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Aslihan Aksar, Zahra Amini Farsani, Alkomiet Hasan, Astrid Röh

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A retrospective analysis of COVID-19 vaccination uptake among patients admitted to psychiatric hospitals in southwest Bavaria

Aslihan Aksar [a,*], Zahra Amini Farsani [a,b], Alkomiet Hasan [a,c], Astrid Röh [a]

[a] Department of Psychiatry, Psychotherapy, and Psychosomatic Medicine, Faculty of Medicine, University of Augsburg, Bezirkskrankenhaus Augsburg, Augsburg, Germany
[b] Bayesian Imaging and Spatial Statistics Group, Institute of Statistics, Ludwig-Maximilian-Universität, Ludwigstraße 33, Munich, Germany
[c] DZPG (German Center for Mental Health), Partner Site Munich/Augsburg, Augsburg, Germany

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ABSTRACT

Individuals with mental illness represent a vulnerable group for coronavirus disease 2019 (COVID-19) severity and mortality, highlighting the need for continued evaluation of preventive measures in this population. Previous studies exploring the COVID-19 vaccination uptake among individuals with mental illness, including comparisons with general population and analyses of high-risk subgroups showed inconsistent results. Large-scale studies from an entire catchment area in Germany are lacking. This retrospective study based on routine clinical data examined COVID-19 vaccination uptake among psychiatric inpatients and daycare patients admitted between 01.01.2022 and 31.03.2023 to psychiatric hospitals in southwest Bavaria in Germany. Documented vaccination uptake in the study group (n = 3734; 6756 cases), corresponding to 44% of total admissions in the study period, was compared with the general population. Statistical analysis focused on differences in vaccination status across demographic and diagnostic groups. Logistic regression models were used to identify factors associated with vaccination status. Overall, the rate of unvaccinated individuals in the study group (13.6%) appeared lower than that of the corresponding federal state, Bavaria and broadly comparable to the national rate in Germany. Higher vaccination rates were associated with increased age and female gender, whereas lower rates were observed in alcohol or substance abuse disorders. The results may suggest a positive impact of targeted in-hospital vaccination initiatives, although further research is needed to elucidate this association. For future public health crises, targeted outreach strategies may improve preventive care among the identified vulnerable subgroups.

1. Introduction

The coronavirus disease 2019 (COVID-19) outbreak has revealed the lack of preparedness for global public health crises. Still recovering, it is essential to reflect on our experiences and to develop more comprehensive and targeted prevention strategies. This requires identifying groups that were harder to reach by broad-based interventions.

Individuals with psychiatric disorders represent a vulnerable group for COVID-19 severity and mortality due to various factors including the high prevalence of comorbidities (De Hert et al., 2021; Vai et al., 2022), barriers in the recognition and care for physical diseases (De Hert et al., 2011), altered immune function and psychopathology-related features such as cognitive dysfunction or delusions (Mazereel et al., 2021a). Moreover, they may be disproportionately affected by social determinants of health – such as low income, unstable housing, lower educational levels, limited access to healthcare services – which may further decrease vaccination uptake. These structural barriers, in combination with stigma and discrimination, create a complex landscape of vulnerability that broad-based public health strategies often fail to address adequately.

Post-pandemic studies on COVID-19 vaccination uptake among people with mental illness show heterogeneous results regarding vaccination uptake compared to general population and at-risk subgroups. While some studies reported lower vaccination rates in this population (Shaffer et al., 2023; Wiegand et al., 2022), others found comparably high uptake (Barker et al., 2024; Mazereel et al., 2021b). Within subgroups, low uptake was observed among individuals with schizophrenia or other non-affective psychotic disorders (Goldberger

* Corresponding author. Department of Psychiatry, Psychotherapy, and Psychosomatic Medicine Medical Faculty, University of Augsburg, Bezirkskrankenhaus Augsburg, Geschwister-Schoenert-Str. 1, 86156, Augsburg, Germany.
E-mail address: Aslihan.Aksar@bkh-augsburg.de (A. Aksar).

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et al., 2022; Lee et al., 2023; Pisl and Vevera, 2023; Tzur Bitan et al., 2021), unmedicated patients with a recent diagnosis of mental illness (Barker et al., 2024) or people with severe mental illness (SMI) or learning disabilities (Curtis et al., 2021).

In Germany, individuals with SMI were prioritized for COVID-19 vaccination, as mandated by national legal regulations, with vaccination recommendations and offers delivered during routine medical contacts. Data on vaccination uptake in this population remain scarce, limiting the ability to inform targeted vaccination strategies. To determine whether patients with mental illness achieved vaccination rates comparable to those of the general population and to identify subgroups characterized by particularly low or high vaccination uptake, we conducted a retrospective study in a model region assessing COVID-19 vaccination uptake among psychiatric patients hospitalized in the Swabia region of Bavaria. We examined demographic factors, primary psychiatric diagnosis and comorbidities, comparing vaccination rates with those of the general population. Considering the nationwide prioritization and periodic in-hospital COVID-19 vaccination campaigns directed at psychiatric inpatients and daycare patients in the psychiatric hospitals of the catchment area, which involved the active assessment of vaccination status and the provision of vaccinations, we considered an evaluation of the outcomes of great importance for the improvement of targeted preventive healthcare measures and for our readiness for future health crises.

