Title page

Title: Building abstinent networks is an important resource in improving quality of life

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Abstract

Aims: To investigate changes in social network and quality of life of a substance use disorder cohort as they progressed through treatment.

Design: Multi-site, prospective, observational study of 338 adults entering substance use disorder treatment.

Setting: Patients at 21 facilities across Norway contributed baseline data when they initiated treatment, and follow-up data was collected from them one year later.

Methods: The cohort was divided into those who completed, dropped out, and remained in treatment one year after treatment initiation. For each treatment status group, general linear models with repeated measures analyzed global and social quality of life with the generic QOL10 instrument over time. The between-group factor was a change in social network variable from the EuropASI.

Findings: Those who gained an abstinent network reported the largest quality of life improvements. Improvements were smallest or negligible for the socially isolated and those who were no longer in contact with the treatment system.

Conclusions: Developing an abstinent network is particularly important to improve the quality of life of those in substance use disorder treatment. Social isolation is a risk factor for impaired quality of life throughout the treatment course.

Keywords: *quality of life, substance use disorder, opioid maintenance treatment, social network, network intervention, isolation, patient-reported outcome*

1. Introduction

Substance use disorders (SUDs) significantly impair individuals' physical health, mental health, occupational engagement and economic security, and social relationships, in addition to impacting those close to them and their communities (Tiffany et al., 2012). As a chronic condition, SUDs require an approach towards an improvement in subjective functioning rather than solely disease cure, i.e. abstinence. Quality of life (QoL), "an individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (The WHOQOL Group, 1996), is a standard patient-reported outcome of chronic disease treatments. QoL is particularly pertinent to SUD treatment because it captures many of the life dimensions that are negatively impacted (Laudet and Stanick, 2010), and includes in particular attention to social aspects which may be neglected when measuring strictly medical outcomes (De Maeyer et al., 2009; De Maeyer et al., 2011; Zubaran et al., 2012).

1.1 Quality of life

While SUD research increasingly measures QoL, the traditional preeminence of substance-related outcomes is reflected in the assumption that reduced substance use will be an important predictor of improved QoL. More research is needed, however, as the latest reviews report no clear relationship between QoL and addiction severity measures among treated opioid dependents (De Maeyer et al., 2010), or between QoL and length of abstinence among people with a SUD in general (Rudolf and Watts, 2002). Recent studies have highlighted how factors such as physical activity and social inclusion can improve QoL while in treatment (Best et al., 2013; Giesen et al., 2016; Muller and Clausen, 2015).

Patients' QoL impacts their treatment trajectory. Low QoL can be a strong impetus for treatment initiation, and improved QoL a concrete goal (Laudet et al., 2009; Weiss et al., 2014). Improved QoL by treatment completion can reinforce abstinence and other positive treatment outcomes (Best et al., 2013; Laudet et al., 2009; Laudet and Stanick, 2010; Vederhus et al., 2016), while low QoL at treatment completion partly predicted relapse in one sample (Laudet et al., 2006). Most studies report significant improvements in QoL after initiating treatment, but among the few studies able to follow up with drop-outs, evidence is mixed as to whether dropping out negatively impacts QoL when comparing drop-outs to either completers or those still in treatment (Giacomuzzi et al., 2005; Gonzales et al., 2009; Stallvik and Clausen, 2017).

1.2 SUD treatment approaches

SUD treatment settings, approaches, and timeframes differ, from residential to outpatient, with and without pharmacological strategies. Inpatient and residential programs are usually of shorter duration than outpatient treatment, often due to healthcare financing models, which McLellan and others argue inappropriately and ineffectively treats SUDs as acute diseases that should respond to small doses of treatment (McLellan et al., 2014). Opioid maintenance treatment (OMT) was the first modality with a chronic-disease approach and the first to advocate for sustained QoL improvements as an independent outcome. Opioid maintenance and other treatments administered in an outpatient setting are considered less intensive options than treatment requiring hospitalization or residence (Proctor and Herschman, 2014), yet patients in OMT are considered "harder to treat" and often present with higher burdens of polysubstance use, multimorbidities, and barriers to employment and social inclusion. In Norway, OMT is considered as a life-long treatment; inpatient treatment is typically provided for 9-12 months, longer than in other countries.

