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FULL-LENGTH REPORT

Longitudinal associations between psychiatric comorbidity and the severity of gambling disorder: Results from a 36-month follow-up study of clients in Bavarian outpatient addiction care

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ABSTRACT

Background and aims: Individuals with gambling disorder (GD) often suffer from psychiatric comorbidities. Previous studies demonstrated greater severity of GD among gamblers with psychiatric comorbidities. However, evidence on the association between psychiatric comorbidity and course of GD severity during and after outpatient treatment is sparse. This study analyses data from a longitudinal one-armed cohort study on outpatient addiction care clients over three years. *Methods:* We investigated the course of GD severity using data from 123 clients in 28 outpatient addiction care facilities in Bavaria using generalized estimation equations (GEE). We applied *time** interaction analyses to examine different development profiles in participants with and without (1) affective disorders, or (2) anxiety disorders, and (3) to account for the co-occurrence of both. *Results:* All participants benefitted from outpatient gambling treatment. Improvement in GD severity was poorer in participants with anxiety disorders compared to participants without anxiety disorders. The co-occurrence of affective and anxiety disorders was linked to a less favourable course of GD than the presence of affective disorders alone. However, the combined occurrence of both disorders was more favourable than the presence of anxiety disorders alone. *Discussion and conclusions:* Our study suggests that clients with GD, with and without psychiatric comorbidities, benefit from outpatient gambling care. Psychiatric comorbidity, especially comorbid anxiety disorders, seems to be negatively associated with the course of GD within outpatient gambling care. Addressing psychiatric comorbidity within the treatment of GD and offering individualised help are required to meet the needs of this clientele.

KEYWORDS

gambling disorder, psychiatric comorbidity, outpatient addiction care, longitudinal study, anxiety disorders, affective disorders

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INTRODUCTION

An estimated three out of four treatment-seeking individuals with gambling disorder (GD) suffer from psychiatric comorbidity (Dowling et al., 2015). More specifically, for major

depression, a prevalence of 29.9% was reported, and high rates were also found for anxiety disorders (17.6%), with social phobia (14.9%), generalized anxiety disorder (14.4%), and panic disorder (13.7%) being the most common forms. This comparatively high coincidence of GD and anxiety or affective disorders might to some extent be related to shared underlying genetic contributions (Potenza, Xian, Shah, Scherrer, & Eisen, 2005). Moreover, depression and anxiety disorders were reported to be linked to the development of more problematic gambling behaviour (Hartmann & Blaszczynski, 2018) and to be related to suicidal ideation and suicide attempts among people with GD (Petry & Kiluk, 2002). In a recent longitudinal study among adults with GD, greater severity of depression and posttraumatic stress disorder were found to be associated with intensified gambling over a follow-up period of 48 months. In addition, greater severity of affective as well as anxiety disorders was associated with greater GD severity (Black, Allen, & Bormann, 2021).

Despite the high prevalence rates of psychiatric comorbidities and their demonstrated detrimental association with GD, few studies have addressed the impact of psychiatric comorbidity on the treatment of GD (Buchner & Wodarz, 2011). While it is known that the presence of psychiatric comorbidity increases both treatment dropout among people with GD (Maniaci et al., 2017) and likelihood of relapse after gambling cessation (Hodgins & el-Guebaly, 2010), there is limited evidence on the implications for treatment outcomes. The association of psychiatric comorbidity and the prospective course of GD during and after treatment has only been studied in the inpatient setting so far. There, psychiatric comorbidity was associated with a higher psychological symptom burden of GD and more gambling involvement 6 months after treatment termination (Premper & Schulz, 2007).

For the outpatient setting, evidence on the association between GD and psychiatric comorbidity is lacking, even though in Germany people are more likely to seek help in the outpatient than in the inpatient setting (Künzel, Daubner, Specht, & Braun, 2019). German outpatient addiction care facilities (OACFs) offer highly need-driven individualised treatment and provide a low threshold and free access to a huge variety of help services and treatment modalities (Meyer & Bachmann, 2017). First and foremost, these services consist of counselling services that are intended to make it easier for those affected to handle their everyday live issues and mainly include financial counselling and motivational interviewing, sometimes (elements of) cognitive behavioural therapy are integrated (Schwarzkopf et al., 2021). However, clients with GD and a psychiatric comorbidity may benefit less from gambling-oriented therapy than those without any psychiatric comorbidity (Premper & Schulz, 2007).

A better understanding of the associations between the presence of psychiatric comorbidity and the course of a pre-existing GD is paramount to better align treatment modalities in outpatient care. Using longitudinal data from clients with GD treated in OACFs, this paper aims (1) to describe and compare socio-demographic and gambling-related characteristics of clients with and without a psychiatric comorbidity, (2) to investigate whether GD severity and its course differ between clients with and without comorbid affective or anxiety disorders, and (3) to analyse the interplay of affective and anxiety disorders in relation to GD.

METHODS

Design and setting

Data stem from assessments of the "Katamnese" study, a prospective naturalistic cohort study addressing GD and its development in the context of German OACFs. Participants were recruited between 2014 and 2016 within 28 OACFs in the Bavarian Competence Network for Gambling Issues of the Bavarian Coordination Centre for Gambling Issues. To create a standard framework for high-quality outpatient gambling care across the Bavarian network, which is multifaceted and highly heterogeneous, the Bavarian Coordination Centre for Gambling Issues has developed a 'Practice Guide Gambling'. This guide serves as a set of guidelines for all institutions within the network and provides valuable information on diagnostic procedures, subgroup-specific requirements, counselling elements (such as target setting, debt counselling, and budget planning), as well as exercises for both group and individual counselling sessions.