2. Methods

2.1. Study design

In this anonymous retrospective multicenter cohort study, we extracted routine data from the clinical information system (CIS) of all psychiatric patients (inpatients and daycare) that were in contact with one of the six following psychiatric community hospitals in the catchment area (Swabia) between 01.01.2022 and 31.03.2023: Augsburg (with 326 beds + 32 daycare places), Günzburg (312 + 2), Donauwörth (40 + 16), Kaufbeuren (202 + 40), Kempten (120 + 35), Memmingen (40 + 12), Lindau (0 + 20), Ursberg (18 + 0) and Obergünzburg (60 + 0). The data encompasses the timeframe, in which large-scale COVID-19 vaccination programs in Germany as well as in-hospital vaccinations were offered and ends with the expiration of the legal framework of COVID-19 protection measures in Germany (Pandemic preparedness, 2025).

The population vaccination rates of individuals aged 18 or older, corresponding to the age range of the study population, were extracted from the open-access database of Robert Koch Institute (RKI) (Robert Koch-Institut, 2024), for both Bavaria and Germany, covering the same timeframe as the study period. Publicly available data on the absolute numbers for the adult population (aged 18 or older) of Bavaria and Germany were retrieved from the Federal Statistical Office of Germany (Federal Statistical Office of Germany, 2025) and were available for the last day of each calendar year. We used the population numbers from 31 December 2023, which differed only minimally from the previous year. After consultation with the local ethic committee, a specific ethical approval and consent to participate were not required for this study, as it involved the secondary use of routinely collected health data stored in a local database in a fully anonymized form, in accordance with applicable data protection regulations.

2.2. Data collection and preparation

A total of 6756 admissions with a documented primary diagnosis and COVID-19 vaccination status during the admission or stay were recorded. This corresponded to 44% (6756 of 15.305) of all admissions to the given hospitals over the study period. Of those, 8 were excluded from the analysis since they did not have a documented primary psychiatric diagnosis in the medical records. In the final analysis, 6748 cases corresponding to 3734 patients were included.

The extracted data was anonymously provided by the central patient administration office and included patient ID, case number, date of admission, date of discharge, gender (as stated in the insurance card), date of birth, vaccination status documented during the admission or stay, legal status of admission or stay (voluntary or involuntary), insurance status (private or public), marital status (if reported), primary and secondary diagnoses by discharge. The psychiatric diagnosis was identified with International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10 codes). In the routine treatment, the primary diagnosis is specified based on the discharge letter, which is reviewed and signed by senior physicians. Secondary discharge diagnoses are, if necessary, revised by clinical documentation assistants who provide supplementary diagnostic details according to the clinical course. Vaccination status was verified using vaccination cards or digital vaccination records.

For the patients with multiple hospitalizations, only the most recent hospitalization was considered for the analysis to avoid overrepresentation. Variables regarding quantity or frequency of substance use and socio-demographics such as occupation, source of income, household composition were not included in the analysis due to inconsistent documentation. Duplicate diagnosis entries were removed.

To examine the association between vaccination status and somatic comorbidities known to be risk factors for increased COVID-19 severity and/or mortality, we considered the following secondary diagnoses: obesity, hypertension, diabetes mellitus, cardiac arrhythmia, phlebitis and thrombosis, allergic rhinitis, asthma, chronic obstructive pulmonary disease (COPD) and cancer.

The aggregated nature of the dataset did not allow for linking the admissions to the individual hospitals. Consequently, center-specific effects could not be assessed.

2.3. Variables and measurements

The primary outcome variable was the vaccination status, considered as a binary variable (vaccinated at least once vs. unvaccinated) to ensure consistency with general population data. The primary exposure variable was the primary psychiatric diagnosis, coded as a categorical variable and grouped into the following ICD-10 diagnostic categories: neurocognitive disorders and mental disorders associated with a general medical condition (F0), alcohol and substance use related disorders (F1), schizophrenia and related psychotic disorders (F2), affective disorders (F3), anxiety, stress-related, dissociative or somatoform disorders (F4), behavioural syndromes associated with physiological disturbances and physical factors (F5), personality disorders (F6), mental retardation (F7), disorders of psychological development (F8), behavioural and emotional disorders with onset usually occurring in childhood and adolescence (F9), diseases of the nervous system (G). Additionally, a variable indicating SMI was derived, defined as a diagnosis of schizophrenia (F20), severe depressive episode (F32.2), recurrent depressive disorder with current severe episode (F33.2), or bipolar affective disorder (F31) according to ICD-10. Secondary exposure variables included age, gender, marital status, duration of stay, insurance status, legal status of stay, having a substance or alcohol use disorder as a primary or secondary diagnosis, having a somatic comorbidity. These variables were identified a priori based on clinical and epidemiological domain knowledge.