Long-term studies of OMT patients have shown the longer the duration of treatment, the more stabilized a patient remains (Appel et al., 2001; Zippel-Schultz et al., 2016). For inpatients, the goal is to complete a distinct course of treatment. Dropping out of a long-term program such as OMT or before an anticipated completion date in inpatient or other treatment modalities increases the immediate risks of relapse and fatal overdose, and undermines other positive outcomes (Clausen, 2014; Simpson et al., 1997; Stark, 1992). Yet while immediate outcomes of those who completed short-term inpatient treatment may be better than outcomes after the same amount of time in those continuing in outpatient treatment, sustained care of former inpatients may be necessary to maintain such successes (Nordfjærn, 2010), hence the need for "continuing care" programs (McLellan et al., 2005; Proctor and Herschman, 2014).

1.3 The salience of social networks to SUD and treatment

Social networks can support or discourage treatment initiation and adherence. Among people with SUDs or in recovery, network support for abstinence is cross-sectionally associated with lower individual substance use (Day et al., 2013), both of which can be reinforced by mutual help groups (Litt et al., 2009). In longitudinal studies, having abstinent friends at treatment completion predicted abstinence, with no impact of family members or partners (Havassy et al., 1995), and adding people who are also in recovery to one's network improved abstinence rates (Jason et al., 2012; Polcin et al., 2010). Jason et al. additionally report that adding heavy users to one's network did not impact abstinence over time, while Zywiak et al. found networks remained unchanged among people who relapsed, but those who remained abstinent decreased their contact with substance-using network members and increased the amount of abstinent members in their networks (Zywiak et al., 2009). Yet abstinent networks may be difficult for adults with a SUD to build, and substance-using networks are the norm by the time substance using persons enter treatment (Valente et al., 2004).

Little is known about how network composition affects the QoL of those with a SUD, and the impact of treatment maintenance, completion, or cessation on these factors, despite an abstinent network and improved QoL both providing important recovery capital (Best et al., 2013; Laudet and White, 2008). Additionally, most social network studies were conducted among single-substance users, despite the new global norm of polysubstance use (UNODC, 2016), and it is unknown whether their results can be generalized to polysubstance users. In this paper, we address these important knowledge gaps with the following aims:

1. Measure global QoL and social QoL changes according to natural treatment progression in a heterogeneous group of polysubstance users.

2. Examine changes in QoL in relation to social network changes.

2. Material and Methods

2.1 Participants and setting

Participants for this analysis were drawn from a longitudinal, naturalistic, multi-site study, the Norwegian Cohort of Patients in Opioid Maintenance Treatment and Other Drug Treatment (NorComt) study (Muller et al., 2016a; Skjaervo et al., 2017). NorComt was designed to increase understanding of factors impacting treatment adherence and outcomes, for a diverse patient population, and across treatment modalities. Participants were consecutively enrolled in the study when beginning treatment at one of 21 participating facilities across Norway between 2012 and 2015, with no exclusion criteria. These facilities provided both OMT and medication-free inpatient treatment, and detoxification preceded enrollment. 548 individuals (74% of those eligible) enrolled and contributed baseline data (T0) through structured interviews with facility staff trained by the research group. As described in Muller et al. (2016a), the entire cohort was analyzed together because participants entering into the two treatment types were remarkably similar with regards to a high prevalence of polysubstance use, long histories of SUDs with previous medication-free outpatient and inpatient treatment experience, separation from the labor market, and physical and mental health problems.

All participants consented at T0 to being contacted to participate again one year later (T1) and provided contact information for themselves and family/friends for this purpose. Research staff spent up to six months attempting to contact participants at T1, and conducted similar structured interviews at locations of the participants' choosing, 11-18 months after T0. 62% (338) contributed useable data at T1. There were no differences in age, gender, substance use characteristics, treatment type, or QoL between the participants lost to follow-up and those who were interviewed at T1. However, participants lost to follow-up were slightly more likely to have been unemployed (93% compared to 86%).

