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Abschlussbericht zum Forschungsprojekt:

CovPsych: Auswirkungen der Covid-19-Pandemie auf die Versorgung von Patienten mit schweren psychischen Erkrankungen

Verfasst von Dr. Alexander Engels
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Projektförderer:

Förderung durch das Zentralinstitut für die kassenärztliche Versorgung in der Bundesrepublik Deutschland (Zi)

1. Einleitung

Das Forschungsvorhaben untersucht die Inanspruchnahme psychiatrischer Versorgungsangebote durch schwer psychisch Erkrankte vor dem Hintergrund der Covid-19-Pandemie. Konkret wurden folgende Fragestellungen analysiert:

A) Welche Auswirkungen hatte die Pandemie auf das Inanspruchnahmeverhalten psychiatrischer und psychosozialer Versorgungsangebote von schwer psychisch erkrankten Patienten?
B) Können regionale Unterschiede in der Einschränkung der teilstationären und vollstationären Versorgung durch das unterschiedliche Infektionsgeschehen sowie bekannte Versorgungsparameter erklärt und verstanden werden?
C) Welche Auswirkungen hatte die Einschränkung der psychiatrischen und psychosozialen Versorgung auf das Suizidrisiko von schwer psychisch erkrankten Patienten?

Zu den Fragestellungen A und B wurde das erste Manuskript im Anhang A verfasst. Das zweite Manuskript im Anhang B beschäftigt sich mit der Fragestellung C. Da in diesen Manuskripten der Stand der Literatur, die Methodik, die Ergebnisse und die Implikationen der Ergebnisse bereits ausführlich beschrieben werden, soll in diesem Abschlussbericht lediglich die übergreifende Methodik des Projektes dargestellt und zusammengefasst werden. Darüber hinaus werden einige – über die Manuskripte hinausgehende – deskriptive Ergebnisse berichtet, um einen noch umfassenderen Überblick über die Entwicklung der Inanspruchnahme während der Pandemie zu geben.

2. Methodik zur Fragestellung A und B

2.1. Selektion und Balancierung

Die Versicherten wurden auf der Grundlage von ICD-10-Diagnosen selektiert. Es wurden alle Versicherte mit einer Schizophrenie (ICD-10: F20.x), schizoaffektiven Störung (F25.x), bipolaren Störung (F31.x), schweren Depression (F32.2, F32.3, F33.2 or F33.3) oder einer Persönlichkeitsstörung (F60.x) ausgewählt. Für die Kontrollkohorte musste die Diagnose zwischen dem 01.10.2018 und dem 28.02.2019 dokumentiert werden. Für die Pandemiekohorte wurden Versicherte berücksichtigt, die eine Diagnose für eine schwere psychische Erkrankung zwischen dem 01.10.2019 und dem 29.02.2020 erhalten haben. Hierbei wurden teil- und vollstationäre Hauptdiagnosen, Diagnosen aus Hochschulambulanzen, aus psychiatrischen Institutsambulanzen und Facharztdiagnosen berücksichtigt. Im ambulanten Bereich waren zur Selektion gesicherte Diagnosen in mindestens 2 aufeinanderfolgenden Quartalen notwendig. Lediglich bei Psychiatern, Psychotherapeuten und Nervenheilkundlern waren einfache Facharztdiagnosen ausreichend.

Die eingeschlossenen Versicherten konnten auf der Grundlage des Wohnortes einem der Kreise zugewiesen werden. Zur Bestimmung der Kontrollvariablen wurde zunächst für jede eingeschlossene Person ein 9-monatiger Vorlaufzeitraum vor der Indexdiagnose ermittelt. In diesem Zeitraum wurden 22 verschiedene Komorbiditäten nach Huber (Huber et al., 2013) bestimmt, welche auf der Grundlage des Wirkstoffes von verschriebenen Medikamenten ermittelt wurden. Allerdings wurden diese Komorbiditäten nicht in der Balancierung berücksichtigt, sofern in einem der Kreise weniger als 30 Fälle je Kohorte mit der entsprechenden Erkrankung eingeschlossen wurden. Dieses Vorgehen erhöht die Robustheit gegenüber Ausreißern, da Versicherte mit seltenen Erkrankungen ein sehr hohes Gewicht erhalten könnten, wenn für seltene Komorbiditäten balanciert wird.

