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Long-term outcomes of pharmacologically treated versus non-treated adults with ADHD and substance use disorder: a naturalistic study☆,☆☆

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ABSTRACT

Background and aims: The pharmacological treatment of individuals with attention deficit hyperactivity disorder (ADHD) and severe substance use disorder (SUD) is controversial, and few studies have examined the long-term psychosocial outcome of these treatments. Our aim was to investigate whether pharmacological treatment was associated with improved long-term psychosocial outcomes.
Methods: The present naturalistic study consisted of a long-term follow-up of 60 male patients with ADHD and comorbid severe SUD; all participants had received compulsory inpatient treatment due to severe substance abuse. The average interval between inpatient discharge and follow-up was 18.4 months. Thirty patients had received pharmacological treatment for ADHD, and 30 patients were pharmacologically untreated. The groups were compared with respect to mortality and psychosocial outcomes operationalized as substance abuse status, ongoing voluntary rehabilitation, current housing situation and employment status.
Results: The groups were comparable with regard to the demographic and background characteristics. Overall, mortality was high; 8.3% of the participants had deceased at follow-up (one in the pharmacologically treated group and four in the untreated group; the between-group difference was not significant). The group that received pharmacological treatment for ADHD exhibited fewer substance abuse relapses, received more frequently voluntary treatments in accordance with a rehabilitation plan, required less frequent compulsory care, were more frequently accommodated in supportive housing or a rehabilitation center, and displayed a higher employment rate than the non-treated group.
Conclusions: The recommendations for the close clinical monitoring of high-risk populations and the prevention of misuse and drug diversion were fulfilled in the structured environment of compulsory care for the treated group. Pharmacological treatment of ADHD in individuals with severe SUD may decrease the risk of relapse and increase these patients' ability to follow a non-pharmacological rehabilitation plan, thereby improving their long-term outcomes.

1. Introduction

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder that is characterized by hyperactivity and deficiencies in impulse control, as well as difficulties with sustained attention and distractibility. Endophenotypically, ADHD frequently involves impairments in executive functioning, such as planning and organizing actions, and in the regulation of emotions and motivation. Coexisting disorders, such as substance use disorder (SUD), are common for ADHD. In adults, the prevalence of ADHD in the general population is estimated to be between 2 and 4% (Fayyad et al., 2007); however, the prevalence of ADHD in adults with SUD is estimated to be as high as 20 to 50% (Gordon, Tulak, & Troncale, 2004; Sullivan & Rudnik-Levin, 2001; van Emmerik-van Oortmerssen et al., 2012). Conversely, the prevalence of SUD among ADHD patients is estimated to be approximately 50%. Thus,

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ADHD has been reported to be a strong predictor of SUD (Sullivan & Rudnik-Levin, 2001; Wilens et al., 2011). Additional and independent predictors of SUD are conduct disorder (CD) during childhood and antisocial personality disorder (ASPD) during adulthood (Hopfer et al., 2013; Rodgers et al., 2014; Saban, Flisher, Laubscher, London, & Morojele, 2014).

In nearly all major life activities, ADHD is associated with considerable functional impairments, which include academic underachievement, occupational limitations and difficulties with social and family life (Gordon et al., 2004; Sullivan & Rudnik-Levin, 2001; van Emmerik-van Oortmerssen et al., 2012). These impairments are also found in individuals with SUD. In a previously published study (Bihlar Muld, Jokinen, Bolte, & Hirvikoski, 2013), we conducted a clinical characterization of patients with ADHD and comorbid severe SUD compared with patients who exhibited severe SUD without known ADHD and patients with ADHD without severe SUD. Overall, both the ADHD/SUD and SUD groups attained a low educational level and minimal work experience; however, the ADHD/SUD group exhibited earlier and more persistent antisocial behaviors and abused stimulants more often than individuals with severe SUD without known ADHD. Compared with patients with ADHD without severe substance abuse, the ADHD/SUD group reported more ADHD symptoms during childhood and exhibited poorer general cognitive capacity (Bihlar Muld et al., 2013).