The Norwegian Regional Ethics Committee approved NorComt, and all participants provided written, informed consent (ref: 2012/1131/REK).

2.2 Measures

2.2.1 QoL

The outcome of QoL was measured using the global and social subscales of the QOL10, a measure recently validated against the gold standard of the WHOQOL-BREF (Muller et al., 2016b). On a Likert-type scale of "very poor" to "very good", the five items in the global subscale elicit self-

evaluations of a respondent's current physical health, mental health, working ability, and overall QoL, as well as how one feels about oneself, while the social subscale includes five items on social functioning, ability to love, relationships with friends and partners, and sexual functioning (Supplementary Figure 1). The resulting scores are transformed to a 0-100 scale as per the WHOQOL Group's instructions (The WHOQOL Group, 1996), to enable comparison with other QoL tools.

2.2.1 Social network

At both T0 and T1, participants were asked a question from the EuropASI, "with whom do you spend most of your free time?" and answered being most alone (indicating social isolation), with family/friends with current substance or alcohol problems (a substance-using network), or with family/friends with no current substance or alcohol problems (an abstinent network) (Lauritzen and Ravndal, 2004). Based on changes between T0 and T1, we computed a change in social network variable: participants a) gained an abstinence network, b) maintained an abstinent network, c) gained a substance-using network, d) maintained a substance-using network, or e) were socially isolated at T1.

2.2.1 Treatment progression and other measures

Participants reported current treatment status at T1. If they were receiving any treatment, regardless of whether it was different from the type they began at T0, such as having switched from inpatient to OMT, or moved from outpatient OMT to a residential program with OMT, or if they had dropped out since beginning the study and subsequently re-entered, they were classified as having remained in treatment. Otherwise they reported having completed according to plan or having dropped out. We chose to measure treatment progression rather than months of treatment completed to account for the heterogeneity of approaches and intended durations of the treatments included in the study. For the remainder of this paper, "dropping out" refers to dropping out of treatment, not those lost to follow-up in the study itself.

Substance use was measured by the substance profile from the EuropASI, in which participants reported their top four most commonly used substances over the past six months (Lauritzen and Ravndal, 2004). The General Symptom Index score (GSI) calculated from the Hopkins Symptoms Checklist-25 measured psychological distress on a 0-3 scale, in which mean scores above the cut-off of 1.0 indicate distress warranting clinical attention (Ravndal and Lauritzen, 2004).

2.3 Analysis strategy

Participants interviewed at T1 were divided into three treatment status groups based on their progression: those who remained in treatment; those who had completed, and those who had dropped out. Each treatment status group's sociodemographics, health, substance, and social network characteristics were described at T0 and T1, and compared at T1 using χ^2 , analyses of variance, and Tukey's post-hoc tests.

General linear models with repeated measures were used to explore the main and interaction effects of time, current treatment status, and changes in social networks on QoL. First, the data were examined to assess acceptability for this analysis, and the assumptions of independence of observations and homogeneity of variance were met. The outcome in each domain was non-normally distributed; however, based on a visual assessment of each Normal Q-Q plot, non-normality was determined to be modest. We used the Greenhouse-Geisser F-tests in every model, because Mauchly's test of sphericity was violated. The first models tested the interaction effect of time and treatment status (the between-subject factor) on global and social QoL. A significant interaction effect indicates the treatment status groups' QoL changes were of different magnitudes. In the second models, each

treatment status group was analyzed separately, and network change was the between-subject factor. A significant interaction effect indicates that QoL changed differentially between the network groups. In both models, a main effect of time indicates that all groups' QoL changed significantly between T0 and T1. Effects are reported in the figures.

The small group sizes created by examining network changes by treatment status preclude the addition of categorical covariates. However, we specifically wished to prevent our QoL models from simply mirroring psychological distress (psychological distress highly correlated to global QoL score, $r = -0.69$, $p < 0.001$ at follow-up), and so we controlled for psychological distress at T1 by adding it as a continuous covariate in each global QoL model.

