The relationship between psychological characteristics of patients and their utilization of psychiatric inpatient treatment: A cross-sectional study, using machine learning

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Abstract

High utilizers (HU) are patients with an above-average use of psychiatric inpatient treatment. A precise characterization of this patient group is important when tailoring specific treatment approaches for them. While the current literature reports evidence of sociodemographic, and socio-clinical characteristics of HU, knowledge regarding their psychological characteristics is sparse. This study aimed to investigate the association between patients’ psychological characteristics and their utilization of psychiatric inpatient treatment. Patients from the University Psychiatric Clinics (UPK) Basel diagnosed with schizophrenia spectrum or bipolar affective disorders participated in a survey at the end of their inpatient treatment stay. The survey included assessments of psychological characteristics such as quality of life, self-esteem, self-stigma, subjective experience and meaning of psychoses, insight into the disease, and patients’ utilization of psychiatric inpatient treatment in the last 30 months. The outcome variables were two indicators of utilization of psychiatric inpatient treatment, viz. “utilization pattern” (defined as HU vs. Non-HU [NHU]) and “length of stay” (number of inpatient treatment days in the last 30 months). Statistical analyses included multiple regression models, the least absolute shrinkage and selection operator (lasso) method, and the random forest model. We included 112 inpatients, of which 50 were classified as HU and 62 as NHU. The low performance of all statistical models used after cross-validation suggests that none of the estimated psychological variables showed predictive accuracy and hence clinical relevance regarding these two outcomes. Results indicate no link between psychological characteristics and inpatient treatment utilization in patients diagnosed with schizophrenia spectrum or bipolar affective disorders. Thus, in this study, the examined psychological variables do not seem to play an important role in patients’ use of psychiatric inpatient treatment; this highlights the need for additional research to further examine underlying mechanisms of high utilization of psychiatric inpatient treatment.
Introduction

High utilizers (HU), also known as heavy or frequent users or repeaters, are a group of patients with an above-average use of psychiatric inpatient treatment. Although only approximately 10% to 30% of all inpatients are HU, these clients’ use of the healthcare system’s resources is well above average [1–3]. However, they seldom receive treatment tailored to their specific characteristics [4].

Prior studies have investigated the high utilization phenomenon to identify characteristics associated with high utilization. Identifying robust characteristics of HU patients is important when tailoring specific treatment approaches for them, to optimize treatment and improve their health and wellbeing [5, 6].

To investigate the high utilization phenomenon, prior studies focused on sociodemographic and socio-clinical patient characteristics and used variables such as length of hospital stay in days, and/or number of hospital admissions within a specific time window as indicators of patients’ utilization of psychiatric inpatient treatment. Some of these studies used a cutoff value for these variables to classify patients into HU and Non-High Utilizer (NHU) [7–10]. Studies showed that patients with a high utilization pattern are younger [8, 11–14] than those with low utilization of psychiatric inpatient treatment. Contradictory results were found regarding the sex of HU and NHU patients. Several studies reported a higher prevalence of men among inpatients with high utilization [2, 15, 16], whereas other studies showed a predominance of women [1, 8, 11, 17, 18].

HU have more often been diagnosed with schizophrenia, schizoaffective disorders, and bipolar affective disorders compared with NHU, indicating that the high utilization phenomenon may be specifically relevant to this patient group [3–5, 11–13, 19–22]. Moreover, HU patients showed higher comorbidity rates with personality disorders and substance abuse disorders than NHU patients [2, 3, 6, 9, 10, 23, 24]. However, one study found no differences in diagnoses between HU and NHU inpatients [25].

Homelessness was also associated with high utilization [9, 14, 22, 24]; moreover, a study reported that 68% of the HU patients had problems with living conditions [26]. The lack of an alternative source of psychosocial care such as access to sheltered housing for HU has been reported previously [3, 10, 27]. The majority of all HU patients reported difficulties in their social/interpersonal relationships [14, 18, 23, 24, 26, 28]. Patients with high utilization reported only four contacts in their social networks on an average, which often consisted of family members and medical staff [18, 26]. Furthermore, HU patients showed higher pharmacological non-adherence, more suicidal tendencies [2, 10, 11, 29], higher personal burden [6] and greater severity of psychopathology [13, 25, 28] compared with NHU inpatients. Moreover, poor insight in psychosis was associated with higher utilization of psychiatric inpatient treatment [30, 31].

While the current literature reports evidence on the demographic and socio-clinical characteristics of high utilization described above, the role of psychological characteristics of patients resulting in high utilization remains unclear. For instance, associations between patients’ psychological characteristics and their utilization of psychiatric inpatient treatment have rarely been examined. This is a research gap as the inclusion of further patient characteristics in high utilizer research may increase the understanding of the underlying mechanisms of high utilization in the context of psychiatric inpatient treatment, potentially informing clinical interventions in the future.

In this context, quality of life, self-esteem, self-stigma, subjective experience and meaning of psychoses, and insight into the disease are promising candidates to examine associations with utilization of psychiatric inpatient treatment in patients with schizophrenia spectrum or...
bipolar affective disorders because they varied depending on the clinical course of these mental disorders in prior studies [32–37]. High severity levels of a mental disorder can generally be considered as an indicator of high utilization [13, 25, 28]. Therefore, we hypothesized an association between the mentioned psychological characteristics and patients’ use of psychiatric inpatient treatment, and investigated it through an exploratory study.

**Aim of study**

This study aimed to examine associations between psychological characteristics and utilization of psychiatric inpatient treatment in patients with schizophrenia spectrum or bipolar affective disorders from the UPK Basel. Psychological characteristics included measures of quality of life, self-esteem, self-stigma, subjective experience and meaning of psychoses, and insight into the disease.

**Materials and methods**

**Ethical approval**

The Ethics Committee Northwest and Central Switzerland (EKNZ) (EKNZ BASEC 2017–02203) provided ethical approval for this study. All participants gave written informed consent after receiving information on the study. Protocols of the present study adhere to the principles expressed in the Declaration of Helsinki regarding research with human participants.

**General framework**

Data were obtained from the research project “Characteristics of High Utilization in the Psychiatric University Hospital (UPK) Basel,” conducted from April 2018 to May 2019 at the UPK Basel in Switzerland. The UPK provides psychiatric treatment for inpatients and outpatients, covering a catchment area of approximately 190,000 people in and around the city of Basel.