Pharmacological treatments for ADHD effectively reduce ADHD symptoms (Castells et al., 2011; Koesters, Becker, Kilian, Fegert, & Weinmann, 2009; Peterson, McDonagh, & Fu, 2008) and improve the daily functioning and quality of life of ADHD patients (Buitelaar et al., 2012; Rosler et al., 2013). Long-term beneficial effects of these pharmacological treatments on both symptom reduction and life functioning have also been reported (Fredriksen, Halmoy, Faraone, & Haavik, 2012). ADHD-specific treatments reduce the negative impact of ADHD on life functioning; however, these treatments do not necessarily restore life functioning to the level of healthy controls (Shaw et al., 2012). Fewer improvements have been found with regard to substance use, antisocial behavior, the use of mental health services and occupational impairments (Shaw et al., 2012). As a result, in patients with ADHD and comorbid SUD, pharmacological treatments have exerted a moderate or negligible effect on ADHD symptoms; however, the effect of these treatments on substance abuse is uncertain (Castells et al., 2011; Cunill, Castells, Tobias, & Capella, 2014; Wilens et al., 2005). One naturalistic study indicated that ongoing SUD was the primary reason for the discontinuation of stimulant medication (Torgersen, Gjervan, Nordahl, & Rasmussen, 2012). However, recent studies of adult male long-term inmates with SUD have shown that methylphenidate (MPH) reduces ADHD symptoms and improves global functioning, quality of life, and cognitive functions (Ginsberg, Hirvikoski, Grann, & Lindefors, 2012). Furthermore, Konstenius et al. (2013) found that ADHD symptoms and the risk for relapse were reduced in criminal offenders with ADHD and comorbid amphetamine abuse after MPH treatment (Konstenius et al., 2013). In this randomized control trial (RCT), individualized treatment protocols were administered with reference to decreased dopamine function in addicted subjects (Volkow, Fowler, Wang, & Swanson, 2004).

The availability of pharmacological treatments for individuals with ADHD and comorbid severe SUD may be limited by the controversy concerning the risks of prescribing stimulant medications to adults with ADHD and SUD, such as the potential misuse and abuse of prescribed stimulants and drug diversion (Bukstein, 2008; Faraone & Wilens, 2007; Kollins, 2008; Sepulveda et al., 2011). The factors that have been found to be critical for the individual assessment of risk include the patient's age, severity of both ADHD and SUD, comorbidity of conduct disorder or antisocial personality disorder, and past history of medication compliance (Klassen, Bilkey, Katzman, & Chokka, 2012; Kollins, 2008; Mariani & Levin, 2007; Perez de Los Cobos, Sinol, Perez, & Trujols, 2012).

In Sweden, approximately 1000 individuals per year are required to complete compulsory treatment for severe substance abuse in accordance with the Care of Alcoholics and Drug Abusers Act (LVM). The legislated duration of compulsory care is 6 months. The National Board of Institutional Care (SiS) is the authority that is responsible for the compulsory treatment of adults with substance abuse. The aim of the present study was to explore whether pharmacological treatment was associated with improved long-term psychosocial outcome using an observational follow-up study design. This study included a cohort of adult males with ADHD who were undergoing compulsory treatment for severe SUD; the same cohort was characterized in a previously published study (Bihlar Muld et al., 2013).

2. Methods

2.1. Study setting

This follow-up study was conducted between February 2008 and February 2009. All participants underwent compulsory care between 2004 and 2008 at SiS Institution Hornö in Enköping, Central Sweden. The target patient population of the SiS Institution Hornö is adult male patients who, in addition to substance abuse, have a history of violence or other severe psychiatric comorbidities. This study was approved by the Regional Ethics Committee of Stockholm (42-790-2012).

2.2. Participants

The patients came from different counties in Sweden and had been placed in a central unit of SiS. Fig. 1 describes the enrolment of the study participants. Between 2004 and 2008, 413 individuals were treated at the SiS Institution Hornö. Of the 71 patients referred for assessment, 47 were diagnosed with ADHD. In addition, 13 of the assessed patients were diagnosed with ADHD prior to admission to the institution and were also included in this study. Thus, the total number of participants in our study was 60; all were adult males with ADHD and comorbid severe SUD and were characterized in a previously published study (Bihlar Muld et al., 2013). The mean age of the participants was 26.25 years (SD = 6.02, range = 20–46 years) upon admission to the SiS Institution Hornö.

2.3. Procedures

2.3.1. General treatment goal at SiS Institutions

The purpose of treatment at SiS Institutions is detoxification, mental state stabilization, social, psychological and diagnostic assessment, motivational intervention, rehabilitation planning and transfer to a voluntary rehabilitation facility.

2.3.2. Diagnostic assessment

The diagnosis of ADHD was based on the *DSM-IV-TR* criteria (American Psychiatric Association, 2000) in all cases. The diagnostic assessment included multiple sources of information, including clinical interviews, standardized self-rating questionnaires such as the Wender Utah Rating Scale (WURS) (Ward, Wender, & Reimherr, 1993), collateral information from questionnaires, clinical interviews with the participants' significant others and additional information from medical records pertaining to child, adolescent and adult psychiatric services (when available). Although neuropsychological testing was not used to establish a diagnosis of ADHD, all diagnostic assessments included cognitive testing. The diagnosis of ADHD was established after a consensus was reached between either two to three experienced clinical psychologists from the institution or the investigative psychologist and a consulting specialist in neuropsychology. Standardized and validated rating scales and interviews, such as the Beck Depression Inventory (BDI), the Beck Anxiety Inventory (BAI), the Symptoms Checklist (SCL-90), and the Structured Clinical Interview for DSM Disorders (SCID-I), were used for the assessment of comorbid disorders (Beck & Steer, 2005; Beck, Steer, & Brown, 2005; Degoratis & Melisaratos, 1983; First & Herlofson, 1998). In patients with severe comorbidity, the diagnosis