Improvement in QoL was defined as an increase exceeding the minimum clinically important difference (MCID), calculated as 0.5 of the standard deviation of change (Den Ouden et al., 2013). Three participants did not report their current treatment status at T1, excluding them from this paper (see Fig. 1). Social network change was also unknown for another participant, excluding them only from the second repeated measures models. Several outliers in QoL scores at T0 and T1 were detected and their removal did not alter results, therefore they remained in the analyses.

A subgroup analysis was conducted by stratifying by treatment type at study initiation, as half of the cohort began OMT and half began medication-free inpatient treatment. All analyses were performed with SPSS v24.

3. Results

3.1 Participants characteristics at T0 and T1

Table 1 displays demographics, health, and substance use of the 338 study participants by treatment progression: 254 participants remained in treatment, 31 had completed, and 53 had dropped out. Participants in treatment were slightly older than both those who completed and dropped out. Otherwise, participants did not differ in demographics. Rates of employment/studying increased over time, and those who completed reported the most employment/studying by T1. Those who completed had the lowest levels of psychological distress at T1, despite the three groups beginning with similar levels at T0.

At T1, those who completed were characterized by lower rates of all substances and those who dropped out by higher rates, with the exception of alcohol, which was consumed by similar proportions of all groups (Table 1). The most commonly used substances at T1 were cannabis, amphetamines, and unprescribed benzodiazepines. All of those who completed had begun medication-free inpatient treatment at T0, as had most who had dropped out (73.6%), while two-thirds of those remaining in treatment had entered OMT (63.8%). Those who completed treatment reported an average of 9.7 months of inpatient treatment, while those who dropped out reported only 3.2 months, and those remaining reported 2.8 months of inpatient and 6.1 months of OMT.

Of the entire cohort, gaining an abstinent network was most common (40.1%), followed by maintaining an abstinent network (21.4%). 13.9% maintained a substance-using network, 7.1% gained a substance-using network, and 17.5% were socially isolated by T1. Those who completed had nearly half the rate of social isolation at T0 (9.7%) than the others (24.5% of those who dropped out and 16.7% of those in treatment), as displayed in Table 1. At T1, nearly all who completed treatment reported an abstinent network (90.3%), compared to 61.4% of those in treatment and less than half of those who

dropped out (45.3%). None who completed treatment maintained their substance-using network at T1 (Figs. 3b, 3e). Social isolation was less than half as likely among those who completed (6.5%) as among those who dropped out (18.9%) or those in treatment (18.5%), while a substance-using network was most common among those who dropped out (35.8%), followed by those in treatment (20.1%) and those who completed (3.2%).

3.2 QoL changes by treatment progression

Participants who had completed reported the highest global and social QoL scores at T1 (Figs. 2a and 2b). Global QoL improved between T0 and T1 for all participants, controlling for psychological distress at follow-up, both statistically and to an extent which can be considered clinically relevant, in excess of the MCID of 7.9. Social QoL also improved between T0 and T1, again in statistically and clinically relevant manners, exceeding the MCID of 10.2. Women and men's QoL changes did not differ, either when analyzed as an entire cohort or divided by treatment status (not reported).

3.3 QoL changes by social network changes

For participants still in treatment, those who gained an abstinent network improved their global QoL more than those whose networks changed in different manners (a statistically significant interaction between *time* and *social network change* on global QoL, Fig 3a). The patterns seen in Figs. 3a-f were for participants who gained or maintained an abstinent network to report the largest gains in both types of QoL. Participants who gained a substance-using network or lacked a network reported the smallest improvements. QoL changes were under the threshold of clinical relevance for those who had completed but were isolated at T1 (global QoL), and for those who had dropped-out and a) gained a substance-using network or b) remained or became isolated (social QoL).

