first emerge might lead to reductions in human suffering and costs to society (44). In addition, effective treatment might protect the offspring of individuals who as adolescents misuse substances from developing problems similar to those presented by their parents. Inter-generational risk is conferred not only by genes but also by parenting practices and the wider environment that parents create for their offspring (45, 46). This is a further incentive to providing adolescents who are misusing substances with evidence-based treatments not only to eliminate their substance misuse, but also to reduce the associated mental and physical health problems and criminality, and to increase academic achievement and employment opportunities.

Acknowledgements

References

1. PATEL V, FLISHER AJ, HETRICK S, MCGORRY P. Mental health of young people: a global public-health challenge. Lancet 2007;**369**:1302–1313.
2. TOUMBOUROU JW, STOCKWELL T, NEIGHBORS C, MARLATT GA, STURGE J, REHN J. Interventions to reduce harm associated with adolescent substance use. Lancet 2007;**369**:1391–1401.
3. MERLINE AC, O'MALLEY PM, SCHULENBERG JE, BACHMAN JG, JOHNSTON LD. Substance use among adults 35 years of age: prevalence, adulthood predictors, and impact of adolescent substance use. Am J Public Health 2004;**94**:96–102.
4. WENNBERG P, ANDERSSON T, BOHMAN M. Psychosocial characteristics at age 10; differentiating between adult alcohol use pathways. A prospective longitudinal study. Addict Behav 2002;**27**:115–130.
5. ARSENEAULT L, CANNON M, POULTON R, MURRAY R, CASPI A, MOFFITT TE. Cannabis use in adolescence and risk for adult psychosis: longitudinal prospective study. BMJ 2002;**325**:1212–1213.
6. BROOK JS, COHEN P, BROOK DW. Longitudinal study of co-occurring psychiatric disorders and substance use. J Am Acad Child Adolesc Psychiatry 1998;**37**:322–330.
7. KANDEL DB, DAVIES M, DARUS D, YAMAGUCHI K. The consequences in young adulthood of adolescent drug involvement. Arch Gen Psychiatry 1986;**43**:746–754.
8. ELLICKSON PL, MARTINO SC, COLLINS RL. Marijuana use from adolescence to young adulthood: multiple developmental trajectories and their associated outcomes. Health Psychol 2004;**23**:299–307.
9. ELLICKSON PL, TUCKER JS, KLEIN DJ. Ten-year prospective study of public health problems associated with early drinking. Pediatrics 2003;**111**:949–955.
10. HOLMBERG MB. Longitudinal studies of drug abuse in a fifteen-year-old population. Acta Psychiatr Scand 1985;**71**:80–91.
11. ROHDE P, LEWINSOHN PM, KAHLER CW, SEELEY JR, BROWN RA. Natural course of alcohol use disorders from adolescence to young adulthood. J Am Acad Child Adolesc Psychiatry 2001;**40**:83–90.
12. MCGEE R, WILLIAMS S, POULTON R, MOFFITT T. A longitudinal study of cannabis use and mental health from adolescence to early adulthood. Addiction 2000;**95**:491–503.
13. VINER RW, TAYLOR B. Adult outcomes of binge drinking in adolescence: findings from a UK national birth cohort. J Epidemiol Community Health 2007;**61**:902–907.