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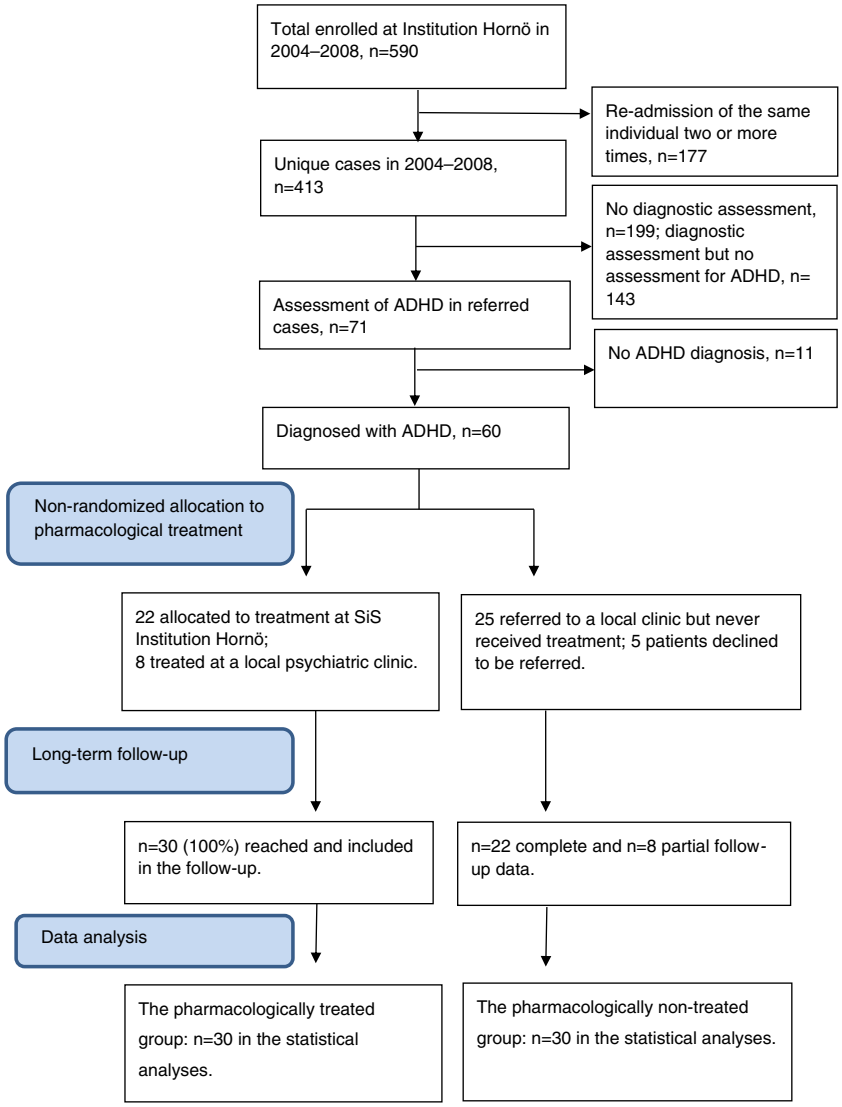

Fig. 1. Flowchart describing the enrollment of the participants.

was discussed with a consulting psychiatrist. This type of extensive, multiple data source, consensus-based diagnostic assessment was the standard in Sweden during the study period. The assessment procedures have been described in further detail in our previously published study (Bihlar Muld et al., 2013; First & Herlofson, 1998). In case of previous diagnosis of ADHD, the clinical procedure was to indent the previous medical records to SiS Institution Hornö. The aim was to validate the ADHD diagnosis before the patients were referred to a clinic within their hometown for pharmacological treatment. There were no large differences in diagnostic procedures between the individuals with previous diagnosis of ADHD ($n = 13$) and the individuals diagnosed at SiS Institution Hornö ($n = 47$).

2.3.3. Rehabilitation planning

During the legislated 6-month period of compulsory care, a rehabilitation plan that was based on the relevant clinical and psychosocial assessments was generated for each patient. The rehabilitation plan was individualized and based on the assessed need for rehabilitation and each patient's motivation to perform voluntary rehabilitation after completion of compulsory care. The rehabilitation options included rehabilitation institutions, family homes and supportive housing (all settings which provide 24-hour care). All rehabilitation options were covered by the social services agency in each patient's local municipality. For patients who had their own accommodations and a sufficient level of psychosocial functioning, outpatient care was offered as an option. All rehabilitation options included or were supplemented with psychiatric treatment and drug screening, except for six participants in supportive housing who refused or did not require parallel psychiatric treatment.