Zusätzlich wurden verschiedene Indikatoren zum Inanspruchnahmeverhalten berücksichtigt. Hierzu zählen die Krankenhaustage, die Anzahl der Besuche beim Psychotherapeuten und Psychiater, die Anzahl der Therapiestunden und die verschriebenen Tagesdosen an Antidepressiva und Antipsychotika. Zum Zeitpunkt der Diagnosestellung wurde außerdem die Quelle der Einschlussdiagnose (Ambulanz vs. Stationär etc.) und das Störungsbild (Schizophrenie vs. Schwere Depression etc.) berücksichtigt. Außerdem wurde das Bundesland des Kreises, der Urbanisierungsgrad des Kreises, das Alter zum Zeitpunkt der Indexdiagnose

und das Geschlecht der Versicherten bestimmt. Anschließend wurde das Entropy Balancing auf Kreisebene durchgeführt. Hierdurch konnte für alle Kreise gewährleistet werden, dass sich die Pandemiekohorte und die Kontrollkohorte zum Zeitpunkt der Diagnosestellung in den ausgewählten Kontrollvariablen nicht systematisch voneinander unterschieden.

2.2. Ergebnisvariablen

Innerhalb der 12 Kalendermonate nach dem Selektionszeitraum wurden zur Beantwortung der Fragestellung A mehrere Inanspruchnahmeparameter aufbereitet. Für jeden Kalendermonat und Kreis wurde die durchschnittliche Anzahl an Behandlungstagen in psychiatrischen und psychosomatischen Kliniken aufgrund einer psychiatrischen Entlassdiagnose (ICD-10: Fx.xx) bestimmt. Ebenso wurden die Behandlungsminuten durch niedergelassene Psychiater bestimmt. Die Behandlungsminuten konnten näherungsweise berechnet werden, indem Leistungen des einheitlichen Bewertungsmaßstabs oder aus dem Selektivvertrag PNP gezählt werden, welche von niedergelassenen Psychiatern erfordern, dass ein Patient mindestens x Minuten behandelt wird. Es wurden psychiatrische Grundpauschalen (PYP1 oder 21210-21215), psychiatrische Behandlungen (PYE1, 21220, 21221) und Betreuungsunterstützung gewertet (21216, 21230, 21231, 21233). Zuletzt wurden auch die Behandlungstage in Tageskliniken und die erbrachten psychotherapeutischen Therapiestunden (je 50 Minuten) aggregiert.

2.3. Durchgeführte Analysen

Zur Beantwortung der Fragestellung A wurden die vier Ergebnisvariablen im Zeitverlauf betrachtet. Mithilfe von Boxplots wurden die Unterschiede zwischen den Kohorten, die regionalen Unterschiede zwischen den Kreisen sowie die Veränderungen der Variablen im Zeitverlauf dargestellt. Hierbei wurden die gewichteten Mittelwerte betrachtet, welche bereits die Gewichte aus dem Entropy Balancing berücksichtigen.
Anschließend wurden zur Beantwortung der Fragestellung B für die psychiatrischen Krankenhaustage und die Behandlungsminuten durch Psychiatrier Verhältniswerte auf der Grundlage der gewichteten durchschnittlichen Inanspruchnahme gebildet. Die Verhältniswerte vergleichen hierbei für jeden Kreis und Monat die durchschnittliche Inanspruchnahme der Pandemiekohorte mit der durchschnittlichen Inanspruchnahme der Kontrollkohorte im Vorjahreszeitraum. Werte > 1 deuten somit auf eine gesteigerte Inanspruchnahme während der Pandemie hin, während Werte < 1 auf eine entsprechende Reduktion hinweisen. Zur

Modellierung dieser Verhältniswerte wurde geprüft, ob räumliche Autokorrelation vorliegt. Zu diesem Zweck wurde für jeden Kalendermonat Moran's I (Moran, 1950) bestimmt. Da es keine Hinweise auf eine bedeutsame statistische Abhängigkeit der Kreise hinsichtlich der Entwicklung der Inanspruchnahme gab, wurden metaanalytische Modelle zur Modellierung logarithmierter Verhältniswerte ausgewählt, welche von einer statistischen Unabhängigkeit der Kreise ausgehen. Zeitliche Abhängigkeiten zwischen den Beobachtungen wurden berücksichtigt, indem eine autoregressive Struktur erster Ordnung angenommen wurde.