14. Williams RJ, Chang SY. A comprehensive and comparative review of adolescent substance abuse treatment outcome. Clin Psychol Sci Pract 2000;**7**:138–166.
15. Winters KC. Treating adolescents with substance use disorders: an overview of practice issues and treatment outcome. Subst Abus 1999;**4**:203–225.
16. Brown SA, D'amico EJ, Mccarthy DM, Tapert SF. Four-year outcomes from adolescent alcohol and drug treatment. J Stud Alcohol 2001;**62**:381–388.
17. Chung T, Martin CS, Grella CE, Winters KC, Abrantes AM, Brown SA. Course of alcohol problems in treated adolescents. Alcohol Clin Exp Res 2003;**27**:253–261.
18. Friedman AS, Utada A, Glickman NW. Outcome for court-referred drug-abusing male adolescents of an alternative activity treatment program in a vocational high school school setting. J Nerv Ment Dis 1986;**174**:680–688.
19. Griffen-Shelley E, Sandler KR, Park-Cameron RP. A follow-up study of dually diagnosed (chemically dependent) adolescents. J Adolesc Chem Depend 1991;**2**:1–11.
20. Doyle H, Delaney W, Tobin J. Follow-up study of young attenders at an alcohol unit. Addiction 1994;**89**:183–189.
21. Mcpeake JD, Kennedy B, Grossman J, Beaulieu L. Innovative adolescent chemical dependency treatment and its outcome: a model based on outward bound programming. J Adolesc Chem Depend 1991;**2**:29–57.
22. Friedman AS, Schwartz R, Utada A. Outcome of a unique youth drug abuse program: a follow-up study of clients of Straight, Inc. J Subst Abuse Treat 1989;**6**:259–268.
23. Chen K, Kandel DB. Predictors of cessation of marijuana use: an event history analysis. Drug Alcohol Depend 1998;**50**:109–121.
24. Jackson KM, O'neill SE, Sher KJ. Characterizing alcohol dependence: transitions during young and middle adulthood. Exp Clin Psychopharmacol 2006;**14**:228–244.
25. Zillberman ML, Tavares H, Blume SB, El-Guebaly N. Substance use disorders: sex differences and psychiatric comorbidities. Can J Psychiatry 2003;**48**:5–15.
26. Patton GC, Coffey C, Carlin JB, Degenhardt L, Lynskey M, Hall W. Cannabis use and mental health in young people: cohort study. BMJ 2002;**325**:1195–1198.
27. Duncan SC, Alpert A, Duncan TE, Hops H. Adolescent alcohol use development and young adult outcomes. Drug Alcohol Depend 1997;**49**:39–48.
28. Irwin CE Jr, Burg SJ, Cart CU. America's adolescents: where have we been, where are we going? J Adolesc Health 2002;**31**:91–121.
29. Nissson AC, Spetz CL, Carsjo K, Nightingale R, Smedby B. Slutenvårdsregistrets tillförlitlighet. Diagnosuppgifter bättre än sitt rykte [The authenticity of the hospital discharge register. Diagnosis-information better than its reputation]. Lakartidningen 1994;**91**:598–605.
30. Cook RL, Clark DB. Is there an association between alcohol consumption and sexually transmitted diseases? A systematic review Sex Transm Dis 2005;**32**:156–164.
31. Room R, Babor T, Rehm J. Alcohol and public health. Lancet 2005;**365**:519–530.
32. Single E, Rehm J, Robson L, Truong MV. The relative risks and etiologic fractions of different causes of death and disease attributable to alcohol, tobacco and illicit drug use in Canada. CMAJ 2000;**162**:1669–1675.
33. Mathers CD, Lopez AD, Murray CJL. The burden of disease and mortality by condition: data, methods, and results for 2001. In: Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJL, eds. Global burden of disease and risk factors. New York, NY: Oxford University Press, 2006:45–240.
34. Larm P, Hodgins S, Larsson A, Samuelson YM, Tengström A. Long-term outcomes of adolescents treated for substance misuse. Drug Alcohol Depend 2008;**96**:79–89.
35. Hicks BM, Blonigen DM, Kramer MD et al. Gender differences and developmental change in externalizing disorders from late adolescence to early adulthood: a longitudinal twin study. J Abnorm Psychol 2007;**116**:433–447.
36. Baker LA, Jacobson KC, Raine A, Lozano DI, Bezdjian S. Genetic environmental bases of childhood antisocial behaviour: a multi-informant twin study. J Abnorm Psychol 2007;**116**:219–235.
37. Rönkä A, Kinnunem U, Pulkkinen L. Continuity in problems of social functioning in adulthood: a cumulative perspective. J Adult Develop 2001;**8**:161–171.
38. Dawes MA, Antelman SM, Vanyykov MM et al. Development sources of variation in liability to adolescent substance use disorders. Drug Alcohol Depend 2000;**61**:3–14.
39. Odgers CL, Caspi A, Broadbent JM et al. Prediction of differential adult health burden by conduct problem subtypes in males. Arch Gen Psychiatry 2007;**64**:476–484.
40. Armstrong TA, Costello EJ. Community studies on adolescent substance use, abuse, or dependence and psychiatric comorbidity. J Consult Clin Psychol 2002;**70**:1224–1239.
41. Hodgins S, Tengström A, Bylin S et al. Consulting for substance abuse: mental disorders among adolescents and their parents. Nord J Psychiatry 2007;**61**:379–386.
42. Compton SN, Burns BJ, Egger HL, Robertson E. Review of the evidence base for treatment of childhood psychopathology: internalizing disorders. J Consult Clin Psychol 2002;**70**:1240–1266.
43. Farmer EMZ, Compton SN, Burns BJ, Robertson E. Review of the evidence base for treatment of childhood psychopathology: externalizing disorders. J Consult Clin Psychol 2002;**70**:1267–1302.
44. Grisso T. Do childhood mental disorders cause adult crime? Am J Psychiatry 2007;**164**:1625–1627.
45. Button TMM, Scourfield J, Martin N, Purcess S, Mcguffin P. Family dysfunction interacts with genes in the causation of antisocial symptoms. Behav Genet 2005;**35**:115–120.
46. Feinberg ME, Button TMM, Neiderhiser JM, Reiss D, Hetherington EM. Parenting and adolescent antisocial behaviour and depression: evidence of genotype × parenting environment interaction. Arch Gen Psychiatry 2007;**64**:457–465.

Supporting Information