2.4. Statistical analysis

Statistical analysis was conducted in three main steps: descriptive analysis, bivariate analysis, and multivariable binary logistic regression. All statistical analyses were performed using IBM SPSS Statistics (Version 29). Descriptive analysis summarized demographic and clinical characteristics, with categorical variables presented as frequencies and percentages. Associations between categorical variables were assessed

using Pearson's chi-square test, and Fisher's exact test was applied where appropriate. Continuous variables were compared using the Mann–Whitney *U* test due to non-normal distribution. To examine group differences in vaccination status, additional methods including Exact Binomial, Mid-p, Score, and Wald tests were applied where appropriate.

Additional subgroup (stratified) analyses were performed to explore the association between hospitalization type (voluntary vs. involuntary) and vaccination status across diagnostic categories using chi-square tests.

Multivariable binary logistic regression analysis was conducted to identify independent predictors of vaccination status. The initial set of potential variables for the logistic regression was based on an exploratory analytical framework including demographic and clinical characteristics. A complete case approach was used, including only observations with available data for all variables in the model. Four candidate variables, (marital status, duration of stay, primary diagnosis

Table 1
Characteristics of study population.

Variable	Total (n = 3734)	Vaccinated at least once (n = 3225)		Unvaccinated (n = 509)		Unvaccinated Rate (13.6%)	p-value
		n	% missing	n	% missing		
Age (Mean ± SD)	49.42 ± 19.99	49.84 ± 20.31	0%	46.75 ± 17.595	0%	not applicable	0.004[b]
Age groups			0%		0%		<0.001[c]
18 – 24	462	412	—	50	—	10.8%	—
25 – 34	640	529	—	111	—	17.3%	—
35 – 44	590	499	—	91	—	15.4%	—
45 – 54	582	477	—	105	—	18.0%	—
55 – 64	605	535	—	70	—	11.6%	—
65 – 74	346	308	—	38	—	11.0%	—
75 – 84	355	322	—	33	—	9.3%	—
85 +	154	143	—	11	—	7.1%	—
Gender			0%		0%		0.002[c]
Female	1902	1673	—	229	—	12.0%	—
Male	1832	1552	—	280	—	15.3%	—
Marital status			79.5%		84.3%		0.261[c]
Single	370	330	—	40	—	10.8%	—
Married	185	168	—	17	—	9.2%	—
Widowed	42	39	—	3	—	7.1%	—
Separated	26	20	—	6	—	23.1%	—
Divorced	119	105	—	14	—	11.8%	—
Insurance status			0%		0%		0.345[c]
Public	3480	3002	—	478	—	13.7%	—
Private	159	143	—	16	—	10.1%	—
None	95	80	—	15	—	15.8%	—
Primary Diagnosis			0%		0%		<0.001[c]
F0: neurocognitive disorders and mental disorders associated with a general medical condition	291	261	—	30	—	10.3%	—
F1: alcohol and substance use related disorders	611	496	—	115	—	18.8%	—
F2: schizophrenia and related psychotic disorders	631	504	—	127	—	20.1%	—
F3: affective disorders	1601	1425	—	176	—	11.0%	—
F4: anxiety, stress-related, dissociative or somatoform disorders	254	216	—	38	—	15.0%	—
F5: behavioural syndromes associated with physiological disturbances and physical factors	29	28	—	1	—	3.4%	—
F6: personality disorders	105	97	—	8	—	7.6%	—
F7: mental retardation	18	18	—	0	—	0.0%	—
F8: disorders of psychological development	18	17	—	1	—	5.6%	—
F9: behavioural and emotional disorders with onset usually occurring in childhood and adolescence	8	8	—	0	—	0.0%	—
G: diseases of the nervous system	168	155	—	13	—	7.7%	—
Presence of Severe Mental Illness (SMI) as primary diagnosis			0%		0%		0.160[c]
Yes	1751	1527	—	224	—	12.8%	—
No	1983	1698	—	285	—	14.4%	—
Somatic comorbidities			0%		0%		
Obesity	51	48	—	3	—	5.9%	0.104[c]
Hypertension	1066	965	—	101	—	9.5%	<0.001[c]
Diabetes mellitus	306	275	—	31	—	10.1%	0.063[c]
Cardiac arrhythmia	160	145	—	15	—	9.4%	0.109[c]
Phlebitis and thrombosis	18	15	—	3	—	16.7%	0.707[c]
Allergic Rhinitis	21	19	—	2	—	9.5%	0.582[c]
Asthma	51	50	—	1	—	2.0%	0.014[c]
COPD[a]	74	64	—	10	—	13.5%	0.976[c]
Cancer	27	26	—	1	—	3.7%	0.131[c]
Legal status of admission or stay			0%		0%		<0.001[c]
Voluntary	3142	2743	—	399	—	12.7%	—
Involuntary	592	482	—	110	—	18.6%	—
Duration of stay (days, mean ± SD)	34.40 ± 39.63	34.0 ± 38.33	0%	36.81 ± 47.01	0%	not applicable	0.271[b]

Subgroup totals may not equal the absolute population total due to missing data for specific variables, such as marital status.
[a] COPD = Chronic obstructive pulmonary disease.
[b] Mann-Whitney *U* test.
[c] Chi-square test.

according to ICD-10 chapters, presence of any of the selected somatic comorbidities described above) were excluded due to substantial missing data or sparse subgroup sizes, resulting in a final set of eight variables entered into the model: Age, gender, insurance status, presence of any of SMI category diagnoses as primary diagnosis, alcohol use disorder as primary diagnosis, substance use disorder as primary diagnosis, alcohol use disorder as secondary diagnosis, substance use disorder as secondary diagnosis. Except for insurance status (categorical: public, private, none) and age (continuous), all remaining variables were coded as binary to ensure sufficient cell sizes. A backward likelihood-ratio procedure was then applied to obtain the final multivariable model.