A second subgroup analysis was conducted for participants who entered the study in inpatient treatment (n=162) or in OMT (n=176). Results for the inpatient cohort (not reported) were similar as for the entire sample: global and social QoL improved as a function of time, and social QoL improved additionally as a function of treatment status; those who completed improved more than those who dropped out or remained in treatment. For those currently in treatment, there was again a significant interaction effect of *time* and *social network change* on global QoL, with those who gained an abstinent network reporting the largest improvements.

The OMT cohort also reported similar global QoL improvements as the entire sample (not reported). The social QoL of these participants, however, was more precarious (Supplementary Fig. 2a). In this subgroup, social QoL did not improve as a function of time as it did for the inpatient subgroup, but as a function of treatment retention: only those who remained in treatment at T1 (n=147) reported improved social QoL. Among those who dropped out (n=12), the socially isolated again reported the lowest social QoL at T1, and participants who maintained a substance-using network reported a clinically significant deterioration of social QoL (Supplementary Fig. 2b).

4. Discussion

Among this heterogeneous sample of 338 adults, most entered SUD treatment with a substance-using social network, and severely impaired QoL was the norm. One year later, gaining or maintaining an abstinent network was related to the highest QoL at T1 for all participants. In particular, participants who gained an abstinent network and remained in treatment reported statistically significantly larger global QoL improvements, and clinically significant improvements in global and social QoL. Participants who completed or dropped out of treatment and who were socially

isolated or with a new a substance-using network reported the smallest, or clinically insignificant, QoL changes. In light of these results the clinical approach to facilitate in treatment should be developing networks that are majority abstinent.

4.1 QoL changes and treatment progression

Several of our findings align with previous studies. All three treatment status groups improved their global and social QoL with statistical and clinical significance – although it is important to note that global QoL still remained under population norms at T1 (Hanestad et al., 2004), similar to findings by other recent longitudinal studies (Feelemyer et al., 2014; Karow et al., 2011; Tracy et al., 2012). Patterns in substance use among networks followed patterns in participants' own use, as predicted by both peer selection and social influence theories (Becker and Curry, 2014; Bohnert et al., 2009). Participants who completed treatment distinguished themselves from those who dropped out and those still in treatment at follow-up by having better mental health, using less substances, and being more connected to the labor market or educational system at T1. All who completed treatment began in inpatient treatment rather than outpatient OMT at T0, which is expected due to the long-term provision of OMT in Norway.

The subgroup analysis showed more similarities than differences in QoL changes between patients entering OMT and inpatient treatment. Global QoL improved over time for both, and the largest improvements by those who had built an abstinent network while remaining in treatment. Social QoL particularly improved for participants who completed inpatient treatment and gained an abstinent network, while it declined for those who dropped out of OMT and maintained a substance-using network. Only twelve participants who began in OMT had dropped out, so this finding of statistical significance should be read with caution. OMT is in any case intended to be long-term, and the more severe social vulnerabilities that these patients face warrant enhanced retention efforts during treatment, including building social networks.

4.2 QoL changes and social network changes

Our observations of abstinent networks, both new and maintained, being linked to higher QoL also agrees with Mawson et al's cross-sectional study, in which identification with an abstinent network was associated with higher QoL in one domain (Mawson et al., 2015). The novelty and strength of our analysis is that we also examine how social networks developed along with QoL over time. The patterns in clinical significance of QoL improvements across the three treatment status groups suggest clear QoL benefits of building an abstinent network, and entering treatment may provide an important push to begin doing so. Particularly notable is that two-thirds of the 31 who completed treatment entered with a substance-using network, but none reported a substance-using network at T1. It may be that all substance-using members in their networks became abstinent during the study's duration, perhaps due to entering treatment themselves, and these members supported participants' own recovery (Davey et al., 2007). More likely is that participants who completed were able to diversify their networks by excluding substance-using members (focusing on existing networks) or including more abstinent members (building new networks). These two strategies have been developed mainly in interventions for the alcohol use disorder population but can be adapted to a polysubstance-using clientele (Day, 2017). Network Therapy recruits existing network members to be part of the therapeutic team (Galanter, 2014), and Motivated Stepped Care requires the participation of at least one existing abstinent network member (Brooner and Kidorf, 2002). Network Support treatment, on the other hand, builds the social skills necessary to meet new people and encourages participation in new abstinent and recovery-oriented networks such as Alcoholics Anonymous (Litt et al., 2016), mutual-help groups whose strategy includes exactly such abstinent network-building.