**Study population and procedure**

We recruited patients from three psychiatric-inpatient wards belonging to the Center for Psychotic Disorders (ZPE) of the Department of Adult Psychiatry UPK Basel. The three wards have an inpatient treatment capacity of 54 beds, and provide diagnosis-specific psychiatric and psychotherapeutic treatment for patients with schizophrenia spectrum disorder (ICD-10: F20-F29) or bipolar affective disorder (ICD-10: F31.1, F31.2). Admission to the ZPE may either be voluntary or involuntary. In the corresponding study period, a trained psychologist responsible for the study’s recruitment assessed all patients admitted to one of the three study wards regarding inclusion and exclusion criteria. Inclusion criteria included good knowledge of the German language, an age range between 18 and 65 years, and a diagnosis of schizophrenia spectrum disorder or bipolar affective disorder. Patients who were unable to consent or those with criminal convictions, dementia, psychiatric diseases resulting from organic causes, or a primary diagnosis of substance abuse disorder were excluded. Subsequently, we asked eligible patients at the end of their inpatient treatment stay, i.e., when the psychiatrist in charge of the case announces that discharge management will be initiated for the respective patient, to participate in this study. After receiving information about the project, the participants signed the informed consent and completed the assessment within an average duration of 50 minutes. The psychologist responsible for the study was present during the entire assessment and aided the patients with queries related to the paper-and-pencil questionnaires if necessary. Patients admitted several times to the ZPE during the study period could only participate once in this study.
Assessments

Assessments included five paper-and-pencil questionnaires on patient psychological characteristics and interviews on utilization of psychiatric inpatient treatment, psychopathology, and sociodemographic information.

Quality of life. The World Health Organization Quality of Life (WHOQOL)-BREF measures quality of life through self-report, and includes four domains: physical health, psychological health, social relationships, and environment. All items were rated on a five-point Likert scale. Domain scores were converted to a 0–100 spectrum, with higher scores indicating a higher quality of life. The WHOQOL-BREF is a validated and well-established questionnaire. Cronbach’s alpha for the German translation indicated good internal consistency within the range of 0.76 to 0.88 [38, 39].

Self-esteem. The Rosenberg Self-Esteem Scale (RSE) assesses self-esteem with 10 items on a five-point Likert scale (from 1 = strongly disagree to 5 = strongly agree) [40]. A higher rating indicates a higher level of self-esteem. The total score was calculated for all items. The German adaptation of the self-report questionnaire revealed satisfactory psychometric properties, while the Cronbach’s alpha was 0.88 [41].

Self-stigma. To detect the reflection of the patients’ internalized self-stigma, the Self-Stigma of Mental Illness Scale-Short Form (SSMIS-SF) was used [42]. The short-form of the self-report questionnaire assesses four constructs rated on a nine-point Likert scale: awareness, agreement, application and hurts-self. Awareness measures patients’ consciousness about common stereotypes about people with mental illnesses. Agreement assesses the degree of belief that the stereotypes are accurate. Application indicates the extent to which patients internalize the stereotypes and apply these to themselves. Consequently, the degree of their decreased self-esteem and self-efficacy is assessed by hurts-self. The constructs were formed by summing up the corresponding items. The English original SSMIS-SF provides good internal consistency ranging between 0.69 and 0.87 [43].

Subjective experience and meaning of psychoses. Aspects of meaning and experiencing the psychosis were measured using self-report with the Subjective Sense in Psychosis questionnaire (SUSE). The questionnaire was adapted using the framework of a dialogue research project [44, 45]. The shortened version consists of 29 items, through five subscales, measuring the past (biographical integration), positive and negative present experiences (symptoms positive and symptoms negative), and positive and negative expectations of the future (positive consequences and negative consequences). The answers are rated on a four-point Likert scale. Cronbach’s alpha of the English original questionnaire demonstrated good internal consistency of 0.73 to 0.86. The test-retest reliability ranged from 0.66 to 0.84 [46, 47].

Insight. Insight into the disease was assessed using Becks Cognitive Insight Scale (BCIS) [48]. This self-report questionnaire assesses patients’ cognitive processes and limitations. The sum of nine items captures the subscale self-reflectiveness and six items represent self-certainty. Answers were rated on a four-point Likert scale (from 0 = strongly not agree to 3 = strongly agree). The English original scale provides good internal consistency, with a Cronbach’s alpha level of 0.60 for self-certainty and 0.68 for self-reflectiveness. The test-retest reliability showed an adequate correlation of 0.60 [49].

Utilization of psychiatric inpatient treatment. We assessed retrospective information regarding patients’ mental health care utilization during the last 30 months before the current admission using the Client Sociodemographic and Service Receipt Inventory (CSSRI; [50, 51]). To improve the data quality, inpatient treatment information was cross-checked with electronic records of our patients. We used two different indicators to operationalize patients’ mental health care utilization pattern. First, we calculated the dichotomous variable
“utilization pattern” by classifying patients into a HU group (HU; ≥180 inpatient treatment days during 30 months and/or ≥3 number of admissions over 18 months) or a NHU group (NHU; <180 inpatient treatment days during the 30 months and/or <3 number of admissions over 18 months). Second, we calculated the continuous variable “length of stay,” which indicates the number of inpatient treatment days in the last 30 months for each patient. We used a dichotomous and a continuous indicator of patients’ inpatient utilization pattern as preliminary literature revealed no consistent standard in this regard [7–10].

**Psychopathology.** We assessed the severity of patients’ psychopathology using the German form of the Brief Psychiatric Rating Scale (BPRS). The assessment consists of 18 items, which capture different symptoms of psychopathology (e.g., somatic complaints, feelings of guilt, depressed mood, hostility, and grandiosity), and was rated by the attending psychiatrist. The items were evaluated on a seven-point Likert scale (from 1 = not present to 7 = extremely severe). The sum score consists of all items; higher scores indicate a higher degree of psychopathology. The BPRS is one of the most widely used and validated scales in clinical research and provides good psychometric properties. The retest reliability was approximately 0.7, the internal consistency ranged between 0.75 and 0.79, and the inter-rater reliability ranged between 0.56 and 0.87 [52, 53].

**Sociodemographic information.** We obtained standard sociodemographic information at the beginning of the assessment.

**Statistical analyses**

To report descriptive statistics, we chose the first quartile, median, and third quartile for continuous variables as well as absolute numbers and percentages for discrete variables.

In the first set of analysis, we estimated the association between psychological characteristics of the patients and their utilization of psychiatric inpatient treatment through two separate multiple logistic and linear regression models. The dichotomous variable “utilization pattern” (HU vs. NHU) and the continuous variable “length of stay” (number of inpatient treatment days in the last 30 months before the current stay) were outcome variables. Physical health, psychological health, social relationships, and environment (four subscales of the quality of life questionnaire; [38, 39]); self-esteem [40], awareness, agreement, application, and hurts-self (five subscales of the self-stigma questionnaire; [42]); biographical integration, symptoms positive, symptoms negative, positive consequences, and negative consequences (five subscales of the subjective sense in psychosis questionnaire; [44, 45]); as well as self-reflectiveness and self-certainty (subscals of the insight into the disease questionnaire; [48]) were the predictors in both regression models. To reduce risk of confounding, we adjusted these analyses for several a priori defined potential confounders including sex [2, 8, 11, 18], age [2, 11, 13, 14], and psychopathology [13, 25, 28]. Multicollinearity among the predictors and covariates was moderate, with variance inflation factors ranging between 1.3 and 5.2.