Individual follow-up covered 36 months. In addition to socio-demographic data, the study assessed information on gambling behaviour, gambling-related problems, and gambling-related consequences. Participants received questionnaires at admission and at 6-, 12-, 24-, and 36-month follow-ups. Moreover, a computer-assisted composite international diagnostic interview (CIDI) was conducted at baseline to collect information on psychiatric comorbidity (Wittchen & Pfister, 1997). To gather information on treatment options sought, questionnaire data were linked to the client's individual OACF routine documentation. Detailed information on the study design has been published elsewhere (Schwarzkopf et al., 2021).

Study sample

Individuals with GD who initiated treatment at one of the participating OACFs and had a minimum of three contacts with their OACF until August 2016 were eligible for the study. Further inclusion criteria were an age of at least 18 years and sufficient German language skills. Of 1,159 clients initiating OACF treatment during the recruitment period, 615 (53.6%) met the inclusion criteria and were invited on a voluntary basis to participate in the study. Out of these, 199 clients (32.4%) provided informed consent, which was subsequently withdrawn by 15 clients (7.5%). After removing one client who could not be contacted for baseline assessment and 38 clients (17.6%) who did not answer the baseline questionnaire, the baseline sample consisted of 145 participants (Fig. 1).

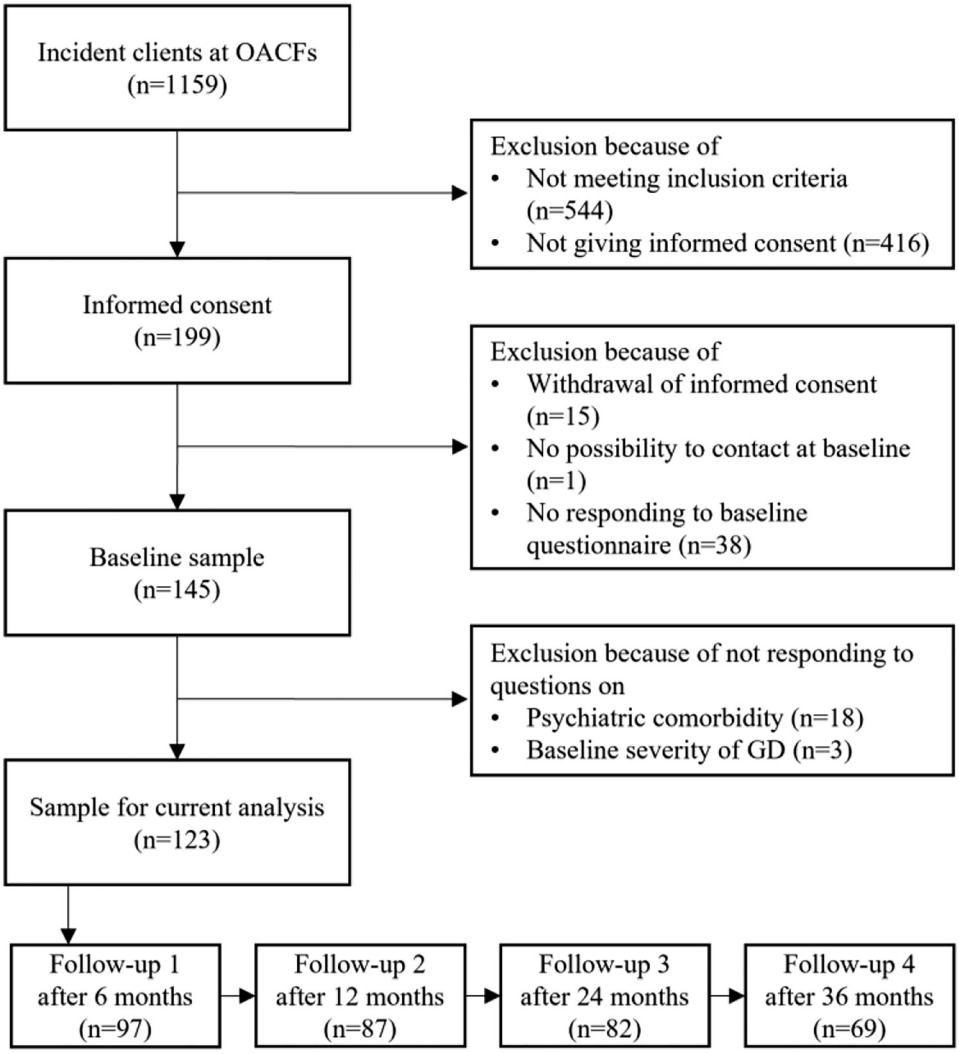


Fig. 1. Participant inclusion/exclusion procedure and study population at each timepoint

Outcome variable

GD severity was assessed within the participant survey at each assessment point via the validated "Stinchfield criteria" (Stinchfield, 2003). By removing the criterion on criminality, the criteria were aligned with the DSM-5 (American Psychiatric Association, 2013). A sum score of the endorsed DSM-5 criteria was calculated at each assessment point, yielding a GD score ranging from 0 to 9. GD was diagnosed with ≥4 DSM-5 criteria endorsed, and GD severity was classified as mild (4–5 criteria), moderate (6–7 criteria) or severe (8–9 criteria).