2.3.4. Pharmacological treatment

The patients who were diagnosed with ADHD were referred to a neuropsychiatric clinic or an addiction disorders clinic within the patient's hometown for pharmacological treatment, except for six patients who declined to be referred. These six patients were provided with the possibility of future referral. In all referred cases, the medical staff at SiS Institution Hornö contacted the patient's local clinic to initiate pharmacological treatment for ADHD, including the medications to be prescribed by the local clinic, during the compulsory care period at SiS Institution Hornö. The allocation of patients to these treatment groups is shown in Fig. 1.

2.4. Measures

2.4.1. Demographic and background data

The demographic and background data were obtained from the evaluation and documentation system (DOK), which is based on semi-

structured interviews with the patients in compulsory care for severe substance abuse. The DOK interviews are voluntary assessments that are performed upon admission to compulsory care and regard background information including life-time psychiatric symptoms. In the ADHD/SUD group, 22 of 60 participants had never participated in a DOK interview; in these cases, the data were obtained from the clinical assessments that were conducted subsequently during the compulsory care period. The DOK interview assessments and the clinical assessments have been described in detail in our previously published study (Bihlar Muld et al., 2013).

2.4.2. Long-term follow-up and outcomes

The follow-up data were collected between February 2008 and March 2009. The time between discharge from the institution and the beginning of the follow-up period ranged from 6 to 45 months ($M = 18.4$ months, median = 16 months, SD = 9.79 months).

The follow-up assessment began by contacting and interviewing the local social worker for each patient. In 46 cases, the patient maintained contact with the social services agency. Five of the 14 patients who no longer maintained contact with the social services agency were deceased. An additional five participants could not be tracked, either through their social workers or the tax authority's population registers; for four of these patients, it was possible to obtain information from their former local social workers regarding some aspects of their current social situation. The follow-up interviews with the patients took the form of either face-to-face meetings or telephone interviews. The questions that were asked during the interviews with the patients' social workers (and the patients who could be reached) were semi-structured. The topics that were surveyed are described below.

The *current abuse status* was categorized as no known substance abuse at the time of follow-up, no abuse due to compulsory care (e.g., imprisonment, forensic care, or a new period of compulsory care for substance abuse) or ongoing substance abuse.

2.4.2.1. Rehabilitation status. Patients who did not require rehabilitation due to good psychosocial functioning were defined as having a combination of no substance abuse, independent accommodation (which, in some cases, included supportive housing without psychiatric treatment) and current employment. Voluntary rehabilitation included long-term stays at an abuse rehabilitation center (24-hour care), a rehabilitation-oriented family home or supportive housing that included regular psychiatric care. Compulsory care was defined as imprisonment, forensic care or a new period of compulsory care for substance abuse at the time of the follow-up assessment. No rehabilitation due to other reasons included all patients who did not meet the rehabilitation criteria defined above, including patients exhibiting ongoing drug abuse, or homelessness, and those who could not be found.

The *accommodation status* was categorized as independent accommodation, rehabilitation center or family home (24-hour care), supportive accommodation or compulsory care, as defined above.

Employment status included two primary categories: employed and unemployed. The participants were considered to be employed if they participated in any form of structured and regular work or schooling. The unemployed participants were separated into subcategories that were related to the cause of unemployment (e. g., compulsory care, voluntary rehabilitation, sick leave and other reasons).

2.5. Statistical analyses

To investigate whether differences in long-term outcomes could be explained by differences at the time of compulsory care, the two groups (i.e., those who received pharmacological treatment for ADHD and those who did not) were compared regarding their demographic and background characteristics. Student's t-test was used for continuous variables, and the chi-squared test was used for categorical variables. On the t-tests, the degrees of freedom were corrected for unequal variance if indicated by Levene's test for the equality of variance. The effect sizes for the t-tests were expressed as Cohen's *d* (Cohen, 1988) and interpreted as follows: approximately .3 for a "small" effect, approximately .5 for a "medium" effect, and ≥.8 for a "large" effect. The effect sizes for the chi-squared tests were expressed as Φ (phi) and interpreted as a weak association (.10–.20), a moderate association (.20–.40), a relatively strong association (.40–.60), a strong association (.60–.80) or a very strong association (>.80) (Cohen, 1988). When comparing the groups regarding their psychosocial outcome variables, chi-squared tests were used. Multiple regression analysis was performed to adjust for the potential effect of follow-up interval on outcome measures. Individuals for which data were missing and deceased individuals were excluded using pairwise exclusion from the analyses of long-term outcomes. The alpha level was set at .05. The statistical analyses were performed using the SPSS statistical software package (IBM, SPSS™, version 20).