Predictive accuracy is the ability of a statistical model to fit well not only with the (training) data it was developed with but also with corresponding new, previously unseen (test) data. Multiple regression models often suffer from overfitting, and therefore have low predictive accuracy [54], especially if the number of predictors is high relative to the number of participants (linear model) or the number of cases (logistic model), as is the case in our study. To avoid model overfit, we ran two additional models that use machine learning algorithms—the least absolute shrinkage and selection operator (lasso) model, and the random forest model. Both models contained the same predictors, outcomes, and adjustments described above. The lasso model uses a variable selection procedure, in which regression coefficients are deliberately shrunk by implying a penalty term to the likelihood function when fitting the model. Consequently, the lasso models are somewhat more biased than those obtained from multiple
regression models but less variable, i.e., they exhibit increased predictive accuracy [55]. Thus, when replicating the current study, predictors whose coefficients have not been shrunk to zero from the lasso are likely to be predictive. The random forest model belongs to the family of decision tree models, which characteristically generate a large number of bootstrapped decision trees, based on random samples of variables. The model has been shown to exhibit high predictive accuracy [56]. Since our two outcome variables were continuous (length of stay) or dichotomous (HU vs. NHU), both the lasso and random forest models were based on a multiple logistic and linear regression model, respectively. To determine the predictive accuracy of the models, we conducted repeated \( n = 10 \) 10-fold cross-validation. We used the root mean square error (RMSE, i.e. the square root of the variance of the residuals) and the R-squared \( (R^2) \) as the measures of model accuracy for continuous and dichotomous outcomes, respectively.

The outcome—"length of stay"—and the predictors—"application" (self-stigma questionnaire), "hurts-self" (self-stigma questionnaire), and "negative consequences" (subjective sense in psychosis questionnaire)—were all log transformed to approximate normality and homoscedasticity.

All models were run with R, version 3.3.0, including the R package glmnet for the lasso model [57]. A significance threshold of \( p < 0.05 \) was set for all univariate analyses.

**Results**

After screening 533 patients admitted to the ZPE over the recruitment period, we excluded 421 patients as they did not meet inclusion criteria, declined to participate, or because participation was not indicated or feasible. Finally, 112 patients participated and were included in the analyses (see Flowchart Fig 1).

Participants spent a median of 71 days, on an average, in psychiatric inpatient care over the past 30 months before the current admission. We classified 50 of them as HU and 62 as NHU. Demographic and clinical characteristics of participants are summarized in Table 1. See the correlation matrix of all relevant variables presented in S1 Table.

**Multiple regression models**

Coefficients based on the multiple logistic and the multiple linear regression models are depicted in Table 2. The multiple logistic regression model reported a significant association between "utilization pattern" (HU vs. NHU) and psychological health (quality of life), awareness (self-stigma), and hurts self (self-stigma) in our sample. HU patients reported higher psychological health, awareness and hurts-self compared with NHU patients. Model performance for the multiple logistic regression model based on the area under curve (AUC) was 0.79 and strongly decreased to 0.59 after cross-validation (an AUC of 0.50 denotes no predictive accuracy at all, i.e., pure guessing).

Results of the multiple linear regression models revealed significant associations between the continuous variable "length of stay" and psychological health (quality of life) and hurts-self (self-stigma); the higher patients' utilization of psychiatric inpatient treatment, the higher were their scores on psychological health and hurts-self. Model performance for the multiple linear regression model based on the root mean square error (RMSE) and the variance explained \( (R^2) \) was 0.88 and 0.22, respectively, and again strongly deteriorated to 1.07 (RMSE) and .08 \( (R^2) \) after cross-validation.

**Lasso models**

Coefficients based on the lasso models are depicted in Table 2. Coefficients for the dichotomous outcome "utilization pattern" were comparable with those based on an ordinary logistic
regression model since the lasso led to the highest predictive accuracy if all predictors were included (and thus none set to 0). However, model performance after cross-validation was low ($AUC = 0.58$) and not better than that for the cross-validated multiple logistic regression model reported above.

Coefficients based on the lasso model of the outcome “length of stay” were set to 0 for all predictors. They were higher than 0 for only the covariates that were deliberately not shrunk. Thus, none of the predictors based on this model showed predictive accuracy. Model performance after cross-validation ($RMSE = 0.99$, $R^2 = 0.10$) was slightly better than that of the cross-validated multiple linear regression model. This was, however, due to the three covariates alone since the lasso excluded all predictors.

In sum, the cross validated lasso models suggest that none of the psychological variables tested in this study were able to predict either of the two indicators of patients’ utilization of psychiatric inpatient treatment.

Random forest models

Variable importance values for the two outcomes “utilization pattern” and “length of stay” are shown in Table 2. The most important variables were awareness (self-stigma), and hurts-self (self-stigma) for “utilization pattern” and psychopathology, psychological health (quality of life), awareness (self-stigma), agreement (self-stigma), symptoms positive (subjective experience and meaning of psychoses), and self-reflectiveness (insight into the disease) for length of stay. However, these results must be seen against the background of the low model performance of the random forest model for both outcomes (utilization pattern: $AUC = 0.60$; length of stay: $RMSE = 0.98$, $R^2 = 0.11$).
This study examined the association between specific psychological characteristics and the use of psychiatric inpatient treatment in patients diagnosed with schizophrenia spectrum or bipolar affective disorders from the UPK Basel. While the multiple regression models reported significant associations between specific psychological variables and patients’ utilization of psychiatric inpatient treatment, the low model performance of the cross validated multiple regression models combined with the findings of the lasso and the random forest models indicated that none of the psychological variables were actually able to predict patients’ utilization of psychiatric inpatient treatment. Hence, our findings do not suggest a link between patients’ psychological characteristics estimated in this study and their utilization of psychiatric inpatient treatment. As the values of the respective measures of accuracy (AUC, RMSE, and R2)

Table 1. Demographic, clinical, and psychological characteristics of High Utilizer and Non-High Utilizer patients and in the total sample *