Covariables

The covariables included in the analyses were baseline age (in years), sex, psychiatric comorbidity, and migration background; and time-dependent treatment status. Comorbid psychiatric disorders were assessed using the CIDI's standardised questions on mood and anxiety during the last 12 months. Diagnoses of affective disorders included major depression, dysthymic disorder, and bipolar disorders. Anxiety disorders included panic disorder, agoraphobia, specific phobia, social phobia, generalized anxiety disorder, unspecified anxiety disorder, obsessive-compulsive disorder, and post-traumatic stress disorder (World Health Organization [WHO], 2004). As the distinct single conditions were rare, summary variables were created indicating whether at least one of the listed disorders was diagnosed in each group.

As migration background has been identified as a risk factor for a less favourable course of GD severity (Bickl et al., 2021), self-reported migration background status was used as a covariable. In accordance with the definition of the Federal Statistical Office of Germany (Statistisches Bundesamt, 2010) a migration background was present if the participant migrated to Germany him/herself or his/her (grand)parents had immigrated before his/her birth.

Treatment status was obtained from the OACF's routine documentation via the Germany-wide standardised core dataset of addiction care (Deutsche Hauptstelle für Suchtfragen [DHS], 2010) and contained information on whether a participant was still in treatment or had terminated treatment in a regular (i.e., stopped after a full course of

outpatient treatment) or irregular (i.e., stopped outpatient treatment before follow-up 2) fashion. We created a trichotomised variable indicating participants' treatment status (still in treatment, regular termination, or irregular termination) at each assessment point. As information on treatment status was only available until follow-up 2, we adopted a conservative perspective by assuming that all participants without information on treatment termination remained in treatment until follow-up 4.

Statistical analyses

First, socio-demographic, gambling-, and comorbidity-related characteristics of participants with and without a psychiatric comorbidity, and of completers (i.e., participants who responded to all follow-up assessments) and dropouts (i.e., participants who did not respond to at least one of the follow-ups), were compared using X^2 and *t*-tests. To examine longitudinal changes in GD severity, first we examined the unadjusted mean values of the GD score and its standard deviation (SD) in the total study sample and among participants with and without a psychiatric comorbidity at each assessment point.

Second, considering the within-subject correlation and the unbalanced, unequally spaced nature of our longitudinal data, generalized estimation equations (GEE) with unstructured working correlations (Ghisletta & Spini, 2004) were applied to estimate adjusted GD scores at each assessment point. Autocorrelation matrices are included in Supplemental tables S6–S8. The GEE approach represents a marginal model with robust parameter estimates addressing population averages instead of subject-specific effects (Ballinger, 2004; Zeger & Liang, 1986). Moreover, this approach counteracts missing data as it does not require the full specification of the joint distribution of repeated responses. If data is not available for all measurement points for some participants, GEE approaches solve the problem of missing data by filling the gaps based on the available data (Lipsitz, Fitzmaurice, & Weiss, 2020).

As the GD score (i.e., number of DSM-5 criteria fulfilled) is calculated from count data, a Poisson regression with log-link and robust Huber/White/Sandwich estimators of standard errors was applied to account for overdispersion (Rodríguez, 2013).

To analyse whether longitudinal changes in GD severity differed between participants with and without a psychiatric comorbidity, we implemented three different models: (1) model 1 contrasts changes in GD scores between participants with and without affective disorders using a *time***affective disorders* interaction term; (2) model 2 contrasts changes in GD scores between participants with and without anxiety disorders using a *time***anxiety disorders* interaction term; (3) model 3 accounts for concurrent affective and anxiety disorders using a *time***affective disorders***anxiety disorders* interaction term. Interaction terms were examined using Wald tests to analyse whether longitudinal changes from baseline to follow-up 4 differed between participants with and without each respective psychiatric comorbidity. Longitudinal changes were described using predicted probabilities (Williams, 2012) and incidence rate ratios (IRR), and were visualised using margins plots. Analyses were adjusted for age, sex (reference: female), migration background (reference: no), and treatment status (reference: still in treatment). Presence of affective/anxiety disorders was not included as a covariable in models 1 and 2 as we wanted to model the isolated influence of the individual disorders on GD scores.

Two different sensitivity analyses were conducted to assess the robustness of the results. To account for loss-to-follow-up bias, the original three models were repeated with exclusively completers (SA-1). As we compared participants with affective/anxiety disorders to participants without these disorders in the main analyses, we re-ran models 1 and 2 to compare participants with each psychiatric disorder of interest to those without any psychiatric comorbidity (SA-2).

All statistical analyses were conducted using Stata/SE 15 (Stata Corp LP; College Station, TX, USA). An alpha level of 0.05 was set.

Ethics

This study received ethical approval from the ethics committee of the German Association of Psychology (application number: LK092014).

RESULTS

Study participation and participants' baseline characteristics

Of the 145 eligible participants, 22 were excluded due to lacking baseline information on psychiatric comorbidity or GD score. Of the 123 participants included, 78.9% (n = 97) participated at follow-up 1, 70.7% (n = 87) at follow-up 2, 66.7% (n = 82) at follow-up 3, and 56.1% (n = 69) at follow-up 4 (Fig. 1), while 49.6% (n = 61) responded at all four follow-ups.