One-fifth of the cohort was socially isolated one year after treatment initiation, a similar proportion as found in Güttinger et al.'s (2003) six-year OMT follow-up. Social isolation and loneliness are established risk factors for impaired QoL among numerous other healthy and clinical populations (Luyckx et al., 2014; Orwelius et al., 2011), and this subgroup is at particular risk. Participants who completed had half the rates of social isolation at T0 as the others, suggesting that entering treatment without a network might deprive one of important recovery support and resources. Havassy et al. (1995) also reported that having no close friends at treatment completion predicted relapse after six months. The aforementioned network interventions may fail if participants have no network to build on. The Social Behavioral and Network Therapy intervention has modified Motivated Stepped Care by both focusing on reducing contact with substance-using network members and adapting to participants who lack a network (Copello et al., 2002), and this could be integrated into standard SUD treatment to specifically help isolated patients and those at risk of dropping out.

It may not be enough to encourage isolated patients to simply make social contact if those around them are also substance-using (Schroeder et al., 2001; Tucker et al., 2015) or engaged in other risky behaviors (Merrin et al., 2016), even if these other substance users provide social support (Day et al., 2013; Falkin and Strauss, 2003). Patients should be assisted in identifying potential sources of substance-free individuals, such as through twelve-step programs and other mutual help groups, occupational training programs, fitness groups, or religious communities, and this should be an ongoing focus, including for long-term treatments such as OMT. Tools that chart network composition, such as the Important People Drug and Alcohol Interview (Zywiak et al., 2009), could be used at both treatment entry and during follow-up, to direct clinical focus to networks and to encourage change during treatment.

4.3 Limitations

The naturalistic study design and subsequent range of participants' substance use, treatment courses, and treatment retention is a strength of this study, as most people with SUD typically use multiple substances and move in and out of the treatment system, yet few studies examine individuals' natural treatment progression. The 62% follow-up rate is at the lower end of the expected range for follow-up studies with this population. While we see no evidence of selection bias at study inclusion between those lost to follow-up and those interviewed again, the 9% treatment drop-out rate in this study – primarily among participants who began in inpatient treatment – is lower than the 59% three-year attrition rate from inpatient treatment reported by a similar longitudinal study (Melberg et al., 2003). It is likely that we were more able to follow up with people remaining in treatment or those who had completed than with those who had dropped out of treatment, meaning the treatment drop-outs we reported on may not be representative of all treatment drop-outs in Norway. The generalizability of our findings related to QoL and abstinent networks among participants who completed or remained in treatment to other SUD populations internationally would not be affected. Moreover, we suspect that including a larger proportion of those who dropped out of treatment would strengthen the associations between QoL and network change.

Further limitations exist. QoL changes could be due to changes in other collected or uncollected variables that occurred between T0 and T1, the most often suggested being reductions in substance use. Treatment groups themselves provided a proxy of substance use at T1, with participants who dropped out using the most and those who completed the least. Nevertheless, a baseline analysis of this sample found no association between addiction severity and QoL at treatment initiation (Muller et al., 2016a). Part of these QoL gains may also be due to regression to the mean, in that treatment succeeded in engaging people with such impaired QoL that improvements could be expected over time (Pasareanu et al., 2015). This concern is somewhat assuaged by the fact that

improvements were not seen across the board: the subgroup of socially isolated participants outside of the treatment system, having completed or dropped out, reported no changes.