Zur Erklärung der Unterschiede in den Verhältniswerten der Kreise je Kalendermonat wurden mehrere Prädiktoren geprüft. Hierbei wurde grundsätzlich erwartet, dass sich der Einfluss der Prädiktoren zwischen dem ersten Lockdown (März bis Mai 2020), dem zweiten Lockdown (Dezember 2020 bis Februar 2021) und dem restlichen Zeitraum (Juni bis November 2020) unterscheiden könnte. Es wurden also jeweils Interaktionseffekte zwischen den Prädiktoren und den Zeitfenstern geprüft, da sich die Zeitfenster erheblich im Infektionsgeschehen unterschieden.

Die zentralen Prädiktoren waren die Strenge der Coronamaßnahmen und das Infektionsgeschehen. Die Strenge der Coronamaßnahmen wurde über den Stringenz-Index (Hale *et al.*, 2021) abgebildet wurde, während das Infektionsgeschehen über die Inzidenz der Intensivpatienten je 100.000 Einwohner abgebildet wurde. Als Kovariaten wurden zudem der German Index of Social Deprivation (Kroll *et al.*, 2017), die Krankenhausdichte, die Ärztedichte (Hausärzte und Psychiater), die Einwohnerdichte und das Durchschnittsalter der Bevölkerung des Kreises berücksichtigt.

3. Methodik zur Fragestellung C

3.1. Selektion und Balancierung

Das Vorgehen zur Analyse der Suizidalität ist zunächst größtenteils identisch zu dem bisher beschriebenen Vorgehen. Allerdings wurde für diese Analyse der Selektionszeitraum nicht eingeschränkt. Zur Beantwortung der Fragestellung A und B wurde der Selektionszeitraum um einen Monat gegenüber dem ursprünglich geplanten Zeitraum gekürzt. Diese Entscheidung wurde getroffen, da die Inanspruchnahme von Kliniken Mitte bis Ende März 2020 bereits reduziert war. Deshalb sollte März 2020 zur Analyse der Inanspruchnahme zum Untersuchungszeitraum zählen – insbesondere, da zur Analyse der Inanspruchnahme Verhältniswerte gebildet wurden. Ein Verhältniswert, der die Inanspruchnahme der Pandemiekohorte aus dem März 2021 mit der Inanspruchnahme der Kontrollkohorte aus dem März 2020 vergleicht, würde zumindest für diesen Monat den Einfluss der Pandemie unterschätzen, da die Inanspruchnahme der Kontrollkohorte zum Beginn der Pandemie im März 2020 bereits reduziert war. Für die Betrachtung der Suizidalität konnte hingegen die ursprünglich geplante Selektionsstrategie verwendet werden, da Suizide nach Naturkatastrophen und anderen Krisen zumeist erst zeitverzögert zunehmen (Kõlves *et al.*, 2013; Matsubayashi *et al.*, 2013). Entsprechend musste für die Kontrollkohorte eine Diagnose zwischen dem 01.10.2018 und dem 31.03.2019 dokumentiert worden sein. Für die Pandemiekohorte musste die Diagnose zwischen dem 01.10.2019 und dem 31.03.2020 kodiert worden sein. Dies bietet den Vorteil, dass der 12-monatige Untersuchungszeitraum für die Fragestellung C den März 2021 noch berücksichtigen kann, wohingegen der Untersuchungszeitraum für die Fragestellung A und B bereits im Februar 2021 endet. Des Weiteren wurden im Gegensatz zu dem oben beschriebenen Vorgehen noch striktere Diagnosekriterien im ambulanten Bereich verwendet, um lediglich Versicherte zu selektieren, die aktuell aufgrund einer schweren psychischen Erkrankung behandelt werden. Um dies zu erreichen, wurden selbst Diagnosen von Psychiatern, Psychotherapeuten und Nervenheilkundlern lediglich berücksichtigt, wenn sie in mindestens 2 aufeinanderfolgenden Quartalen dokumentiert wurden.