At baseline, the average age of participants was 36.7 years (SD = 10.8), 88.6% (n = 109) were male, and 28.5% (n = 35) had a migration background (Table 1). The mean GD score was 7.9 (SD = 1.4) and 61.8% (n = 76) of participants presented with a psychiatric comorbidity. More specifically, the participants' diagnostic rates were 55.3% (n = 68) for affective disorders and 33.3% (n = 41) for anxiety disorders. Whilst 26.8% (n = 33) presented with both types of disorder, 28.5% (n = 35) were affected only by affective disorders and 6.5% (n = 8) were affected only by anxiety disorders. At follow-ups 1 through 4, psychiatric comorbidity was present in 60.8% (n = 59), 58.6% (n = 51), 59.8% (n = 49) and 57.8% (n = 40) of participants, respectively.

At baseline, participants with and without a psychiatric comorbidity did not differ regarding age, sex, and migration background, but the mean GD score was higher in participants with a psychiatric comorbidity, to a statistically

Table 1. Baseline characteristics of participants

Variables	Baseline 123 (100)
Age in years, *M (SD)*	36.7 (10.8)
Sex, *n (%)*	
Male	109 (88.6)
Migration background, *n (%)*	
Yes	35 (28.5)
Severity of GD, *M (SD)*	
Fulfilled criteria of GD	7.9 (1.4)
Affective disorders, *n (%)*	**68 (55.3)**
Depressive disorders	61 (49.6)
Major Depression – single episodes	28 (22.8)
Major Depression – recurrent	22 (17.9)
Dysthymic disorder	32 (26.0)
Bipolar disorders	10 (8.1)
Bipolar I disorder	7 (5.7)
Bipolar II disorder	3 (2.4)
Anxiety disorders, *n (%)*	**41 (33.3)**
Panic disorder	8 (6.5)
Agoraphobia	3 (2.4)
Specific phobia	28 (22.8)
Social phobia	10 (8.1)
Generalized anxiety disorder	2 (1.6)
Unspecified anxiety disorder	2 (1.6)
Obsessive-compulsive disorder	10 (8.1)
Post-traumatic stress disorder	6 (4.9)
Affective disorders only, *n (%)*	**35 (28.5)**
Anxiety disorders only, *n (%)*	**8 (6.5)**
Both disorders, *n (%)*	**33 (26.8)**

GD = gambling disorder, *M* = mean value, *n* = participant count, *SD* = standard deviation.

significant degree (Table 2). Treatment status at follow-up 2 was also comparable. Study completers and dropouts presented similar demographic and GD severity (i.e., GD score) characteristics (Table S1).

Longitudinal changes in GD severity

Unadjusted mean GD scores at each assessment point were consistently higher among participants with a psychiatric comorbidity compared to participants without any psychiatric comorbidity (for all assessment points, $p < 0.05$ or lower; see Table S2).

Model-based predictions for GD severity

For all three models (Table 3), we observed statistically significant reductions of GD scores between baseline and follow-up 4 (−56.5% in model 1, −58.9% in model 2, −56.8% in model 3), with the most pronounced improvements between baseline and follow-up 1 (Table S3). Thereafter, GD scores remained almost stable (Fig. 2a–c).

In terms of how GD scores changed, differences between participants with a psychiatric comorbidity and those without were apparent (Fig. 3 a–c). Whilst participants without affective disorders achieved a reduction of 67.8% until follow-up 4, the reduction was only 47.2% in participants with affective disorder. For participants without and with anxiety disorders, reductions were 67.6% and 39.4%, respectively.

Participants without affective disorders experienced a sustained decrease in GD score until follow-up 4, whereas participants with affective disorders experienced a less pronounced improvement between baseline and follow-up 1, followed by a mostly steady increase in GD score (Fig. 3a). However, these differences were only statistically significant at follow-up 4 ($p < 0.05$) and the Wald test for the entire observation period was not statistically significant. Similar profiles were observed for participants with and without anxiety disorders (Fig. 3b), with statistically significant differences at follow-ups 2 through 4 ($p < 0.05$ at follow-up 2, $p = 0.001$ at follow-up 3, $p < 0.001$ at follow-up 4) and a statistically significant Wald test for the entire observation

Table 2. Distribution of demographic variables and GD severity at baseline and treatment status at follow-up 2 for participants with and without a psychiatric comorbidity

Variables	With psychiatric comorbidity 76 (61.8)[a]	Without any psychiatric comorbidity 47 (38.2)[a]	Comparison test	*p*-value
Age in years, *M (SD)*	36.0 (10.9)	37.9 (10.5)	0.93[b]	0.352
Sex, *n (%)*				
Male	65 (85.5)	44 (93.6)	1.88[c]	0.170
Migration background, *n (%)*				
Yes	26 (34.2)	9 (19.2)	3.23[c]	0.072
Treatment status (at follow-up 2), *n (%)*	*n* = 71	*n* = 47		
Still in treatment	2 (2.8)	5 (10.6)	3.36[c]	0.187
Regular termination	28 (39.4)	15 (31.9)		
Irregular termination	41 (57.8)	27 (57.5)		
GD severity, *M (SD)*				
Fulfilled criteria of GD	8.2 (1.1)	7.4 (1.6)	−2.98[b]	0.003

GD = gambling disorder, *M* = mean value, *n* = participant count, *SD* = standard deviation.
[a]For some analyses, *n* differ due to missing data and are reported separately.
[b]Student's *t*-test for interval variables.
[c]Pearson X^2 test for ordinal and nominal variables.