5. Conclusion

In this analysis, we compared participants who remained in SUD treatment after one year with those who had completed or dropped out of treatment, all of whom had initiated treatment with severely impaired QoL. The QoL benefits of any contact with the treatment system, regardless of treatment type or even if terminated prematurely, are apparent. Furthermore, gaining or maintaining an abstinent network after treatment initiation was related to improved QoL, while social isolation, particularly for those outside of the treatment system, predicted little to no QoL improvements. Particular clinical attention should be given to those without a network. The first step is for network composition to be assessed regularly during treatment and follow-up. Every clinical SUD practice should actively support and facilitate abstinent network-building, as both abstinent networks and higher QoL itself can support recovery efforts.

Conflict of interest

The authors report no conflicts of interest.

Funding

This study was funded by the Norwegian Centre for Addiction Research.

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Table 1 Participant characteristics of 338 substance use disorder patients followed up one year after beginning treatment

	Treatment progression							
	In treatment (n=254)		Completed (n=31)		Dropped out (n=53)		Total (n=338)	
	Column A		Column B		Column C			
	T0 N (%)	T1 N (%)	T0 N (%)	T1 N (%)	T0 N (%)	T1 N (%)	T0 N (%)	T1 N (%)
Women	77 (30.3)		6 (19.4)		16 (30.2)		99 (29.3)	
Age [mean (SD)] **	35.0 (10.0) ^{BC}		29.8 (7.8) ^A		31.4 (10.1) ^A		34.0 (10.0)	
Treatment type at inclusion***								
Inpatient	92 (36.2)		31 (100.0)		39 (73.6)		162 (47.9)	
OMT	162 (63.8)		0		14 (26.4)		176 (52.1)	
Nordic-born	233 (92.5)		29 (93.5)		48 (90.6)		310 (92.3)	
Secondary school or more	118 (47.0)		11 (35.5)		18 (34.0)		147 (43.9)	
Single	234 (93.3)	209 (83.6)	30 (96.8)	25 (80.6)	50 (94.3)	43 (82.7)	316 (93.8)	277 (83.2)
Working or studying***	36 (14.5)	82 (32.3)	6 (20.0)	23 (74.2)	5 (9.4)	18 (34.0)	47 (14.2)	123 (36.4)
Stable recent housing situation	203 (80.6)	240 (95.2)	22 (73.3)	27 (90.0)	35 (66.0)	49 (92.5)	260 (77.6)	316 (94.3)
Social network**								
Abstinent network	87 (34.4)	156 (61.4)	6 (19.4)	28 (90.3)	7 (13.2)	24 (45.3)	100 (29.7)	208 (61.5)
Substance-using network	123 (48.6)	51 (20.1)	22 (71.0)	1 (3.2)	33 (62.3)	19 (35.8)	178 (52.8)	71 (21.0)
No network	43 (17.0)	47 (18.5)	3 (9.7)	2 (6.5)	13 (24.5)	10 (18.9)	59 (17.5)	59 (17.5)
Psychological distress [mean (SD)]**	1.32 (0.84)	1.18 (0.83) ^B	0.99 (0.61)	0.64 (0.50) ^{AC}	1.29 (0.76)	1.32 (0.95) ^B	1.3 (0.8)	1.2 (0.8)
Treatment past 12 mo. [mean (SD)]								
Inpatient, in months		2.8 (4.5) ^B		9.7 (2.8) ^{AC}		3.2 (3.2) ^B		3.5 (4.6)
OMT, in months		6.1 (5.6) ^{BC}		0 ^A		1.3 (3.0) ^A		4.8 (5.5)
<u>Substance use</u>								
Any**	243 (96.8)	165 (65.0)	29 (96.7)	11 (35.5)	53 (100)	40 (75.5)	328 (97.6)	216 (63.9)
Alcohol	64 (25.2)	68 (26.8)	9 (29.0)	11 (35.5)	18 (34.0)	13 (24.5)	91 (26.9)	92 (27.2)
Cannabis***	152 (69.8)	90 (35.4)	24 (77.4)	3 (9.7)	45 (84.9)	30 (56.6)	221 (65.4)	123 (36.4)
Heroin*	95 (37.4)	51 (20.1)	4 (12.9)	0	15 (28.3)	13 (24.5)	114 (33.7)	64 (19.0)
Unprescribed OMT medicines*	61 (24.0)	14 (5.5)	2 (6.5)	0	8 (15.1)	7 (13.2)	71 (21.0)	21 (6.2)
Unprescribed benzodiazepines***	124 (48.8)	60 (23.6)	19 (61.3)	1 (3.2)	33 (62.3)	22 (41.5)	176 (52.1)	83 (24.6)
Amphetamines***	141 (55.5)	74 (29.1)	19 (61.3)	1 (3.2)	40 (75.5)	26 (49.1)	200 (59.2)	101 (39.9)
Cocaine, LSD, ecstasy, other central stimulants*	50 (19.7)	12 (4.7)	13 (41.9)	0	16 (30.2)	7 (13.2)	79 (23.4)	19 (5.6)