Das Entropy Balancing wurde zur Analyse der Suizidalität nicht auf Kreisebene durchgeführt, da die Inzidenz von Suiziden zu gering ist, um regionale Unterschiede ermitteln zu können. Stattdessen wurde auf Patientenebene die Kontrollkohorte so gewichtet, dass sie sich in

bedeutsamen Kontrollvariablen zum Indexzeitpunkt nicht systematisch von der Pandemiekohorte unterschied. Es wurden die gleichen Kontrollvariablen verwendet wie bei den Fragestellungen A und B. Allerdings konnte für alle Komorbiditäten nach Huber balanciert werden, da in jeder Kohorte deutlich mehr als 30 Fälle je Erkrankung eingeschlossen wurden.

3.2. Operationalisierung von Suiziden

Das zentrale Ergebnismaß ist das Risiko für einen Suizid. Da die Todesursache nicht an Krankenkassen übermittelt wird, konnte lediglich ein Proxy für Suizide bestimmt werden. Es wurden zwei leicht abweichende Definitionen geprüft. Beide Definitionen berücksichtigen Todesfälle von Versicherten im 12-monatigen Untersuchungszeitraum. Zudem musste bei den Versicherten zwischen dem 1. Januar 2018 (Kontrollkohorte) bzw. dem 1 Januar 2019 (Pandemiekohorte) und ihrem Tod eine absichtliche Selbstverletzung (ICD-10: X60.x – X84.x) dokumentiert worden sein. Für diese Strategie spricht, dass Suizidversuche und absichtliche Selbstverletzungen häufig vor tödlichen Suizidversuchen auftreten (Franklin *et al.*, 2017). Allerdings schließt diese Strategie die Möglichkeit natürlicher Todesursachen nicht aus. Daher mussten alternative Erklärungsansätze ausgeschlossen werden, welche eine erhöhte Mortalität in einer der beiden Kohorten erklären könnten. In unserer Hauptanalyse haben wir die Tode von Versicherten deshalb nicht berücksichtigt, sofern die Versicherten während eines COVID-19 bedingten Krankenhausaufenthalts verstorben sind (ICD-10: U07.1). Darüber hinaus haben wir eine Sensitivitätsanalyse durchgeführt, welche Todesfälle nur wertet, sofern diese nicht im Zusammenhang mit einem körperlich bedingten Krankenhausaufenthalt stehen. Dies bedeutet, dass in der Sensitivitätsanalyse lediglich Krankenhausaufenthalte aufgrund einer psychischen Erkrankung oder einer Verletzung zulässig waren (ICD-10: Fxx.x, Sxx.x oder. Txx.x). Das Suizidrisiko wurde jeweils mithilfe einer logistischen Regression verglichen.

4. Ergebnisse

4.1. Stichprobe je nach Fragestellung

Es wurden die Daten von n=1.538.595 Versicherten aufbereitet. Hiervon wurden n=15.623 Versicherte ausgeschlossen, da sie entweder vor dem Beginn des Follow-Ups verstarben oder soziodemographische Informationen zum Durchführen des Entropy Balancing fehlten. Anschließend wurden die n=1.522.972 Versicherten je nach Fragestellung noch weiter eingeschränkt.

Zur Beantwortung der Fragestellung A und B wurden weitere n=46.019 Versicherte ausgeschlossen, da ihre schwere psychische Erkrankung erstmalig im März 2019/2020 des Selektionszeitraums diagnostiziert wurde. Zudem mussten n=4.165 Versicherte entfernt werden, da sie in Salzgitter oder Bottrop wohnten und für diese Kreise das Entropy Balancing nicht erfolgreich durchgeführt werden konnte. Insgesamt wurden zur Beantwortung der Fragestellung A und B also n= 1.472.788 Versicherte eingeschlossen.
Zur Beantwortung der Fragestellung C wurden ebenfalls nicht alle n=1.522.972 Versicherten berücksichtigt. Da für diese Fragestellung striktere Diagnosekriterien im ambulanten Bereich verwendet wurden, mussten n=138.670 Versicherte ausgeschlossen werden, da ihre Facharztdiagnose nicht in 2 aufeinanderfolgenden Quartalen dokumentiert wurde. Insgesamt wurden zur Beantwortung der Fragestellung C also n=1.384.302 Versicherte eingeschlossen.