For the variables retained in the final model, odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using the Wald test. Model performance was evaluated using the receiver operating characteristic (ROC) curve. All statistical tests were two-tailed, and a p-value < 0.05 was considered statistically significant. Figures were generated using SPSS and Microsoft Excel.

3. Results

Table 1 summarizes the characteristics of the study population. Overall, 46.9% (n = 1751) had a psychiatric primary diagnosis associated with SMI. Most of the patients (63.4%, n = 2368) were hospitalized only once during the study period.

Compared with the adult population in Bavaria (16.2%; n = 1.8 million/11 million), the psychiatric population showed significantly lower (p = 0.000016) non-vaccination rates (13.6%; n = 509/3734). However, the proportion of non-vaccinated individuals was not clinically significant (p = 0.049) when compared with non-vaccination rates in the total German population aged 18 years or over (13.1%; n = 9.1 million/69.5 million). Vaccination uptake in the psychiatric population compared to the general population in Germany and Bavaria is displayed in Fig. 1.

The oldest patients (aged 85 and older) showed the highest vaccination rates (92.9%, n = 154), whereas individuals aged 45 – 54 years the lowest (82.0%, n = 582). The difference in mean age between the unvaccinated (46.75 years) and the individuals vaccinated at least once (49.84 years) was statistically significant (p = 0.004) (Fig. 2).

The overall comparison of vaccination status across primary diagnostic categories was statistically significant (Pearson chi-square test, $\chi^2 = 65.001$, $p < 0.001$). Additionally, we performed an analysis with selected subgroups (F0, F1, F2, F3, F4, F6) based on clinical relevance and cell sizes, presented in Fig. 3 (Pearson chi-square test, $\chi^2 = 50.046$, $p < 0.001$). G chapter diagnoses were not included as they are not routinely documented in our CIS of psychiatric hospitals. In bivariate analysis, patients with alcohol and substance use disorders (F1) as primary or secondary diagnosis were more frequently unvaccinated than those without an F1 diagnosis (17.1% [168/982] vs. 12.4% [341/2752]; Pearson $\chi^2(1) = 13.678$, $p < 0.001$). Similar associations were observed for alcohol use disorders (F10) ($\chi^2(1) = 5.102$, $p = 0.024$) and for other substance use disorders (F11–F19) ($\chi^2(1) = 12.545$, $p < 0.001$). Patients with schizophrenia spectrum disorders (F2) showed an association with lower vaccination rates ($\chi^2(1) = 27.48$, $p < 0.001$), whereas mood disorders (F3) appeared to have higher vaccination rates ($\chi^2(1) = 16.263$, $p < 0.001$). No statistically significant difference in vaccination status was observed between patients with SMI and those without SMI (Pearson chi-square test, p = 0.16; Fisher's exact test p = 0.166).

Individuals with at least one involuntary hospitalization were significantly less likely to be vaccinated than those who were only hospitalized voluntarily ($p < 0.001$). In total, 22.6% of unvaccinated patients and 14.8% of vaccinated patients were involuntarily hospitalized. Among vaccinated individuals, 85.2% were hospitalized only on a voluntary basis, compared to 77.4% of unvaccinated individuals. Additional analyses showed that the association between involuntary hospitalization and lower vaccination rates remained statistically significant after adjustment for the main ICD-10 diagnostic chapter ($p < 0.001$).

Neither type of health insurance (private, public, or none) nor number of hospitalizations (single vs. multiple) was associated with differences in vaccination status (p = 0.345 and p = 0.378, respectively).

As for physical comorbidities, hypertension ($p < 0.001$) and asthma (p = 0.014) were significantly associated with higher vaccination rates in the psychiatric population, whereas other comorbidities did not have a statistically significant effect on the COVID-19 vaccination uptake in the cohort with mental disorders (Table 1).

The results of the multivariable binary logistic regression (Table 2) indicated an increase in odds of being vaccinated by 0.7% (95% CI [0.2, 1.2]) per 1-year increase in age. Female patients have an approximately 22% (95% CI [1, 48]) increased odds of being vaccinated compared to males. Patients with a primary diagnosis of alcohol or substance use disorder had lower odds of being vaccinated (OR = 0.722, 95% CI