OMT: opioid maintenance therapy.

Differences in treatment progression groups at T1 (follow-up) were explored using either chi-squares for categorical variables or analyses of variance for continuous variables; group differences at T1 are indicated by: * $p<0.05$, ** $p<0.01$, *** $p<0.001$. For continuous variables, Tukey's post hoc tests were then conducted, and superscripts (A,B,C) indicate which column means differ from a column at $p<0.05$).

Fig. 1

Figure 2

Figure titles

Fig. 1: Participant flow chart of 338 substance use disorder patients followed up one year after beginning treatment

Fig. 2a: Global QoL by treatment progression

Fig. 2b: Social QoL by treatment progression

Fig. 3a: Global QoL of those in treatment

Fig. 3b: Global QoL of those who dropped out

Fig. 3c: Global QoL of those who completed

Fig. 3d: Social QoL of those in treatment

Fig. 3e: Social QoL of those who dropped out

Fig. 3f: Social QoL of those who completed

Figure legends

Fig. 1: Participant flow chart showing 338 individuals who had completed treatment, dropped out, or remained in treatment at the time of the T1 interview, one year after beginning treatment.

Fig. 2: Both global and social QoL improved over one year for participants who completed, dropped out, or remained in treatment.

Fig. 3: Global and social quality of life changes among each treatment progression group, with social network as the between-subject factor. Statistical and clinical significance are reported.

Role of funding source

Nothing declared

Contributors

AEM collected participant data at T1, prepared the files for statistical analysis, performed the statistical analysis, and drafted the paper. SS participated in the statistical analysis, discussion of the paper, and writing up. TC was the project manager for the study and participated in the statistical analysis, discussion of the paper, and writing up. All authors read and approved the final manuscript.

Conflict of Interest

No conflict declared.

Acknowledgements

The authors are grateful to Marte Handal for her constructive feedback on the manuscript, NorComt's patients and facility staff for their participation, and fellow PhD students Kristine Fiksdal Abel and Ingeborg Skjærvø for their contributions and advice.

Drug and Alcohol Dependence Highlights

- Patients who stayed in treatment, dropped out, or completed were interviewed twice
- Gaining an abstinent social network correlated with quality of life improvements
- Social isolation appears particularly risky for those outside of the treatment system
- Clinical focus needs to be on increasing contact with abstinent peers

Supplementary Figure 1: QOL10	
<u>Global subscale</u> How do you consider your mental health at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How would you assess your quality of your life now? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How do you consider your physical health at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How do you feel about yourself at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How is your working ability at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good	<u>Social subscale</u> How do you consider your social functioning at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How do you consider your ability to love at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How are your relationships with your friends at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How do you consider your sexual functioning at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good How is your relationship with your partner at the moment? (1) very poor (2) poor (3) neither good nor poor (4) good (5) very good
QoL: quality of life	

Supplementary Figure 1 legend: The five items in each of the QOL10's global and social subscales.

Supplementary Figure 2: Quality of life of opioid maintenance treatment subgroup

Supplementary Figure 2 legend: In a subgroup analysis of participants who began in OMT, social QoL improved over time only for those who remained in treatment. The most precipitous decline was reported by those who had dropped out of treatment and maintained a substance-using network.