4.2. Ergänzende Ergebnisse

Die zentralen Ergebnisse sind in den Manuskripten im Anhang A und B dargestellt. An dieser Stelle sollen lediglich ergänzende deskriptive Ergebnisse dargelegt werden. Für die vier zentralen Ergebnismaße wurden Boxplots erstellt, welche die Verteilungen der gewichteten Mittelwerte je Kreis (gewichtet via Entropy Balancing) für jeden Kalendermonat und die beiden Kohorten zeigen. Die Abbildung 1 zeigt die Entwicklung der vollstationären Krankenhaustage im Zusammenhang mit einer psychiatrischen Entlassdiagnose (ICD-10: Fx.xx). Es ist klar erkennbar, dass die Inanspruchnahme der psychiatrischen und psychosomatischen Kliniken während der Pandemie in allen Kalendermonaten niedriger war als im Monat des Vorjahres. Zudem fällt auf, dass der Rückgang während des ersten Lockdowns (März bis Mai 2020) und während der zweiten Lockdowns (Dezember 2020 bis Februar 2021) besonders stark ausgeprägt ist. Eine ähnliche Entwicklung zeigt sich für die Behandlungstage in Tageskliniken in Abbildung 2. Zudem fällt bei der Betrachtung der Inanspruchnahme von Tageskliniken zusätzlich auf, dass im April 2020 über 25% der Kreise keinerlei Behandlung in Tageskliniken zu verzeichnen hatten, da ein nicht unerheblicher Anteil der Tageskliniken aufgrund der Pandemie geschlossen wurde.

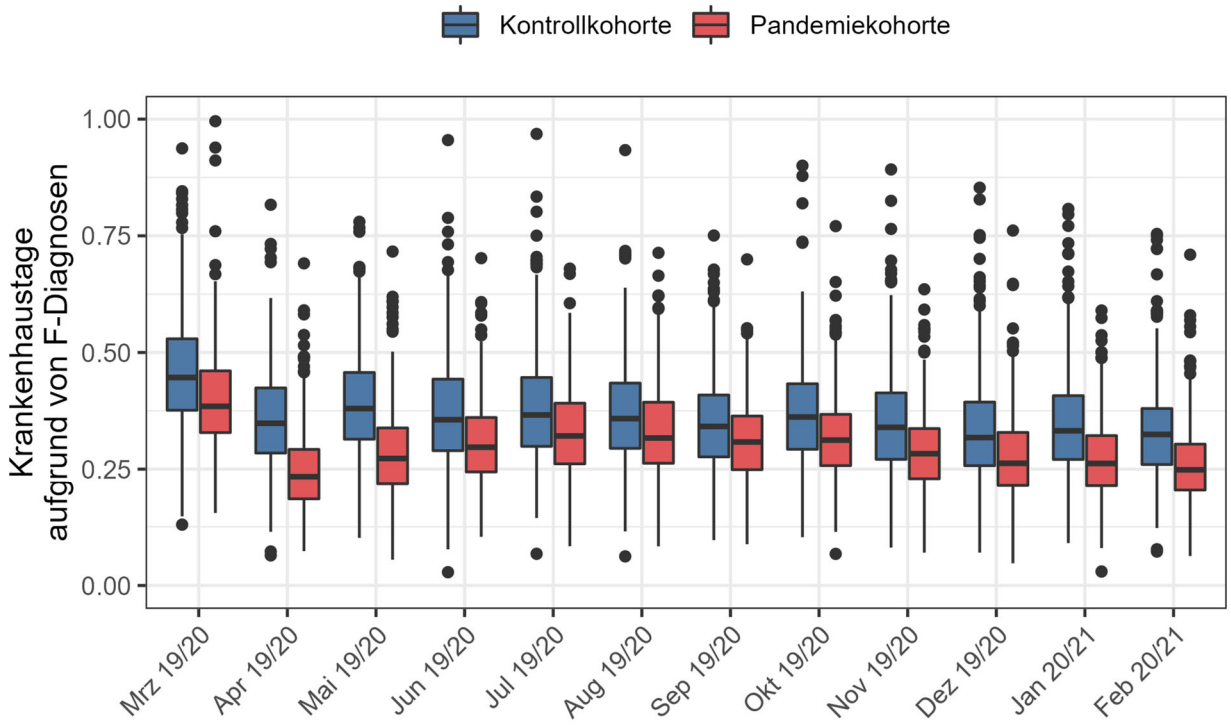

Abbildung 1: Entwicklung der vollstationären Krankenhaustage im Zusammenhang mit einer psychiatrischen Entlassdiagnose (ICD-10: Fx.xx)