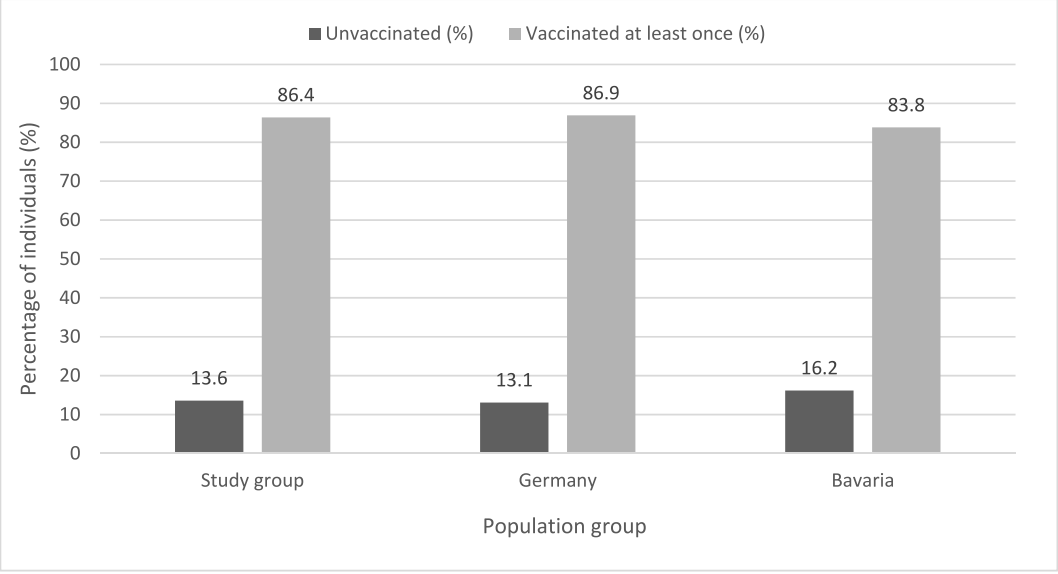

Fig. 1. COVID-19 vaccination uptake in the study group compared to the general population in Germany and Bavaria according to data obtained from Robert Koch Institute for the same timeframe as the study period.

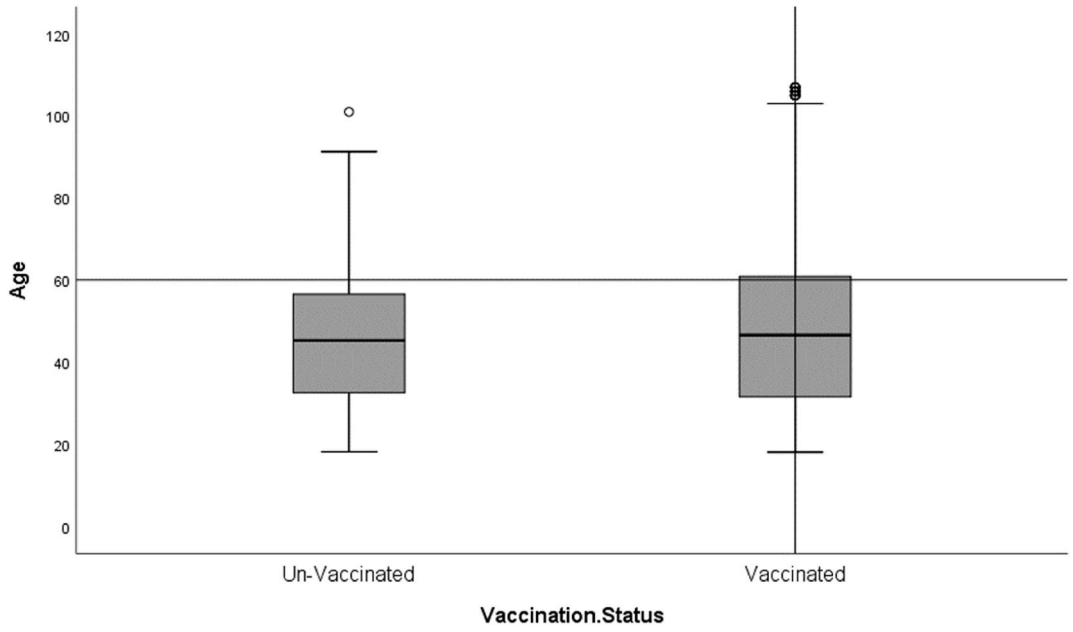

Fig. 2. Age distribution of patients stratified by COVID-19 vaccination status. Error bars show 95% confidence intervals.