| Characteristic | Utilization | Total |
|---------------|-------------|-------|
|               | High Utilizer (n = 50) | Non-High Utilizer (n = 62) | (n = 112) |
| Sex ^b         |             |       |     |
| Female        | 22.00 (44.00%) | 28.00 (45.16%) | 50.00 (44.64%) |
| Male          | 28.00 (56.00%) | 34.00 (54.84%) | 62.00 (53.36%) |
| Age           | 42.00 (32.75; 50.25) | 38.00 (28.00; 50.25) | 40.00 (30.00; 50.00) |
| Length of stay in days in the last 30 months | 144.50 (94.50; 224.75) | 35.50 (16.75; 63.25) | 71.50 (29.00; 145.25) |
| Primary diagnosis |             |       |     |
| Bipolar disorder | 12.00 (24.00%) | 14.00 (22.58%) | 26.00 (23.21%) |
| Schizophrenia spectrum disorder | 38.00 (76.00%) | 48.00 (77.42%) | 86.00 (76.79%) |
| Psychopathology | 44.50 (36.00; 50.00) | 40.00 (33.75; 47.00) | 43.00 (35.00; 48.00) |
| Quality of life |             |       |     |
| Physical health | 71.43 (56.25; 78.57) | 67.86 (55.36; 75.00) | 67.86 (57.14; 78.57) |
| Psychological health | 68.75 (53.13; 83.33) | 66.67 (54.17; 75.00) | 66.67 (54.17; 79.17) |
| Social relationships | 66.67 (50.00; 75.00) | 66.67 (50.00; 83.33) | 66.67 (50.00; 75.00) |
| Environment | 68.75 (56.25; 78.13) | 71.88 (59.38; 81.25) | 68.75 (56.25; 81.25) |
| Self-esteem | 37.00 (31.00; 44.25) | 38.00 (34.50; 45.00) | 38.00 (33.00; 45.00) |
| Self-stigma |             |       |     |
| Awareness | 30.00 (24.00; 37.25) | 28.00 (23.00; 33.00) | 29.00 (23.00; 35.00) |
| Agreement | 18.50 (11.50; 23.00) | 17.00 (11.50; 22.00) | 17.00 (12.00; 23.00) |
| Apply | 12.00 (5.00; 18.25) | 11.00 (8.00; 16.50) | 11.00 (7.00; 17.00) |
| Hurts-self | 9.00 (5.00; 20.00) | 7.00 (5.00; 13.00) | 8.00 (5.00; 15.00) |
| Subjective experience and meaning of psychoses |             |       |     |
| Biographical integration | 3.40 (2.60; 3.85) | 3.20 (2.60; 3.80) | 3.40 (2.60; 3.80) |
| Symptoms positive | 3.00 (1.75; 3.43) | 2.75 (2.00; 3.37) | 2.80 (1.80; 3.40) |
| Symptoms negative | 2.79 (1.97; 3.50) | 2.75 (2.06; 3.35) | 2.75 (2.06; 3.38) |
| Positive consequences | 3.40 (2.35; 3.80) | 3.40 (2.90; 3.90) | 3.40 (2.80; 3.80) |
| Negative consequences | 1.83 (1.50; 2.38) | 1.83 (1.50; 2.42) | 1.83 (1.50; 2.37) |
| Insight into the disease |             |       |     |
| Self-reflectiveness | 15.00 (11.00; 18.75) | 15.00 (11.00; 19.00) | 15.00 (11.00; 19.00) |
| Self-certainty | 9.50 (7.25; 12.00) | 9.00 (7.00; 11.00) | 9.00 (7.00; 11.00) |

Note. Values based on row data.

* If not otherwise specified, median (25th percentile; 75th percentile) is reported

https://doi.org/10.1371/journal.pone.0266352.t001

Discussion
This study examined the association between specific psychological characteristics and the use of psychiatric inpatient treatment in patients diagnosed with schizophrenia spectrum or bipolar affective disorders from the UPK Basel. While the multiple regression models reported significant associations between specific psychological variables and patients’ utilization of psychiatric inpatient treatment, the low model performance of the cross validated multiple regression models combined with the findings of the lasso and the random forest models indicated that none of the psychological variables were actually able to predict patients’ utilization of psychiatric inpatient treatment. Hence, our findings do not suggest a link between patients’ psychological characteristics estimated in this study and their utilization of psychiatric inpatient treatment. As the values of the respective measures of accuracy (AUC, RMSE, and R2)
were insufficient in all the models, this suggests that other patient characteristics—which were not captured in this study—were relevant for utilization of psychiatric inpatient treatment.

To date, prior studies primarily investigated whether sociodemographic and clinical characteristics such as employment, housing or education status (e.g., [9, 22, 23, 26]), social network [18, 26], pharmacological adherence [2, 10, 11, 29], diagnostic information [3, 5, 19, 22], or insight into the disease [31] were related to patients’ use of psychiatric inpatient treatment. In contrast, this study examined patients’ quality of life, self-esteem, self-stigma, and subjective experience and meaning of psychoses. Thus, this study broadens prior findings by focusing on psychological variables to examine associations between patient characteristics and their utilization of psychiatric inpatient treatment.

In this study, the findings of the cross-validated multiple regression models and the lasso and random forest models indicated that none of the estimated psychological patients’ variables showed predictive accuracy regarding patients’ utilization of psychiatric inpatient treatment. However, this does not indicate that these psychological patient characteristics are not clinically relevant to patients with schizophrenia spectrum or bipolar affective disorders. In

### Table 2. Estimated independent effects of psychological characteristics.

| Variable                          | Utilization pattern (High Utilizer vs. Non-High-Utilizer) | Length of stay (number of inpatient treatment days) |
|-----------------------------------|----------------------------------------------------------|---------------------------------------------------|
|                                  | Multiple logistic regression model                        | Lasso RF                                           |
|                                  | β  | Std. Error | z-value | p  | β  | VIV | β  | Std. Error | t-value | p  | β  | VIV |
|                                  |    |            |         |   |    |     |    |            |         |   |    |     |
| (n = 112)                        |    |            |         |   |    |     |    |            |         |   |    |     |
| Sex                               | -0.27 | 0.27 | -1.00 | 0.32 | -0.27 | 0.00 | -0.10 | 0.11 | -0.91 | 0.37 | -0.09 | 0.00 |
| Age                               | 0.26 | 0.27 | 0.99 | 0.32 | 0.26 | 14.96 | 0.01 | 0.11 | 0.11 | 0.91 | 0.03 | 20.49 |
| Psychopathology                   | 0.58 | 0.27 | 2.19 | 0.03 | 0.57 | 70.78 | 0.17 | 0.11 | 1.55 | 0.13 | 0.19 | 82.59 |
| Quality of life                   |      |            |         |   |    |     |    |            |         |   |    |     |
| Physical health                   | 0.20 | 0.34 | 0.60 | 0.55 | 0.20 | 43.41 | -0.08 | 0.14 | -0.55 | 0.58 | 0.00 | 58.90 |
| Psychological health              | 1.26 | 0.52 | 2.41 | 0.02 | 1.23 | 67.62 | 0.45 | 0.21 | 2.11 | 0.04 | 0.00 | 84.41 |
| Social relationships              | -0.12 | 0.33 | -0.37 | 0.71 | -0.12 | 26.83 | -0.10 | 0.14 | -0.76 | 0.45 | 0.00 | 62.58 |
| Environment                       | -0.12 | 0.30 | -0.41 | 0.68 | -0.12 | 51.35 | -0.05 | 0.13 | -0.44 | 0.66 | 0.00 | 69.77 |
| Self-esteem                       | -0.77 | 0.45 | -1.71 | 0.09 | -0.76 | 58.73 | -0.21 | 0.18 | -1.13 | 0.26 | 0.00 | 75.13 |
| Self-stigma                       |      |            |         |   |    |     |    |            |         |   |    |     |
| Awareness                         | 0.53 | 0.27 | 1.99 | 0.05 | 0.52 | 100.00 | -0.03 | 0.11 | -0.26 | 0.80 | 0.00 | 100.00 |
| Agreement                         | -0.23 | 0.27 | -0.85 | 0.40 | -0.23 | 46.95 | 0.13 | 0.11 | 1.15 | 0.25 | 0.00 | 89.68 |
| Application                       | -0.62 | 0.38 | -1.62 | 0.11 | -0.60 | 63.57 | -0.25 | 0.15 | -1.73 | 0.09 | 0.00 | 77.84 |
| Hurts-self                        | 1.05 | 0.44 | 2.40 | 0.02 | 1.03 | 93.17 | 0.44 | 0.17 | 2.57 | 0.01 | 0.00 | 77.35 |
| Subjective experience and meaning of psychoses |    |            |         |   |    |     |    |            |         |   |    |     |
| Biographical integration          | 0.23 | 0.26 | 0.86 | 0.39 | 0.22 | 36.42 | -0.03 | 0.11 | -0.23 | 0.82 | 0.00 | 58.26 |
| Symptoms positive                 | 0.61 | 0.39 | 1.58 | 0.11 | 0.59 | 64.55 | 0.14 | 0.15 | 0.96 | 0.34 | 0.00 | 84.20 |
| Symptoms negative                 | 0.23 | 0.32 | 0.70 | 0.49 | 0.21 | 60.39 | -0.09 | 0.13 | -0.67 | 0.51 | 0.00 | 74.82 |
| Positive consequences             | -0.48 | 0.33 | -1.44 | 0.15 | -0.47 | 56.20 | -0.02 | 0.13 | -0.13 | 0.90 | 0.00 | 63.04 |
| Negative consequences             | -0.18 | 0.32 | -0.55 | 0.58 | -0.17 | 40.51 | 0.02 | 0.13 | 0.16 | 0.88 | 0.00 | 71.68 |
| Insight into the disease          |      |            |         |   |    |     |    |            |         |   |    |     |
| Self-reflectiveness               | -0.08 | 0.29 | -0.27 | 0.79 | -0.08 | 60.31 | -0.13 | 0.12 | -1.04 | 0.30 | 0.00 | 81.75 |
| Self-certainty                    | 0.06 | 0.26 | 0.24 | 0.81 | 0.06 | 46.12 | 0.08 | 0.11 | 0.75 | 0.45 | 0.00 | 68.53 |