3. Results

Fig. 1 describes the enrolment of the participants in the ADHD/SUD group from SiS Institution Hornö. Among the 413 unique cases treated at SiS Institution Hornö between 2004 and 2008, assessments for ADHD were conducted on 71 patients, 13 of whom had previously been diagnosed with ADHD before admission and 47 of whom were diagnosed with ADHD at SiS Institution Hornö. Depending on the prerequisites and guidelines at their local clinic, 30 patients received pharmacological treatment for ADHD, and 30 patients did not receive pharmacological treatment. Of those patients who were being pharmacologically treated at the time of the follow-up evaluation, 22 patients had already begun pharmacological treatment for ADHD at SiS Institution Hornö (utilizing prescriptions from their local clinic), whereas eight patients began treatment at a local outpatient clinic after discharge. Thirty patients never began pharmacological treatment for ADHD. The reasons (when known) why these patients never started treatment are presented in a table within the supplementary materials.

3.1. Demographic and background characteristics

No statistically significant differences were found between the two groups in childhood conditions, IQ, educational level, work experience, history of treatment interventions or self-reported psychiatric symptoms, reported at admission to the SiS Institution Hornö (Tables 1–3).

3.2. Long-term outcomes

The follow-up interval was not a significant predictor of the patients' rehabilitation status, substance abuse status, accommodation status or employment status (all *p*-values >.10).

Table 4 compares the long-term outcome measures between the treated and non-treated ADHD groups.

3.2.1. Mortality

Upon the follow-up assessment, 5 of the 60 patients (8.3%) had deceased. The mean age at death was 25.0 years (SD = 3.8). No statistically significant difference in mortality was found between the two groups.

3.2.2. Substance abuse status

Our results indicate that relapses into substance abuse were significantly less frequent in the pharmacologically treated ADHD group than in the group that was not treated for ADHD ($p = .01$) (Table 4).

3.2.3. Rehabilitation status

Non-rehabilitation due to good psychosocial functioning was twice as frequent in the pharmacologically treated group (20%) than in the untreated group (10%). Voluntary treatment at the time of the follow-

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Table 1
Family background, education and work experience of the two groups of patients with ADHD and comorbid SUD in compulsory care: the pharmacologically treated group and the non-pharmacologically treated group.

	Pharmacologically treated $n = 30$	Untreated $n = 30$	χ^2	p	Φ
Family background					
Custodian other than biological parents	1 (3.3%)	2 (6.7%)	.87	.83	.12
Single parent	7 (23.3%)	5 (16.7%)			
Parents separated before the patient was 18 years old	13 (43.3%)	15 (50.0%)			
Both parents	9 (30.0%)	8 (26.7%)			
Psychiatric disorder and/or substance abuse among parents					
Psychiatric disorder and/or substance abuse among parents	18 (60.0%)	14 (46.7%)	.59	.44	.10
No psychiatric disorder and/or substance abuse in parents	12 (40.0%)	14 (46.7%)			
Missing data	0	2 (6.7%)			
Educational level					
Less than 9 years	6 (20.0%)	6 (20.0%)	.40	.82	.08
9 years	18 (60.0%)	16 (53.3%)			
Secondary school/vocational education	6 (20.0%)	8 (26.7%)			
Work experience					
Work experience ≤6 months	9 (30.0%)	14 (46.7%)	5.3	.07	.31
Work experience 6–24 months	8 (26.7%)	2 (6.7%)			
Work experience >24 months	13 (43.3%)	8 (26.7%)			
Missing data	0	6 (20.0)			

up assessment was more frequent in the pharmacologically treated group (36.7%) than in the untreated group (6.7%). Compulsory care was less frequent in the pharmacologically treated group (3.3%) than in the non-treated group (20%) ($p = .01$).

3.2.4. Accommodation status

Nearly 57% of the patients in the pharmacologically treated group were residing in supportive housing or a rehabilitation center, compared with just over 13% of those in the untreated group. Additionally, 30% of the patients in the untreated group were homeless or resided in compulsory care, compared with 10% of those in the treated group ($p = .028$).

3.2.5. Employment status

Because 60% of the participants were undergoing compulsory care or voluntary rehabilitation or were on sick leave, the employment status was relevant for only 24 participants (15 patients in the treated group and 9 patients in the non-treated group). Overall, 20% of the patients in the treated group and 13.3% of the patients in the untreated group were employed, whereas 30% of the patients in the treated group and 16.5% of the patients in the untreated group were unemployed ($p = .028$).

4. Discussion

To the best of our knowledge, this is the first long-term follow-up study of individuals with ADHD and severe SUD after compulsory care for SUD. In this naturalistic study, the group that had received pharmacological treatment for ADHD exhibited better long-term outcomes on all measures of functioning than the non-treated group. Mortality was high in the entire study group; however, mortality did not significantly differ between the two groups.