Table 3. Model-based estimates of effects of psychiatric comorbidities, time, demographic variables, and treatment status on GD severity (i.e., fulfilled DSM-5 criteria) over time

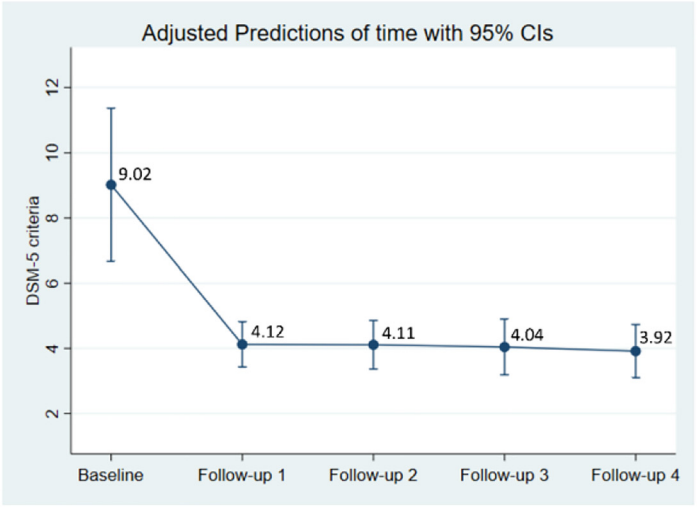
Variables	Model 1 *IRR (SD)*	Model 2 *IRR (SD)*	Model 3 *IRR (SD)*
Time			
Baseline	REF	REF	REF
Follow-up 1	0.42 (0.08)***	0.40 (0.08)***	0.37 (0.08)***
Follow-up 2	0.38 (0.09)***	0.38 (0.08)***	0.33 (0.09)***
Follow-up 3	0.37 (0.09)***	0.35 (0.08)***	0.30 (0.08)***
Follow-up 4	0.32 (0.09)***	0.32 (0.08)***	0.24 (0.08)***
Affective disorders			
No	REF	-	REF
Yes	1.07 (0.04)	-	1.12 (0.04)**
Anxiety disorders			
No	-	REF	REF
Yes	-	1.01 (0.36)	1.06 (0.06)
Time*affective disorders			
Follow-up 1	1.15 (0.19)	-	1.26 (0.26)
Follow-up 2	1.37 (0.24)	-	1.45 (0.32)
Follow-up 3	1.37 (0.25)	-	1.48 (0.37)
Follow-up 4	1.64 (0.34)*	-	1.94 (0.54)*
Time*anxiety disorders			
Follow-up 1	-	1.31 (0.21)	1.88 (0.44)**
Follow-up 2	-	1.44 (0.23)*	2.01 (0.49)**
Follow-up 3	-	1.68 (0.27)***	2.51 (0.57)***
Follow-up 4	-	1.87 (0.31)***	3.31 (0.85)***
Time*affective disorders*anxiety disorders			
Follow-up 1	-	-	0.57 (0.17)
Follow-up 2	-	-	0.57 (0.18)
Follow-up 3	-	-	0.52 (0.16)*
Follow-up 4	-	-	0.37 (0.12)**
Affective disorders*anxiety disorders	-	-	0.90 (0.06)
Age	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Sex			
Female	REF	REF	REF
Male	1.11 (0.07)	1.07 (0.08)	1.11 (0.08)
Migration background			
No	REF	REF	REF
Yes	1.22 (0.65)***	1.20 (0.07)***	1.15 (0.06)**
Treatment status			
Still in treatment	REF	REF	REF
Regular termination	1.07 (0.19)	1.06 (0.20)	1.02 (0.19)
Irregular termination	1.35 (0.28)	1.48 (0.30)	1.39 (0.27)
Wald test (Baseline – Follow-up 4)			
Time*affective disorders	6.42; $p = 0.17$	-	6.43; $p = 0.17$
Time*anxiety disorders	-	16.40; $p = 0.0025$	24.49; $p = 0.0001$
Time*affective disorders*anxiety disorders	-	-	10.69; $p = 0.03$
Number of observations	443	443	443
Number of groups	123	123	123

Note. Model 1 analysed whether severity of GD developed differently between participants with and without affective disorders and therefore included an interaction term: *time*affective disorders*. Model 2 analysed whether severity of GD developed differently between participants with and without anxiety disorders and therefore included an interaction term: *time*anxiety disorders*. Model 3 accounted for the combined occurrence of affective and anxiety disorders and therefore included an interaction term: *time*affective disorders*anxiety disorders*.

IRR = incidence rate ratio, REF = reference, *SD* = standard deviation.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

a:



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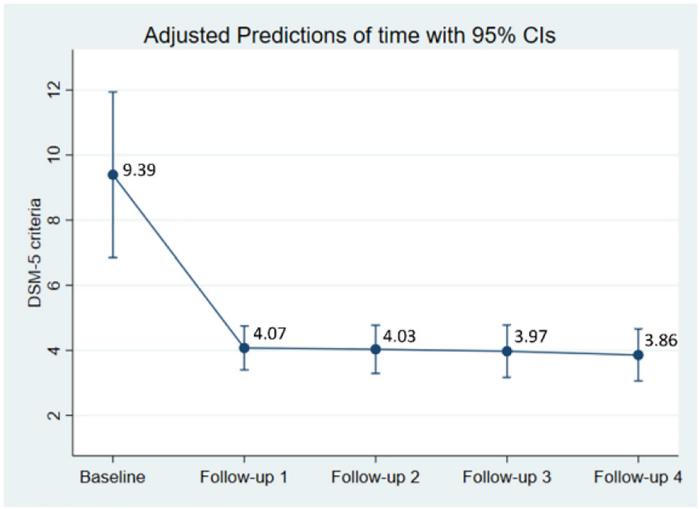