Note. Values based on transformed data.

Lasso = Least absolute shrinkage and selection operator; RF = Random forest; VIV = Variable importance values; p = Significance value. Variable importance values are scaled to lie between 0 and 100.

https://doi.org/10.1371/journal.pone.0266352.t002
contrast, there is a growing body of evidence suggesting that self-stigma, self-esteem, and insight into the disease varies among these patients compared to other patient groups. Moreover, these characteristics should be specifically addressed in the psychotherapeutic treatment of patients with psychoses (e.g., [31, 58–62]). In contrast to our findings, prior studies have reported a link between a decreased insight into disease and a higher utilization of psychiatric inpatient treatment in patients with psychosis [30, 31]. However, the findings of this study do not suggest a link between the estimated psychological variables including insight into disease and utilization of psychiatric inpatient treatment. One potential explanation for this observation might be that the examined psychological characteristics of the patients do not vary depending on the use of psychiatric inpatient treatment in patients diagnosed with schizophrenia spectrum or bipolar affective disorders. In this case, there is no evidence that these characteristics should be addressed differently in the psychotherapeutic treatment of HU compared to NHU patients diagnosed with schizophrenia spectrum or bipolar affective disorders. However, this explanation brings up other questions to the fore: whether it is not rather the previously reported factors (e.g., problems in the areas of housing/social network or services that are not tailored to the needs of the patients) that are linked to patients’ utilization of psychiatric inpatient treatment, or whether there are other psychological patient characteristics relevant in this context but not examined in this study. Other possible explanations for our observations could be that the methodological aspects in this study ensured that no link between the psychological characteristics of patients and their utilization of psychiatric inpatient treatment was revealed. Potential methodological aspects that can be considered in this context include the comparatively small sample size, potential presence of further confounders that were not included in the analyses, and a potential bias in the estimation of the psychological patient characteristics. It could be, for example, that the self-report questionnaires used in this study did not reliably estimate the patients’ psychological characteristics due to their acute psychosis during inpatient treatment. Hence, future studies should be performed in order to either replicate or correct the findings of this study in larger samples. To reduce the risk of a bias, these studies may include further potential confounders such as drug adherence, social support, or substance use in their research design and may investigate patients’ psychological characteristics among other less severe psychopathological conditions during outpatient treatment.

Identification of robust psychological variables linked to utilization of psychiatric inpatient treatment in future studies may enhance the understanding of the underlying mechanisms of high utilization and, in turn, foster tailoring of psychotherapeutic interventions to the specific characteristics of HU patients. Describing specific patient groups and tailoring psychiatric and psychotherapeutic interventions to their specific characteristics were discussed as important factors in the implementation of a patient-centered psychiatry with open doors and least restrictive treatment [63–67].

This study has some limitations. First, the sample size is rather small and a substantial proportion of screened patients declined participation. Hence, the findings should be replicated with a larger sample. Second, we measured patients’ psychological characteristics in the presence of a researcher; thus, the occurrence of the “interviewer effect” is possible [68]. Accordingly, patients may have trivialized statements, which may have potentially led to underestimating respective variable levels. Third, in this cross-sectional observational study, we entered patients’ psychological variables as predictors and “utilization pattern” and “length of stay” as outcome variables into our statistical models. One reason for this was that quality of life, self-esteem, self-stigma, and insight into the disease revealed a relatively high stability over time in prior research [69–73]. These psychological variables may precede and cause patients’ behaviors related to their use of psychiatric inpatient treatment. Another reason was that prior observational studies investigating utilization of psychiatric inpatient treatment usually
defined indicators of utilization as outcomes based on the assumption that utilization relates to an outcome concept, which can be influenced by therapeutic interventions (e.g., [5]). In future studies, the use of prospective study designs could clarify the question about whether variables estimating patients’ utilization of psychiatric inpatient treatment should be defined as predictors or outcomes. Fourth, another potential limitation is that we cannot rule out the presence of selection bias [74]. As participation was voluntary and inclusion and exclusion criteria were applied, our study sample may possess specific characteristics compared to the respective total patient population, which may limit the generalizability of our findings. Due to these limitations, it is necessary to replicate our findings through further studies before clinical implications for practice can be drawn. Despite these limitations, this study has important strengths. We applied methodologically rigorous “state of the art” statistics to estimate associations between patients’ psychological characteristics and their utilization of psychiatric inpatient treatment. These included the lasso model for variable selection combined with cross-validation to assess the predictive accuracy of the investigated models based on test data rather than training data. The lasso method considers the family-wise error rate and is, therefore, less likely to cause chance effects [75–77]. Moreover, cross-validation is associated with a higher predictive accuracy, especially when the number of predictors considered is large, relative to the sample size [54]. In this study, using only multiple regression models without cross-validation would have led to several significant associations between psychological variables and utilization, which would likely disappear when replicated. Another strength of the study is the application of two different indicators for utilization of inpatient treatment: the dichotomous classification HU versus NHU, and the continuous variable number of inpatient treatment days during the last 30 months. As prior studies criticized the heterogeneous definition of “high utilization,” the use of different parameters seemed more appropriate for the statistical analyses of our data [10]. Furthermore, this study examined the high utilization phenomenon in patients diagnosed with schizophrenia spectrum or bipolar affective disorders. High utilization occurs more often in this group of patients compared to patient groups with other primary diagnoses (e.g., [13, 19–22]); thus, we studied the high utilization phenomenon in a particularly relevant population.

In conclusion, our findings do not suggest a link between the estimated psychological characteristics and utilization of psychiatric inpatient treatment in patients with schizophrenia spectrum or bipolar affective disorders. The insufficient understanding of the mechanisms linking specific patients to high utilization, the potentially high personal burden of HU patients and their relatives, as well as the objective to tailor treatment concepts to their specific characteristics highlights the need for greater understanding in this field.