4.1. Functional outcome measures

Pharmacological treatment for ADHD has been shown to effectively reduce ADHD symptoms in several short-term randomized controlled trials (Castells et al., 2011; Koesters et al., 2009; Peterson et al., 2008); however, the results of studies that included individuals with ADHD and comorbid SUD have been inconclusive (Castells et al., 2011; Wilens et al., 2005). Few studies have evaluated the long-term effects of pharmacotherapy on functional outcome (Fredriksen et al., 2012). Functional outcome measures may better characterize the long-term outcome of patients with chronic disorders that display complex symptomatology, such as ADHD, than measures of symptom reduction (Rostain, Jensen, Connor, Miesle, & Faraone, 2013). The patients in the present study

Table 2
Previous rehabilitation, treatment intervention, and psychiatric care in the two groups of patients with ADHD and comorbid SUD in compulsory care (LVM): the pharmacologically treated group and the non-pharmacologically treated group.

	Pharmacologically treated $n = 30$	Untreated $n = 30$	χ^2	p	Φ
Special pedagogical support in primary school					
Special pedagogical support in primary school	11 (36.7%)	11 (36.7%)	.00	1.0	.00
No special pedagogical support	18 (60.0%)	18 (60.0%)			
Missing data	1 (3.3%)	1 (3.3%)			
Compulsory care during childhood					
Compulsory care	14 (46.7%)	12 (40.0%)	.17	.68	.05
No compulsory care	16 (53.3%)	17 (56.7%)			
Missing data	0	1 (3.3%)			
Previous imprisonment					
Imprisonment	23 (76.7%)	18 (60.0%)	.70	.40	.11
No imprisonment	7 (23.3%)	9 (30.0%)			
Missing data	0	3 (10.0%)			
Previous adult psychiatric care (in addition to care due to SUD)					
Psychiatric care during adulthood	19 (63.3%)	19 (63.3%)	.15	.70	−.05
No psychiatric care during adulthood	10 (33.3%)	8 (26.7%)			
Missing data	1 (3.3%)	3 (10.0%)			

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Table 3
Clinical characteristics in the two groups of patients with ADHD and comorbid SUD: the pharmacologically treated group and the non-pharmacologically treated group.

	Pharmacologically treated $n = 30$	Untreated $n = 30$	t or χ^2	p	d or Φ
Self-reported hallucinations and other psychotic symptoms (life-time)					
Hallucinations and other symptoms of psychosis	16 (53.3%)	19 (63.3%)	1.71	.19	−.17
No hallucinations or other symptoms of psychosis	11 (36.7%)	9 (30.0%)			
Missing data	3 (10.0%)	2 (6.7%)			
Self-reported symptoms of depression and anxiety (life-time)					
Symptoms of depression/anxiety	23 (76.7%)	28 (93.3%)	3.14	.08	−.24
No symptoms of depression/anxiety	5 (16.7%)	1 (3.3%)			
Missing data	2 (6.7%)	1 (3.3%)			
Preferred substance of abuse					
Heroin	6 (20.0%)	5 (16.7%)	.84	.99	.12
Amphetamines	15 (50.0%)	14 (46.7%)			
Cocaine	1 (3.3%)	2 (6.7%)			
Alcohol	2 (6.7%)	2 (6.7%)			
Hashish/marijuana	3 (10.0%)	2 (6.7%)			
GHB	2 (6.7%)	1 (3.3%)			
Benzodiazepines	1 (3.3%)	1 (3.3%)			
Missing data	0	3 (10%)			
Self-reported ADHD symptoms	*M* (SD)	*M* (SD)			
WURS score	61.20 (15.8)	58.95 (19.2)	−.44	.66	.131
Missing information	5 (16.7%)	8 (26.7%)			
Cognitive functions (WAIS-III)					
Full scale IQ (FSIQ)	88.8 (8.81)	87.4 (9.1)	−.55	.58	.157
Verbal IQ (VIQ)	87.8 (9.5)	87.2 (8.9)	−.23	.82	.066
Performance IQ (PIQ)	91.9 (10.6)	90.4 (11.4)	−.48	.64	.135
Verbal Comprehension Index (VCI)	88.9 (8.7)	91.5 (10.1)	.99	.33	.279
Perceptual Organization Index (POI)	93.3 (20.8)	93.3 (12.9)	−.02	.99	.004
Working Memory Index (WMI)	87.6 (12.9)	82.2 (12.5)	−1.52	.13	.436
Processing Speed Index (PSI)	81.7 (10.6)	81.7 (10.6)	−.55	.59	.161

who suffered from ADHD and comorbid severe SUD were characterized by early and persistent antisocial behavior, poor cognitive capacity, extensive psychiatric comorbidity and low psychosocial functioning (Bihlar Muld et al., 2013). Therefore, the present study evaluated the long-term functional outcomes of these patients after their discharge from compulsory care.

Table 4
Follow-up results for the rehabilitation group and the non-rehabilitation group regarding mortality, substance abuse status, rehabilitation status, accommodation status and employment status.