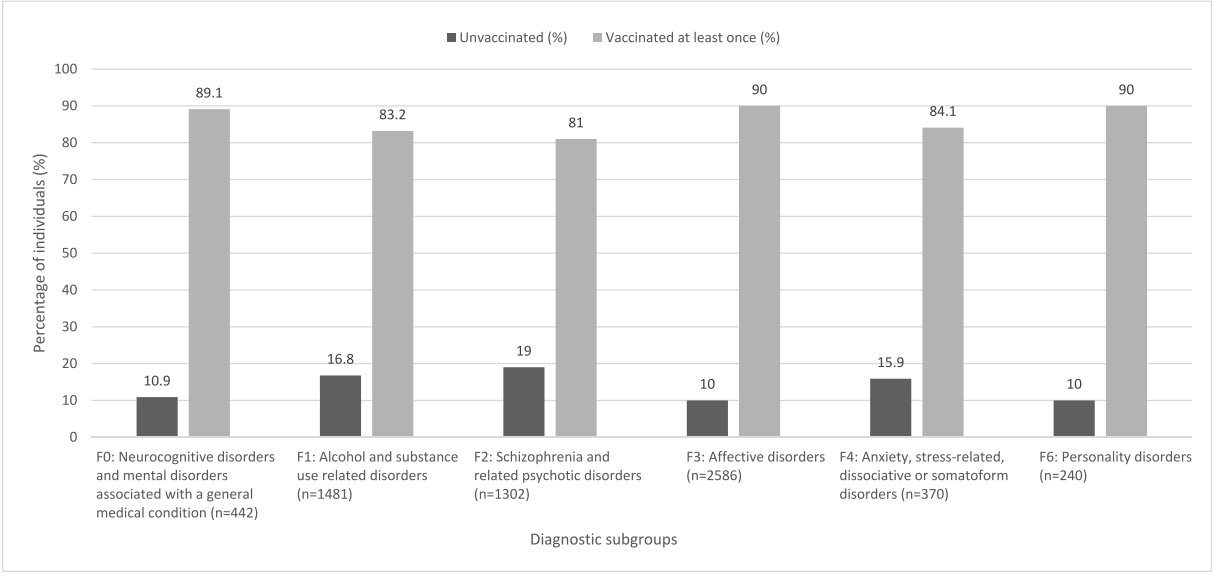

Fig. 3. COVID-19 vaccination uptake across diagnostic subgroups.

Table 2
Summary of the logistic regression model after backward stepwise elimination. Coefficients of significant predictors are marked in bold.

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Age	**0.007**	0.003	7.187	1	**0.007**	**1.007**	1.002	1.012
Gender (female vs. male)	**0.198**	0.098	4.057	1	**0.044**	**1.219**	1.005	1.477
Alcohol use disorder as primary diagnosis	**−0.326**	0.134	5.926	1	**0.015**	**0.722**	0.555	0.938
Substance use disorder as primary diagnosis	**−0.636**	0.215	8.728	1	**0.003**	**0.529**	0.347	0.807
Constant	1.500	0.140	114.916	1	<0.001	4.481		

[0.555–0.938] and OR = 0.529, 95% CI [0.347–0.807], respectively). Neither alcohol use disorder nor substance use disorder recorded as secondary diagnoses was significantly associated with vaccination status after adjustment. As a sensitivity analysis, alcohol and substance use disorders were combined into a single variable indicating the presence of any F10–F19 diagnosis, regardless of whether it was recorded as the primary or secondary diagnosis. This combined variable remained significantly associated with lower odds of vaccination in the logistic regression model (OR = 0.767, CI 95% [0.616–0.954], p = 0.017). In the corresponding ROC curve (Fig. 4), the area under the curve (AUC) was

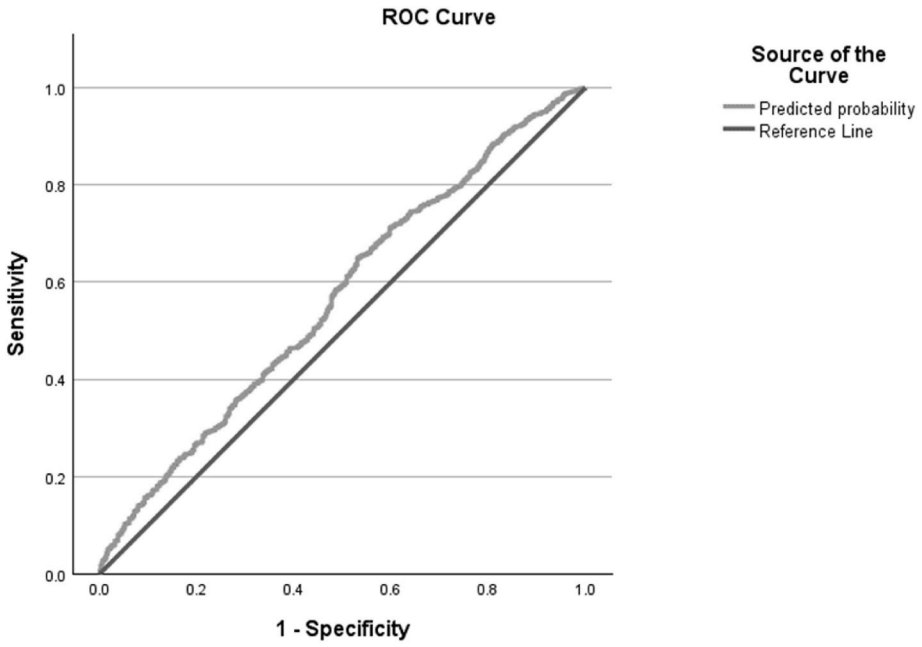

Fig. 4. Receiver operating characteristic (ROC) curve of the final multivariable logistic regression model for COVID-19 vaccination status.

0.566, indicating limited discriminatory capacity of the model. At the optimal probability cut-off value of 0.8618, the model achieved a sensitivity of 64.8% and a specificity of 47%, suggesting moderate ability to identify vaccinated individuals but limited accuracy in identifying unvaccinated individuals.