Supporting information
S1 Table. Correlation matrix containing bivariate correlations between all relevant variables.

(DOCX)

Acknowledgments
The authors want to thank Lukas Imfeld for his help with the extraction of anonymized data and Melanie Nuoffer for her help with the preparation of the tables and literature research.

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References

1. Hadley TR, Culhane DP, McGurrin MC. Identifying and tracking “heavy users” of acute psychiatric inpatient services. Adm Policy Ment Health. 1992; 19: 279–290.
2. Kent S, Fogarty M, Yellowlees P. A review of studies of heavy users of psychiatric services. Psychiatr Serv. 1995; 46(12): 1247–1253. https://doi.org/10.1176/ps.46.12.1247 PMID: 8590109
3. Spießl H, Hübner-Liebermann B, Binder H, Cordig C. “Heavy Users” in einer psychiatrischen Klinik—Eine Kohortenstudie mit 1811 Patienten über fünf Jahre. Psychiatr Prax. 2002; 29: 350–354. https://doi.org/10.1055/s-2002-34659 PMID: 12378415
4. Golay P, Morandi S, Conus P, Bonsack C. Identifying patterns in psychiatric hospital stays with statistical methods: towards a typology of post-deinstitutionalization hospitalization trajectories. Soc Psychiatry Psychiatr Epidemiol. 2019; 54: 1411–1417. https://doi.org/10.1007/s00127-019-01717-7 PMID: 31041468
5. Kromka W, Simpson S. A narrative review of predictors of adult mental health emergency department return visits and interventions to reduce repeated use. J Emerg Med. 2019; 57: 671–682. https://doi.org/10.1016/j.jemermed.2019.08.005 PMID: 31610908
6. Roick C, Gärtner A, Heider D, Dietrich S, Angermeyer MC. Heavy use of psychiatric inpatient care from the perspective of the patients affected. Int J Soc Psychiatry. 2006; 52: 432–446. https://doi.org/10.1177/0020764006066824 PMID: 17278345
7. Broadbent E, Kydd R, Sanders D, Vanderpyl J. Unmet needs and treatment seeking in high users of mental health Services: role of illness perceptions. Aust N Z J Psychiatry. 2008; 42: 147–153. https://doi.org/10.1080/00048670701787503 PMID: 18197510
8. Kent S, Fogarty M, Yellowlees P. Heavy utilization of inpatient and outpatient services in a public mental health service. Psychiatr Serv. 1995; 46(12): 1254–1257. https://doi.org/10.1176/ps.46.12.1254 PMID: 8590110
9. Lindamer LA, Liu L, Sommerfeld DH, Folsom DP, Hawthorne W, Garcia P, et al. Predisposing, enabling, and need factors associated with high service use in a public mental health system. Adm Policy Ment Health. 2012; 39: 200–209. https://doi.org/10.1007/s10488-011-0350-3 PMID: 21533848
10. Roick C, Gärtner A, Heider D, Angermeyer MC. Heavy user psychiatrischer Versorgungsdienste. Psychiatr Prax. 2002; 29: 334–342. https://doi.org/10.1055/s-2002-34658 PMID: 12378413
11. Junghan UM, Brenner HD. Heavy use of acute in-patient psychiatric services: the challenge to translate a utilization pattern into service provision. Acta Psychiatr Scand Suppl. 2006; 113: 24–32. https://doi.org/10.1111/j.1600-0447.2004.00713.x PMID: 16445478
12. Katschnig H, Strassmayr C, Endel F, Berger M, Zauner G, Kalseth J, et al. Using national electronic health care registries for comparing the risk of psychiatric re-hospitalisation in six European countries: opportunities and limitations. Health Policy. 2019; 123: 1028–1035. https://doi.org/10.1016/j.healthpol.2019.07.006 PMID: 31405616
13. Lay B, Lauber C, Rössler W. Prediction of in-patient use in first-admitted patients with psychosis. Eur Psychiatry. 2006; 21: 401–409. https://doi.org/10.1016/j.eurpsy.2005.12.004 PMID: 16530392
14. Morlino M, Calento A, Schiavone V, Santone G, Picardi A, de Girolamo G, et al. Use of psychiatric inpatient services by heavy users: findings from a national survey in Italy. Eur Psychiatry. 2011; 26: 252–259. https://doi.org/10.1016/j.eurpsy.2010.11.005 PMID: 21296559
15. Casper ES, Pastva G. Admission histories, patterns, and subgroups of the heavy users of a state psychiatric hospital. Psychiatr Q. 1990; 61: 121–134. https://doi.org/10.1007/BF01064912 PMID: 2386959
16. Holohan ED, Pulice RT, Donahue SA. Utilization of acute inpatient psychiatric services: “heavy users” in New York State. Adm Policy Ment Health. 1991; 18: 173–181.
17. Hadley TR, McGurrin MC, Pulice RT, Holohean EJ. Using fiscal data to identify heavy service users. Psychiatr Q. 1990; 61: 41–48. https://doi.org/10.1007/BF01065163 PMID: 2201053

18. Kent S, Yellowlees P. The relationship between social factors and frequent use of psychiatric services. Aust N Z J Psychiatry. 1995; 29: 403–408. https://doi.org/10.3109/00048679509064947 PMID: 8573042

19. Evans LJ, Harris V, Newman L, Beck A. Rapid and frequent psychiatric readmissions: associated factors. Int J Psychiatry Clin Pract. 2017; 21: 271–276. https://doi.org/10.1080/13651501.2017.1324037 PMID: 2854237

20. Jeppesen RM, Christensen T, Vestergaard CH. Changes in the utilization of psychiatric hospital facilities in Denmark by patients diagnosed with schizophrenia from 1970 through 2012: the advent of ‘revolving door’ patients. Acta Psychiatr Scand Suppl. 2016; 133: 419–425. https://doi.org/10.1111/acps.12549 PMID: 26748617

21. Kapur K, Young AS, Murata D. Risk adjustment for high utilizers of public mental health care. J Ment Health Policy Econ. 2000; 3: 129–137. https://doi.org/10.1002/mhp.85 PMID: 11967448

22. Lorine K, Goenjian H, Kim S, Steinberg AM, Schmidt K, Goenjian AK. Risk factors associated with psychiatric readmission. J Nerv Ment Dis. 2015; 203: 425. https://doi.org/10.1097/NMD.0000000000000540 PMID: 27227558

23. Di Lorenzo R, Sagona M, Landi G, Martire L, Piemonte C, Del Giovane C. The revolving door phenomenon in an Italian acute psychiatric ward: a 5-year retrospective analysis of the potential risk factors. J Nerv Ment Dis. 2016; 204: 686–692. https://doi.org/10.1097/NMD.000000000000540 PMID: 27227558

24. Pasic J, Russo J, Roy-Byrne P. High utilizers of psychiatric emergency services. Psychiatr Serv. 2005; 56: 678–684. https://doi.org/10.1176/appi.ps.56.6.678 PMID: 15939943