	All	Pharmacologically treated $n = 30$	Untreated $n = 30$			
	$N = 60$			χ^2	p	Φ
Mortality						
Deceased at follow-up	5 (8.3%)	1 (3.3%)	4 (13.3%)	1.96	.16	−.18
Substance abuse status						
No known substance abuse at follow-up	32 (53.3%)	23 (76.7%)	9 (30.0%)	8.08	**.02**	.41
No substance abuse due to compulsory care	7 (11.7%)	1 (3.3%)	6 (20.0%)			
Ongoing substance abuse	9 (15.0%)	5 (16.7%)	4 (13.3%)			
Deceased at follow-up	5 (8.3%)	1 (3.3%)	4 (13.3%)			
Missing data	7 (11.7%)	0	7 (23.3%)			
Rehabilitation status						
No rehabilitation due to good psycho-social functioning	9 (15.0%)	6 (20.0%)	3 (10.0%)	13.22	**.01**	.47
Voluntary rehabilitation	13 (21.7%)	11 (36.7%)	2 (6.7%)			
Compulsory care	7 (11.7%)	1 (3.3%)	6 (20.0%)			
No rehabilitation due to other reasons	26 (43.3%)	11 (36.7%)	15 (50.0%)			
Deceased at follow-up	5 (8.3%)	1 (3.3%)	4 (13.3%)			
Accommodation status						
Own housing	17 (28.3%)	9 (30.0%)	8 (27.7%)	10.88	**.028**	.47
Rehabilitation center/family home	10 (16.7%)	8 (26.7%)	2 (6.7%)			
Supportive housing	11 (18.3%)	9 (30.0%)	2 (6.7%)			
Compulsory care	7 (11.7%)	1 (3.3%)	6 (20.0%)			
Homeless	5 (8.3%)	2 (6.7%)	3 (10.0%)			
Deceased at follow-up	5 (8.3%)	1 (3.3%)	4 (13.3%)			
Missing data	5 (8.3%)	0	5 (16.7%)			
Employment status						
Employed or studying	10 (16.7%)	6 (20.0%)	4 (13.3%)	12.55	**.028**	.49
No employment	14 (23.3%)	9 (30.0%)	5 (16.7%)			
In voluntary rehabilitation	13 (21.7%)	11 (36.7%)	2 (6.7%)			
In compulsory care	7 (11.7%)	1 (3.3%)	6 (20.0%)			
On sick-leave	3 (5.0%)	2 (6.7%)	1 (3.3%)			
Deceased at follow-up	5 (8.3%)	1(3.3%)	4 (13.3%)			
Missing data	8 (13.3%)	0	8 (27.7%)			

Note: The numbers of individuals with missing data and deceased individuals are shown for the psychosocial outcome measures; these data were excluded from the statistical analyses using pairwise exclusion. The *p*-values presented in bold indicate a statistically significant difference.

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4.2. The institutional setting

Twenty-two of the 30 patients (73.3%) in the pharmacologically treated group began treatment for ADHD during a compulsory inpatient care period. The compulsory care setting facilitated the structured and monitored initiation of pharmacological treatment, which included drug screening, daily observations of each patient's mental state and response to the medication, and daily support and feedback regarding behavioral improvements. Initiating the pharmacological treatment at this institution may have reduced the risk for relapse during the vulnerable period immediately after discharge. Moreover, the patients may have also been more likely to select a voluntary rehabilitation option after discharge as a result of the benefits of multimodal treatment.

The institutional context in compulsory care for substance abuse corresponds to a prison context, as it pertains to a structured environment and treatment monitoring (Ginsberg & Lindefors, 2012). Additionally, the clinical characteristics of our study group, including the cognitive, psychosocial and comorbidity profiles, were similar to those of prison inmates with ADHD and SUD (Bihlar Muld et al., 2013; Ginsberg, Hirvikoski, & Lindefors, 2010). In previous studies, both symptom reduction and functional improvements were observed in inmates with ADHD after treatment with stimulant medication (Ginsberg et al., 2012; Konstenius et al., 2013). Thus, utilizing an institutional setting as an environment for the initiation of pharmacological treatment may be beneficial for severely disabled patients with ADHD and comorbid severe SUD.

4.3. Risks, benefits and treatment needs

The patient population with ADHD, SUD and persistent antisocial behavior is a group that is at high risk for the misuse and diversion of prescribed psycho-stimulants (Kollins, 2008; Rabiner, 2013; Wilens et al., 2008). Undoubtedly, it is a challenging task for clinicians to balance the pharmacologic needs of these patients with the risk of drug misuse and diversion (Mariani & Levin, 2007). In the current study, only half of the patients received pharmacological treatment for ADHD, which may be partially attributable to these risks.