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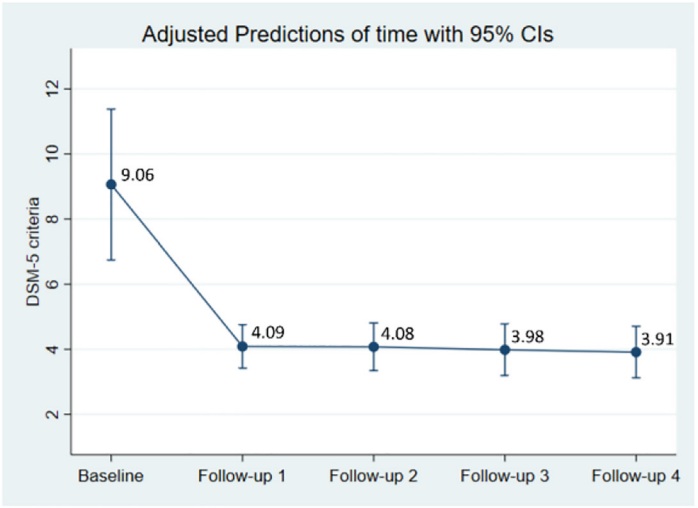
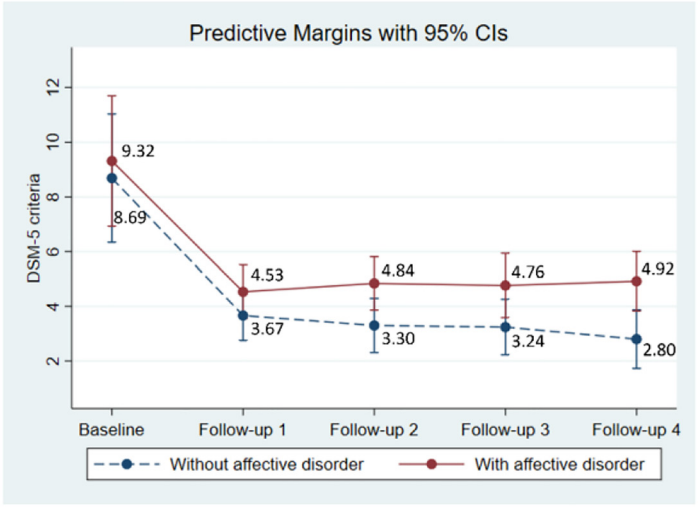


Fig. 2. Adjusted predictions of GD severity. a: Model-based trajectories for GD severity with adjustment for affective disorders. b: Model-based trajectories for GD severity with adjustment for anxiety disorders. c: Model-based trajectories for GD severity with adjustment for affective and anxiety disorders

a:



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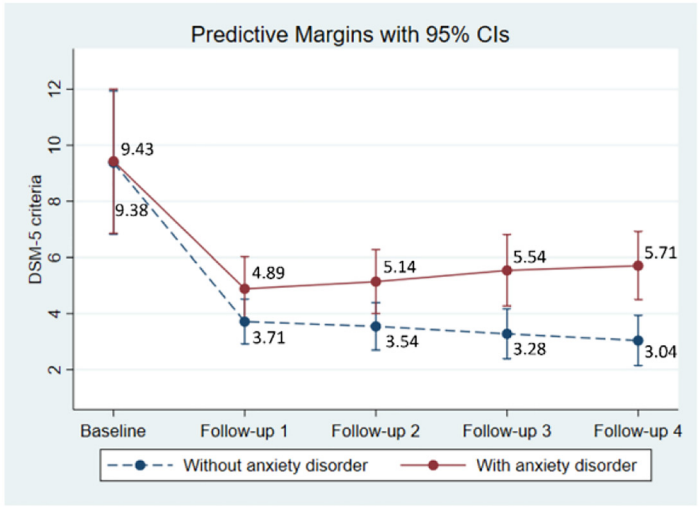

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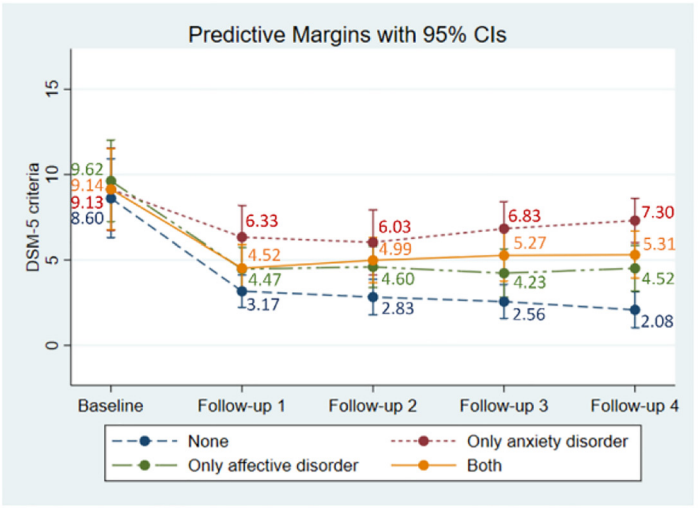

Fig. 3. Trajectories for GD severity. a: Model-based trajectories for GD severity by presence of affective disorders. b: Model-based trajectories for GD severity by presence of anxiety disorders. c: Model-based trajectories for GD severity with consideration of interplay between affective and anxiety disorders

period ($p < 0.01$). Combined anxiety and affective disorders were linked to a less favourable course of the GD score than the presence of affective disorders alone (Fig. 3c). However, the GD score of participants with combined affective and anxiety disorders developed more favourably than the GD score of participants who were affected only by anxiety disorders. Corresponding differences were statistically significant at follow-up 3 ($p < 0.05$) and follow-up 4 ($p < 0.01$), and so was the Wald test for the entire observation period ($p < 0.05$).