25. Lucas B, Harrison-Read P, Tyrer P, Ray J, Shipley K, Hickman M, et al. Costs and characteristics of heavy inpatient service users in outer London. Int J Soc Psychiatry. 2001; 47: 63–74. https://doi.org/10.1177/0020764001047000106 PMID: 11322407

26. Kent S, Yellowlees P. Psychiatric and social reasons for frequent rehospitalization. Hosp Community Psychiatry. 1994; 45: 347–350. https://doi.org/10.1176/ps.45.4.347 PMID: 8020919

27. Stulz N, Bielinski D, Junghan UM, Hepp U. Stationärer Heavy Use und die Inanspruchnahme institutioneller ambulanter Dienste in einem Schweizerischen Versorgungssystem. Psychiatr Prax. 2012; 39: 332–338. https://doi.org/10.1055/s-0032-1305231 PMID: 23044847

28. Roick C, Heider D, Kilian R, Matschinger H, Toumi M, Angermeyer MC. Factors contributing to frequent use of psychiatric inpatient services by schizophrenia patients. Soc Psychiatry Psychiatr Epidemiol. 2004; 39: 744–751. https://doi.org/10.1007/s00127-004-0807-8 PMID: 15672296

29. Kennedy P, Hird F. Description and evaluation of a short-stay admission ward. Br J Psychiatry. 1980; 136: 205–215. https://doi.org/10.1192/bjp.136.3.205 PMID: 7388229

30. Kemp RA, Lambert TJR. Insight in schizophrenia and its relationship to psychopathology. Schizophr Res. 1995; 18: 21–28. https://doi.org/10.1016/0920-9964(95)00118-9 PMID: 8929757

31. Ramu N, Kolliakou A, Sanyal J, Patel R, Stewart R. Recorded poor insight as a predictor of service use outcomes: cohort study of patients with first-episode psychosis in a large mental healthcare database. BMJ Open. 2019; 9: e028929. https://doi.org/10.1136/bmjopen-2019-028929 PMID: 31196905

32. Gumley A, Karatzias A, Power K, Reilly J, McNay L, O’Grady M. Early intervention for relapse in schizophrenia: impact of cognitive behavioural therapy on negative beliefs about psychosis and self-esteem. Br J Clin Psychol. 2006; 45: 247–260. https://doi.org/10.1348/014466505X49925 PMID: 16719982

33. Lysaker PH, Roe D, Ringer J, Gilmore EM, Yanos PT. Change in self-stigma among persons with schizophrenia enrolled in rehabilitation: associations with self-esteem and positive and emotional discomfort symptoms. Psychiatr Serv. 2012; 9: 240–247. https://doi.org/10.1001/psychserv.2012.9 PMID: 22468614

34. Ritsner M, Gibel A, Ratner Y. Determinants of changes in perceived quality of life in the course of schizophrenia. Qual Life Res. 2006; 15: 515–526. https://doi.org/10.1007/s11136-005-2808-9 PMID: 16547790

35. Moritz S, Mahike CI, Westermann S, Ruppelt F, Lysaker PH, Bock T, et al. Embracing psychosis: a cognitive insight intervention improves personal narratives and meaning-making in patients with schizophrenia. Schizophr Bull. 2018; 44: 307–316. https://doi.org/10.1093/schbul/sbx072 PMID: 29106693

36. Carroll A, Fattah S, Clyde Z, Coffey I, Owens DGC, Johnstone EC. Correlates of insight and insight change in schizophrenia. Schizophr Res. 1999; 35: 247–253. https://doi.org/10.1016/s0920-9964(98)00142-x PMID: 10093870
37. Weiler MA, Fleisher MH, McArthur-Campbell D. Insight and symptom change in schizophrenia and other disorders. Schizophr Res. 2000; 45: 29–36. https://doi.org/10.1016/s0920-9964(99)00215-7 PMID: 10978870

38. Skevington SM, Lotfy M, O’Connell KA, WHOQOL Group. The World Health Organization’s WHOQOL-BREF quality of life assessment: psychometric properties and results of the international field trial. A report from the WHOQOL group. Qual Life Res. 2004; 13: 299–310. https://doi.org/10.1023/B:QUAL.0000018486.91360.00 PMID: 15085902

39. Group WHOQOL. Development of the World Health Organization’s WHOQOL-BREF quality of life assessment. Psychiatr Med. 1998; 28: 551–558. https://doi.org/10.1017/j.pychres.2012.04.009 PMID: 9626712

40. Rosenberg M. Rosenberg self-esteem scale (RSE). Accept Commit Ther Meas Package. 1965; 61: 52.

41. Roth M, Decker O, Herzberg PY, Brähler E. Dimensionality and norms of the Rosenberg self-esteem scale in a German general population sample. Eur J Psychol Assess. 2008; 24: 190–197. https://doi.org/10.1027/1023-B:QURE.0000018486.91360.00 PMID: 16282265

42. Corrigan PW, Watson AC, Barr L. The self-stigma of mental illness: implications for self-esteem and self-efficacy. J Soc Clin Psychol. 2002; 56: 1441–1443. https://doi.org/10.1176/appi.ps.56.11.1441 PMID: 12733289

43. Corrigan PW, Michaels PJ, Vega E, Gause M, Watson AC, Rüscher N. Self-stigma of mental illness scale—short form: reliability and validity. Psychiatry Res. 2012; 199: 65–69. https://doi.org/10.1016/j.psychres.2012.04.009 PMID: 22578819

44. Klapheck K, Nordmeyer S, Cronjäger H, Naber D, Bock T. Subjective experience and meaning of psychoses: the German subjective sense in psychosis questionnaire (SUSE). Psychol Med. 2012; 42: 61–71. https://doi.org/10.1017/S0033291711001103 PMID: 21733289

45. Bock T, Priebe S. Psychosis seminars: an unconventional approach. Psychiatr Serv. 2005; 56: 1441–1443. https://doi.org/10.1176/appi.ps.56.11.1441 PMID: 16282265

46. Bock T, Byrski T, Klapheck K, Bening U, Lenz A, Naber D. On subjective meaning of psychoses. Construction, validation and first application of a new questionnaire—the SuSi-Project (Hamburg). Psychiatr Prax. 2010; 37: 285–291. https://doi.org/10.1055/s-0030-1248424 PMID: 20552540

47. Klapheck K, Lincoln TM, Bock T. Meaning of psychoses as perceived by patients, their relatives and clinicians. Psychiatry Res. 2014; 215: 760–765. https://doi.org/10.1016/j.psychres.2014.01.017 PMID: 24495572

48. Beck AT, Baruch E, Balter JM, Steer RA, Warman DM. A new instrument for measuring insight: the Beck cognitive insight scale. Schizophr Res. 2004; 68: 319–329. https://doi.org/10.1016/S0920-9964(03)00189-0 PMID: 15099613

49. Riggs SE, Grant PM, Perivoliotis D, Beck AT. Assessment of cognitive insight: a qualitative review. Schizophr Bull. 2012; 38: 338–350. https://doi.org/10.1093/schbul/sbq085 PMID: 20693342