The current guidelines for the treatment of ADHD (Bolea-Alamanac et al., 2014; Kooij et al., 2010; National Institute for Clinical Exellence, 2008) recommend non-stimulant medication as the first-line treatment for patients with ADHD and comorbid SUD. Additionally, close monitoring, the avoidance of short-acting stimulants and additional psychological treatments have been proposed to reduce the risks of abuse and misuse of prescribed stimulants (Klassen et al., 2012; Kollins, 2008; Mariani & Levin, 2007; Perez de Los Cobos et al., 2012).

Nevertheless, these risks should be weighed against the potential benefits of pharmacologic treatment, which include a decrease in criminality (Lichtenstein et al., 2012), a reduction in relapses, and better long-term functional outcomes in high-risk patients during pharmacologic ADHD treatment (Ginsberg et al., 2012). The mortality rate was high in the present study group. Moreover, this severely disabled patient group appears to be at risk for lifelong social exclusion. Thus, it is important to strive to improve the clinical care of this patient population (National Institute for Clinical Exellence, 2008). Both pharmacological and non-pharmacological treatment modalities (Hirvikoski, Waaler, Lindstrom, Bolte, & Jokinen, 2014; Hirvikoski et al., 2011) should be adjusted to the individual characteristics of each patient with ADHD and comorbid severe SUD.

4.4. Risk for confounding by indication

Because this study did not include a randomized design, it is possible that the association between the positive outcomes and the pharmacological treatment could be explained by differences in the baseline clinical characteristics. However, no between-group differences were detected at baseline. Furthermore, both the pharmacologically treated and non-treated groups had been sentenced to compulsory care on the same basis and were diagnosed according to the same assessment procedures. Moreover, the protocols for referral were identical. Although we cannot exclude the potential confounding resulting from the naturalistic design of this study, it does not appear to be plausible that background characteristics adequately explain the differences between the two groups in their long-term psychosocial outcomes.

4.5. Mortality and missing data

Mortality was high in the entire study group. The cause of death of the deceased patients was not reported because objective data could not be obtained from the Causes of Death Register. However, a common cause of death in patients with severe drug abuse, such as heroin abuse, is drug overdose. Our previous study (Bihlar Muld et al., 2013) of the same cohort of patients showed that that multiple drug abuse was common in this cohort; this characteristic may increase the risk of mortality due to drug overdose.

All of the patients who had no contact with social services or could not be reached were in the untreated group. This finding implies that the actual rate of ongoing drug abuse in the untreated group is unknown. However, in accordance with clinical experience and anecdotal information from their social workers, these patients were assumed to have relapsed into substance abuse. The differences at baseline (i.e., in the background characteristics) between the reachable and non-reachable patients could not be analyzed due to the small number of cases in the non-reachable group.

4.6. Limitations

One limitation of the naturalistic design of the present study was that the follow-up intervals differed between the two groups; however, this difference was not statistically significant and the follow-up interval was not a significant predictor of any of the psychosocial outcome measures. Moreover, despite the relatively long follow-up interval in the present study, many of the patients were continuing their planned rehabilitation at the time of the follow-up assessment. An even longer follow-up interval would have provided data on psychosocial outcomes after the rehabilitation context. Furthermore, the proportion of missing data was relatively high in the non-treated group, and we excluded individuals for which data were missing from the analyses. Based on our clinical experience and the information from patients' social workers, we assume that many of the patients who either did not respond to our attempts to contact them or could not be reached had relapsed. If this assumption is correct, the differences between the pharmacologically treated group and the non-treated group would be even greater. One further limitation of this study was that the data on pharmacological treatments were limited because we had no data regarding the details of the treatment regimen or information on the potential misuse or diversion of the prescribed medications. An additional limitation may be the generalizability of these results. The present study group was characterized by an extensive clinical burden, including persistent antisocial behaviors and high frequency of life-time substance use induced psychotic symptoms (in case of psychotic symptoms at admission, these generally disappeared after the detoxication and stabilization period). These attributes may not characterize the total population of individuals with ADHD and comorbid SUD. Furthermore, the study context of compulsory care due to SUD has no equivalent in most other countries. In this regard, the generalizability of our results is limited. However, individuals who exhibit a high symptom severity of both ADHD and SUD, in addition to comorbid psychiatric symptoms, are often found in other compulsory care settings, such as forensic care and institutional youth care, and in voluntary outpatient and inpatient addiction and psychiatric clinics (Klein et al., 1997; Rosler et al., 2004; Torok, Darke, & Kaye, 2012; Wilens et al., 2008).

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4.7. Conclusions and clinical implications

The present study suggests that the pharmacological treatment of ADHD may improve the long-term outcomes of individuals with ADHD and severe comorbid SUD after discharge from compulsory care. An institutional treatment setting during the initiation of pharmacological treatment may decrease the risk for relapse and increase the patient's motivation and ability to follow the corresponding non-pharmacological rehabilitation plan after discharge. In high-risk populations, close clinical monitoring is important for not only treatment compliance but also the prevention of drug misuse or diversion.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jsat.2014.11.005.

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