The only statistically significant covariate within all models was migration background, which was consistently associated with a higher GD score (model 1: $p < 0.001$, model 2: $p = 0.001$, model 3: $p < 0.01$).

Sensitivity analyses

The sensitivity analyses by and large confirmed the profiles of the main analyses (Tables S4 & S5). In SA-1, which included exclusively study completers, differences between participants with affective or anxiety disorders and those without were less pronounced (Figure S1 a–c). Moreover, in models 1 and 3, sex gained statistical significance with a less favourable course of the GD score for men, and in model 2 the course of the GD score was significantly less favourable for participants with irregular treatment termination.

In SA-2, in model 1 (Figure S2 a–b), the comparison of participants with affective disorders to those without any psychiatric comorbidity showed less favourable changes in GD scores among those with affective disorders (Wald test $p < 0.05$), with statistically significant differences at follow-ups 2 through 4 ($p < 0.05$ at follow-ups 2 and 3, $p < 0.01$ at follow-up 4). Further, migration background lost statistical significance whilst sex gained statistical significance in model 2, with a less favourable course of the GD score for men.

DISCUSSION

Using longitudinal data from the "Katamnese" study, we contrasted gamblers with and without a psychiatric comorbidity and investigated the impact of baseline affective and anxiety disorders on the course of GD severity over a 3-year period. Though they had similar socio-demographic characteristics, the baseline GD score was significantly higher among study participants with comorbid affective or anxiety disorders and their GD score developed less favourably. Contrary to our expectation, we found a more favourable course of the GD score in participants with combined affective and anxiety disorders than in participants with anxiety disorders alone. Indeed, the GD score course was, as we expected, less favourable in those with combined affective and anxiety disorders than in participants with affective disorders alone.

A previous German study on inpatients with GD estimated the prevalence of comorbid affective disorders at 51.1% and comorbid anxiety disorder prevalence at 47.5% (Premper & Schulz, 2008). In our outpatient sample, the prevalence of comorbid affective disorders was similar (55.3%, $n = 68$) but the prevalence of comorbid anxiety disorders was substantially lower (33.3%, $n = 41$). These estimates exceed those of a systematic literature review which reported mean prevalence rates of 23.1% for any affective disorder and 17.6% for any anxiety disorder in help-seeking individuals with GD. However, noteworthily, there was high between-study heterogeneity in the evidence used for the estimates for individual disorders (range: 2.0%–41.3%) due to differences in sample characteristics, methodological approach, or treatment factors (Dowling et al., 2015). Hence, the results of our study can reasonably be placed in the context of existing evidence.

At all assessment points, we observed (at times significantly) higher mean GD scores among study participants with affective or anxiety disorders compared to those among study participants without psychiatric disorders. This supports previous findings of a disadvantageous correlation between psychiatric comorbidity and GD severity in the general population (Barry, Stefanovics, Desai, & Potenza, 2011; Kong, Smith, Pilver, Hoff, & Potenza, 2016; Pilver, Libby, Hoff, & Potenza, 2013) as well as among help-seeking individuals with GD (Shek, Chan, & Wong, 2012). A possible explanation may be that gambling serves as an escape from problems (Blanco, Hasin, Petry, Stinson, & Grant, 2006) that may occur due to psychiatric comorbidity. Furthermore, gambling can act as a coping strategy in individuals with depressive disorders to compensate for feelings of emptiness and inability to feel pleasure, leading to a stronger urge to gamble and increased GD severity (Rømer Thomsen, Callesen, Linnet, Kringelbach, & Møller, 2009).

According to our models, the GD score improved significantly in both participants with and without a psychiatric comorbidity over the 3-year observation period. Participants with psychiatric comorbidity, thereof particularly those with anxiety disorder, had poorer treatment success than participants without. This is in line with a previous study in adults with GD, reporting greater GD severity in participants with a psychiatric comorbidity at all assessments over a 48 months study period (Black et al., 2021).

In our sample, we found a corresponding detriment, particularly in participants with anxiety disorders, who achieved minor and less stable improvements than participants without anxiety disorders in our study. This does not suggest that outpatient gambling care does not meet the treatment needs of individuals with comorbid anxiety disorders. As both groups face different starting conditions, similar achievements in GD score development for individuals with and without a psychiatric comorbidity are not to be expected. Within a previous study, participants with comorbid anxiety disorders presented with significantly higher GD-related psychological symptom burden during treatment and in the post-treatment period compared to participants without anxiety disorders. After treatment termination, participants with comorbid anxiety disorders were more strongly involved in gambling, and relapse was more likely compared to participants without comorbid anxiety disorders (Premper & Schulz, 2007).