4. Discussion

This study analyzed the COVID-19 vaccination uptake among individuals hospitalized for mental disorders in a model region in Bavaria, suggesting a subtle, but statistically significant higher vaccination uptake (86.4%) compared with the overall population in Bavaria (83.8%), while no significant difference to Germany-wide uptake (86.9%) was observed. Increasing age and female gender were positively associated with being vaccinated. Alcohol and substance use disorders were associated with lower vaccination uptake.

4.1. Comparison of the vaccination rates with the state and national general population

In the existing literature, we identified only one other study from Germany (Wiegand et al., 2022) that reported lower full vaccination rates among 1320 hospitalized psychiatric patients compared with the general population in August 2021 (59 vs. 64%), but a slightly higher rate for at least one dose (68 vs. 67%). Our study in contrast – conducted after the main vaccination campaigns and improved vaccine access – found higher vaccination rates among psychiatric inpatients and day-care patients. The full vaccination rate (≥2 doses) according to our analysis was 71.4%, consistent with the expected increase since 2021, but still below the RKI-reported rates for adults in Germany (85.5%) and Bavaria (84.1%) as of 31 March 2023. The discrepancy may reflect regional differences in vaccination uptake, possibly associated with political and ideological factors (Jäckle and Timmis, 2023).

Internationally, findings regarding COVID-19 vaccination uptake in cohorts with mental illness are heterogeneous, likely reflecting differences in study populations (e.g. in- or outpatients), national vaccination policies, psychiatric diagnoses in the study focus, and the timing of data collection (Barker et al., 2024; Bosnjak et al., 2024; Jia et al., 2024; Mazereel et al., 2021c; Shaffer et al., 2023), but generally suggest that vaccination uptake among individuals with mental illness is comparable with that of the general population – particularly when vaccination is facilitated through targeted programs or integrated into routine psychiatric care. For instance, a Belgium based study using data from March to September 2021 including 2105 patients showed high vaccine uptake (91.7%), nearly equal to that of the regional population (91.9%) following a targeted vaccination program (Mazereel et al., 2021c). Similarly, data from the multinational COVIDMENT consortium comprising 325,298 individuals and 8,080,234 individuals from the Swedish national registers showed comparable overall uptake (Barker et al., 2024).

4.2. Diagnostic categories

According to the bivariate and multivariate analyses reported above, alcohol and substance use disorders as primary diagnoses were associated with lower vaccination odds. Evidence from other studies likewise indicates lower vaccination rates among patients with substance use disorders (Barker et al., 2024; Iversen et al., 2022; Wiegand et al., 2022). For patients with alcohol or substance use disorders, who were specifically prioritized under the German Corona Virus Vaccination Ordinance of February 2021, low-threshold community settings such as drug counselling centres and outreach services, alongside trained peer workers, could serve as alternative vaccination access points. General practitioners should be systematically integrated into vaccination outreach through coordination with the inpatient psychiatric network.

In the bivariate analysis, schizophrenia spectrum disorders as a primary diagnosis (F2) were associated with lower vaccination rates. In contrast, a primary diagnosis of affective disorder (F3) was associated with higher vaccination rates. Because the broader ICD-10 diagnostic chapter variable was not included in the multivariable model due to sparse subgroup sizes, these findings should be interpreted as exploratory. Our study did not find any differences in the COVID-19 vaccination uptake for the SMI cohort.

Considering the findings in the literature, diagnostic subgroups appear to play a role in vaccination behaviour, but there are also contradicting reports (Mazereel et al., 2021b). Some studies have shown that patients with affective or anxiety disorders tend to have higher vaccination rates (Hassan et al., 2022). Other studies described lower vaccination rates for patients with non-affective psychotic disorders (Goldberger et al., 2022; Wiegand et al., 2022), in line with our findings.

4.3. Involuntary hospitalization

Our findings highlighted that an involuntary mode of admission or stay was associated with a statistically significant lower vaccination rate compared to the voluntary mode of treatment, which was also in line with previous reports (Wiegand et al., 2022). The observed association remained significant after adjustment for the main ICD-10 diagnostic chapter, suggesting that it was not explained by diagnostic category alone. Nevertheless, the interpretation of diagnosis-specific subgroup analyses is limited by the small subgroup sizes.

The observed associations suggest a need for targeted approaches in this subgroup. Stigma associated with conditions requiring an involuntary psychiatric hospitalization, identified as a major barrier in accessing healthcare services and a factor limiting the quality of care (Kågström et al., 2025), may partly explain the observed lower vaccination rates in this cohort. Under German guardianship law, legally appointed guardians are involved in medical treatment decisions and could serve as an important lever for improving uptake in patients with limited decision-making capacity.

4.4. Age and gender

In our study, older age was associated with a higher COVID-19 vaccination uptake among psychiatric patients, with each additional year of age associated with a 0.7% increase in odds of vaccination. This finding is consistent with the observations from a Belgian study (Mazereel et al., 2021c), who similarly reported higher vaccination uptake among older adults with mental illness. This likely reflects higher risk for COVID-19 severity and mortality, more frequent contact with healthcare services, and earlier prioritization in national vaccination rollouts.