50. Chisholm D, Knapp MR, Knudsen HC, Amaddeo F, Gaite L, van Wijngaarden B. Client sociodemographic and service receipt inventory—European version: development of an instrument for international research. EPSILON Study 5. European psychiatric services: inputs linked to outcome domains and needs. Br J Psychiatry Suppl. 2000;(39): 28–33. https://doi.org/10.1192/bjp.177.39.s28 PMID: 10945075

51. Roick C, Kilian R, Matschinger H, Bernert S, Mory C, Angermeyer MC. German adaptation of the client sociodemographic and service receipt inventory—an instrument for the cost of mental health care. Psychiatr Prax. 2001; 28 Suppl 2: 84–90. https://doi.org/10.1055/s-2001-17790 PMID: 11605129

52. Mass R, Burmeister J, Kraus M. Dimensionale Struktur der deutschen Version des Brief Psychiatric Rating Scale (BPRS). Nervenarzt. 1997; 68: 239–244. https://doi.org/10.1007/s001150050119 PMID: 9198784

53. Overall JE, Gorham DR. The brief psychiatric rating scale. Psychol Rep. 1962; 10: 799–812.

54. Harrell FE. Regression modeling strategies: with applications to linear models, logistic and ordinal regression, and survival analysis. Cham: Springer International Publishing; 2015. https://doi.org/10.1007/978-3-319-19425-7

55. Hastie T, Tibshirani R, Friedman J. The elements of statistical learning. New York, NY: Springer New York; 2009. https://doi.org/10.1007/978-0-387-84858-7

56. Breiman L. Random Forest. Mach Learn. 2001; 45: 5–32. https://doi.org/10.1023/A:1010933404324

57. Friedman J, Hastie T, Tibshirani R. Regularization paths for generalized linear models via coordinate descent. J Stat Softw. 2010; 33: 1–22. https://doi.org/10.18637/jss.v033.i01 PMID: 20809728

58. Amador X. I am not sick, I don’t need help!: how to help someone with mental illness accept treatment. Vida Press; 2000.
59. Collett N, Pugh K, Waite F, Freeman D. Negative cognitions about the self in patients with persecutory delusions: an empirical study of self-compassion, self-stigma, schematic beliefs, self-esteem, fear of madness, and suicidal ideation. Psychiatry Res. 2016; 239: 79–84. https://doi.org/10.1016/j.psychres.2016.02.043 PMID: 27137965

60. Mittal D, Sullivan G, Chekuri L, Allee E, Corrigan PW. Empirical studies of self-stigma reduction strategies: a critical review of the literature. Psychiatr Serv. 2012; 63: 974–981. https://doi.org/10.1176/appi.ps.20110045 PMID: 22855130

61. Mortz S, Andreou C, Schneider BC, Wittekind CE, Menon M, Balzan RP, et al. Sowing the seeds of doubt: a narrative review on metacognitive training in schizophrenia. Clin Psychol Rev. 2014; 34: 358–366. https://doi.org/10.1016/j.cpr.2014.04.004 PMID: 24866025

62. Mortz S, Woodward TS. Metacognitive training in schizophrenia: from basic research to knowledge translation and intervention. Curr Opin Psychiatry. 2007; 20: 619–625. https://doi.org/10.1097/YCO.0b013e3282f0b8ed PMID: 17921766

63. Arnold BD, Moeller J, Hochstrasser L, Schneeberger AR, Borgwardt S, Lang UE, et al. Compulsory admission to psychiatric wards—who is admitted, and who appeals against admission? Front Psychiatry. 2019; 10: 544. https://doi.org/10.3389/fpsyt.2019.00544 PMID: 31447710

64. Hochstrasser L, Voulgaris A, Möller J, Zimmermann T, Steinauer R, Borgwardt S, et al. Reduced frequency of cases with seclusion is associated with “opening the doors” of a psychiatric intensive care unit. Front Psychiatry. 2018; 9: 57. https://doi.org/10.3389/fpsyt.2018.00057 PMID: 29536561

65. Hochstrasser L, Fröhlich D, Schneeberger AR, Borgwardt S, Lang UE, Stieglitz R-D, et al. Long-term reduction of seclusion and forced medication on a hospital-wide level: implementation of an open-door policy over 6 years. Eur Psychiatry. 2018; 48: 51–57. https://doi.org/10.1016/j.eurpsy.2017.09.008 PMID: 29331599

66. Lang U. Innovative Psychiatrie mit offenen Türen: Deeskalation und Partizipation in der Akutpsychiatrie. Berlin: Springer; 2013.

67. Steinauer R, Krückl JS, Moeller J, Vogel M, Wiesbeck GA, Walter M, et al. Opening the doors of a substance use disorder ward—benefits and challenges from a consumer perspective. Front Psychiatry. 2020; 11: 580885. https://doi.org/10.3389/fpsyt.2020.580885 PMID: 33192724

68. West BT, Blom AG. Explaining interviewer effects: a research synthesis. J Surv Stat Methodol. 2016; 5 (2): 175–211. https://doi.org/10.1093/jssam/smw024

69. Atkinson T. The stability and validity of quality of life measures. Soc Indic Res. 1982; 10: 113–132. https://doi.org/10.1007/BF01070256

70. Kuster F, Orth U. The long-term stability of self-esteem: its time-dependent decay and nonzero asymptote. Pers Soc Psychol Bull. 2013; 39: 677–690. https://doi.org/10.1177/0146167213480189 PMID: 23478674

71. Lysaker PH, Tunze C, Yanos PT, Roe D, Ringer J, Rand K. Relationships between stereotyped beliefs about mental illness, discrimination experiences, and distressed mood over 1 year among persons with schizophrenia enrolled in rehabilitation. Soc Psychiatry Psychiatr Epidemiol. 2012; 47: 849–855. https://doi.org/10.1007/s00127-011-0396-2 PMID: 21603968

72. McEvoy JP, Apperson LJ, Appelbaum PS, Ortlip P, Brecosky J, Hammill K, et al. Insight in schizophrenia: Its relationship to acute psychopathology. J Nerv Ment Dis. 1989; 177: 43–47. https://doi.org/10.1097/00005053-198910000-00007 PMID: 2562850

73. McGorry PD, McConville SB. Insight in psychosis: an elusive target. Compr Psychiatry. 1999; 40: 131–142. https://doi.org/10.1016/s0010-440x(99)90117-7 PMID: 10080260

74. Heckman JJ. Sample selection bias as a specification error. Econometrica. 1979; 47: 153–161. https://doi.org/10.2307/1913253

75. Kukreja SL, Löhberg J, Brenner MJ. A least absolute shrinkage and selection operator (LASSO) for nonlinear system identification. IFAC Proc Vol. 2006; 39: 814–819. https://doi.org/10.3182/20060329-3-AU-2901.00128

76. Schneider A, Hommel G, Blettner M. Linear regression analysis. Dtsch Arztebl Int. 2010; 107(44): 776–782. https://doi.org/10.3238/arztebl.2010.0776 PMID: 21116397

77. Tibshirani R. Regression shrinkage and selection via the Lasso. J R Stat Soc Series B Stat Methodol. 1996; 58: 267–288. https://doi.org/10.1111/j.2517-6161.1996.tb02080.x