We observed a less pronounced detriment within individuals with affective disorders. A possible explanation for higher GD scores in gamblers with anxiety disorders than in gamblers with affective disorders may be the disorder-specific symptomatology and its impact on gambling behaviour. While people with anxiety disorders often experience symptoms such as restlessness, difficulty concentrating, and sleep disturbances, common symptoms of affective disorders include listlessness, inability to experience pleasure, and lack of energy (American Psychiatric Association, 2013). Thus, individuals with affective disorders might often not even have the energy to participate in gambling during acute episodes of their comorbid psychiatric disorder, whereas people with anxiety disorders may increasingly use gambling as a distraction from anxiety-related thoughts when anxiety disorder symptoms are most severe.

Unlike in previous studies (Black et al., 2021; Premper & Schulz, 2007), we found no statistically significant difference in GD scores between clients with and without affective disorders. As there appears to be a correlation between severity of depressive symptoms and GD severity (Rømer Thomsen et al., 2009), the initial degree of severity of affective disorders might have been low in our sample, which might explain the lack of a difference between participants with and without affective disorders in our findings. Another explanation is that the group of individuals without affective disorders contains both individuals without any psychiatric comorbidity and individuals with an anxiety disorder. Hence, considering the elevated GD scores among gamblers with anxiety disorders mentioned above, GD-score estimates for the group without affective disorders may be overestimated. SA-2, which compares participants with affective disorders and participants without any psychiatric comorbidity, supports this hypothesis, as it shows a statistically significant detriment in the first group.

Combined affective and anxiety disorders were associated with more favourable GD score development than the presence of anxiety disorders alone, but with a less favourable course than the presence of affective disorders alone, which we did not anticipate. This might be explained by the fact that anxiety disorders predominantly manifest before the development of GD and that anxiety disorder-related symptomatology might encourage gambling behaviour. In contrast, affective disorders often develop as sequelae of gambling, further encouraging GD (Premper & Schulz, 2008). Furthermore, symptoms of affective disorders such as listlessness and lack of energy might moderate the symptoms of anxiety disorders such as restlessness which potentially drive intensified gambling behaviour.

Limitations and strengths

In addition to the usual caveats of cohort studies (e.g., selection bias due to voluntary participation, information bias due to self-reported data), the following limitations ought to be considered. As the "Katamnese" study was an one-armed observational study, our results indicate associations and do not allow one to make a causal attribution between OACF treatment and GD score development. First, although the dropout rate was satisfactory (43.9% at follow-up 4), it led to small sample sizes and consequently large confidence intervals. Hence, it appears possible that our models failed to detect the true differences between participant subgroups with and without a psychiatric comorbidity. Second, our models are limited by overdispersion and we could not appropriately account for the distribution of our count data by assuming a negative binomial distribution because of convergency issues (Rodríguez, 2013). Thus, GD scores are probably overestimated in our results. We strongly believe that this issue affects group-specific levels of GD score more so than the between-group differences in GD score development. Third, we had no information on severity of psychiatric disorders, potential treatment of psychiatric disorders, and presence/new occurrence of psychiatric disorders during the follow-up period. There is evidence that the severity of GD changes according to the severity of psychiatric disorders over time (Black et al., 2021), which could have been intertwined with the development of GD severity in our analyses. Finally, information on treatment status was only available until follow-up 2. Hence treatment termination for individuals still in treatment at follow-up 2 could not be verified for subsequent follow-ups, and we imputed the follow-up 2 status instead, which results in a not fully precise covariate specification. As we had to impute treatment status for only 7 study participants, we are strongly convinced that this imprecision has not crucially affected our results.

On the other hand, the main strength of this study is its unique focus on the development of GD score in individuals with and without a psychiatric comorbidity who were seeking outpatient gambling care. Therefore, our study population is rather unselected, as OACFs offer a broad range of addiction support services, and we presumably achieved a high degree of external validity. Moreover, we were able to investigate associations between comorbid affective and anxiety disorders with the course of GD severity over a three year period, which exceeds the short-term follow-up of previous research (Premper & Schulz, 2007). Additionally, our analyses revealed realistic results by including not only study completers but also dropouts. SA-1 suggests that dropout of participants without any psychiatric comorbidity occurred mainly among those with less GD severity, whilst dropout of participants with a psychiatric comorbidity mainly occurred among those with greater GD severity. This indicates that we avoided underestimating the negative influence of psychiatric comorbidity on severity of GD by analysing the data of dropouts in the main models. Finally, our advanced modeling techniques (GEE) counteracted missing data and misspecification of within-group correlation, yielding robust results.

CONCLUSIONS AND FURTHER RESEARCH

Our study suggests that individuals with GD and psychiatric comorbidity benefit from outpatient gambling care, though to a lesser degree than individuals with GD but without any

psychiatric comorbidity. Hence, the broad spectrum of treatment services offered by OACFs might not yet fully address the needs of clients with psychiatric comorbidity. Due to the dual burden of GD and psychiatric comorbidity, affected individuals most probably require comprehensive treatment services that outpatient gambling care alone might not provide. Therefore, establishing cooperative networks with facilities that offer, for instance, psychotherapy and pharmacotherapy, could support outpatient treatment care. Such combined efforts could support continuous management of both GD and psychiatric disorders, which might in turn help clients to better exploit their resources to overcome GD. To assess the comprehensiveness of treatment services, further research is necessary to understand existing treatment modalities and cooperative networks. Additional longitudinal research on interactions between the course of psychiatric comorbidity and the course of GD severity is paramount.

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SUPPLEMENTARY MATERIAL

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