Logistic regression findings of our study showed that female patients had an increased likelihood of being vaccinated after adjustment by age. In fact, previous findings suggested lower vaccination intentions among women than men (Jayawardana et al., 2024; Sallam, 2021; Zintel et al., 2023), mainly associated with concerns about potential side-effects (Flor et al., 2022). In other cohorts, no statistically significant gender effect was observed (Flor et al., 2022). Overall, gender-specific findings in vaccination uptake remain heterogeneous.

4.5. Somatic comorbidities

Among somatic comorbidities, hypertension and asthma being significantly associated with higher vaccination rates in the psychiatric population may reflect age-related effects, consequences of higher risk perception or more frequent outpatient healthcare contacts.

4.6. Strengths and limitations

Strengths of this study include the large sample size and the use of robust statistical methods. The inclusion of multiple variables such as age, gender, primary and secondary psychiatric diagnoses and presence of somatic comorbidities contributed to a more comprehensive analysis. Limitations include the retrospective design and the dichotomous classification of the vaccination status, reflecting rather a cross-sectional snapshot, not accounting for possible variations across different phases of the pandemic rollout. A further limitation is the inability to compare patients with documented vaccination status to those without, since records of patients with missing vaccination records could not be extracted. Consequently, this precluded a systematic analysis of potential selection bias and limited the representativeness and generalizability of our findings. Additionally, our study lacks data on outpatients and hence capture particularly severe cases. Since many patients were hospitalized only briefly and had no subsequent follow-up, vaccinations received after discharge could not be assessed. Missing and inconsistently recorded sociodemographic data prevented adjustment for confounders, including employment status, income, educational status, place of residence (urban vs. rural). The primary-diagnosis-based estimates concerning alcohol or substance use should be interpreted with caution, since this classification does not capture patients with alcohol or substance use as a comorbidity. When coded as the primary diagnosis, it reflects an acute presentation — such as withdrawal or severe intoxication — driving the admission, rather than substance use per se. Finally, cohort vaccination rates were compared with a fixed population rate at the end of the study period, likely overestimating general population coverage and biasing comparisons toward the null. Relatedly, the comparison with general population vaccination rates should be interpreted cautiously as the absolute difference remains subtle.

Despite these limitations, these results suggest several theoretical and practical implications. Vaccine availability or a broadly defined prioritization strategy alone may not be sufficient to ensure the equitable access of patients with mental illness to vaccination. The inpatient setting represents a valuable opportunity for systematic vaccination status assessment and proactive counselling, and the transition from inpatient to outpatient care may serve as an additional touchpoint for vaccination within structured discharge planning.

4.7. Perspectives for further research

Future research could extend current findings by examining the causes of non-vaccination in patients with psychiatric disorders, exploring the role of stigma, potentially focusing on patients who were initially hesitant but ultimately received the vaccination during the rollout. A more comprehensive data collection would allow for more precise analyses - particularly in a dynamic context such as the COVID-19 pandemic. Longitudinal research focusing on changes in vaccine uptake may allow further illuminating the effects of responses to changes in vaccination campaigns or access to vaccination, such as the nationwide prioritization for individuals with SMI during the vaccination rollout as well as the impact of the periodic in-hospital COVID-19 vaccination strategies.

5. Conclusion

Overall, present study indicated satisfactory COVID-19 vaccination uptakes in the cohort hospitalized due to mental illness. We focused on the differences in vaccination status across demographic and diagnostic groups. Our findings suggest that patients with alcohol or substance use disorders represent a high-risk subgroup that may warrant particular attention in the development of future vaccination strategies.

CRediT authorship contribution statement

Aslihan Aksar: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Zahra Amini Farsani:** Data curation, Formal analysis, Investigation, Methodology, Writing – review & editing. **Alkomiet Hasan:** Conceptualization, Data curation, Methodology, Supervision, Writing – review & editing. **Astrid Röh:** Conceptualization, Data curation, Investigation, Methodology, Supervision, Writing – review & editing.

Ethics declaration

The authors have NOT obtained informed consent from participants or their legal representatives. After consultation with the local ethic committee, a specific ethical approval and consent to participate were not required for this study, as it involved the secondary use of routinely collected health data stored in a local database in a fully anonymized form, in accordance with applicable data protection regulations.

This study was performed in compliance with relevant laws, regulatory frameworks and guidelines where the research took place. Ethics committee approval was not required under relevant laws and

institutional guidelines. After consultation with the local ethic committee, a specific ethical approval and consent to participate were not required for this study, as it involved the secondary use of routinely collected health data stored in a local database in a fully anonymized form, in accordance with applicable data protection regulations.

Data availability

The raw data supporting the conclusions of this article will be made available by the authors on request.

Declaration of generative AI in scientific writing

During preparation of this work, ChatGPT-4o and −5 by Open AI and Claude Sonnet 4.6 were used in order to improve language and readability. After using these tools/services, the authors reviewed and edited the content as needed and take full responsibility for the content of publication.

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Declaration of competing interests

A. Hasan was a member of the advisory boards of Axunio, Boehringer-Ingelheim, Lundbeck, Janssen, Otsuka, Rovi, Recordati, Teva and received paid speakership by these companies as well as by AbbVie and Advanz. He is the editor of the German schizophrenia guideline. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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