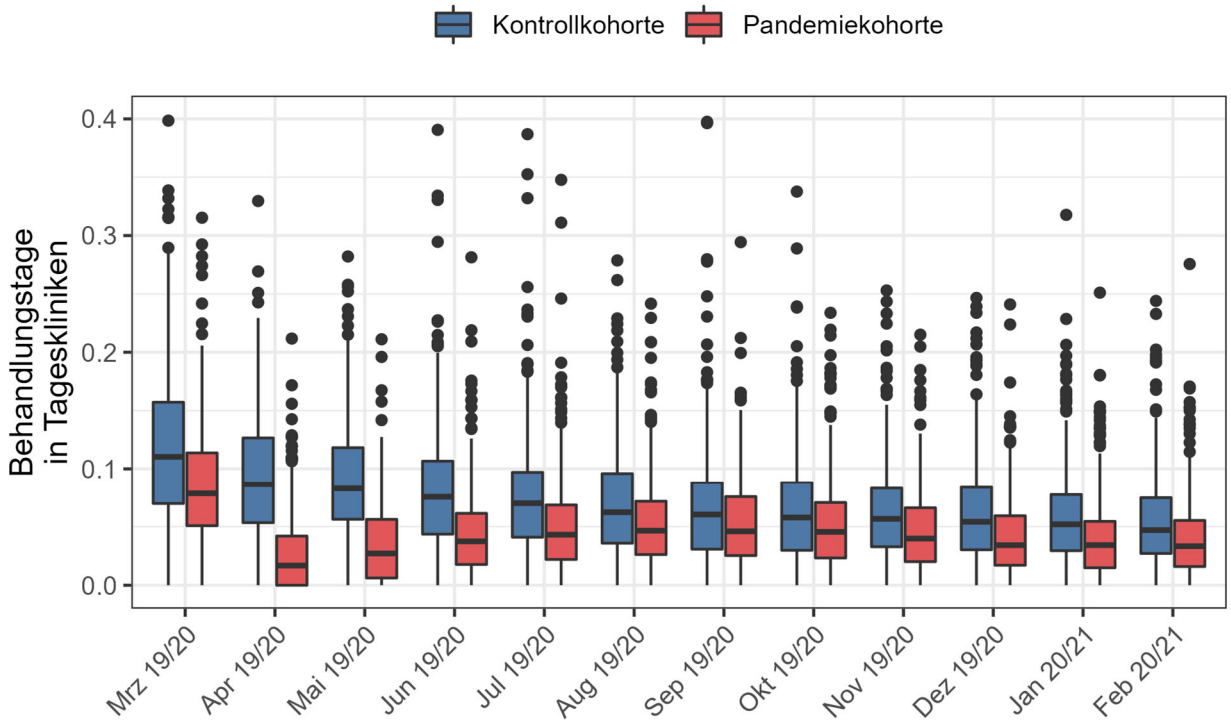

Abbildung 2: Entwicklung der Behandlungstage in Tageskliniken im Zusammenhang mit einer psychiatrischen Diagnose (ICD-10: Fx.xx)

Die Abbildung 3 zeigt die Entwicklung der Behandlungsminuten durch niedergelassene Psychiater. Es zeigen sich tendenziell höhere Werte zum Beginn eines Quartals, da beim ersten Kontakt in einem Quartal die psychiatrische Grundpauschale abgerechnet werden kann (PYP1 oder 21210-21215). Die tatsächliche Behandlungszeit kann also mithilfe des gewählten Ansatzes nur approximativ geschätzt werden. Dennoch zeigt sich eine deutlich reduzierte Inanspruchnahme zum Beginn der Pandemie im April und Mai 2020. Im Gegensatz zur Entwicklung in den Tageskliniken und den vollstationären Einrichtungen zeigen sich jedoch deutlich geringere Unterschiede zwischen den Kohorten während des zweiten Lockdowns. Des Weiteren lassen sich sogar mögliche Nachholeffekte im Juni und September 2020 beobachten, sodass die Einschränkung der ambulanten Versorgung insgesamt deutlich geringer sind als die Einschränkungen im voll- und teilstationären Bereich.

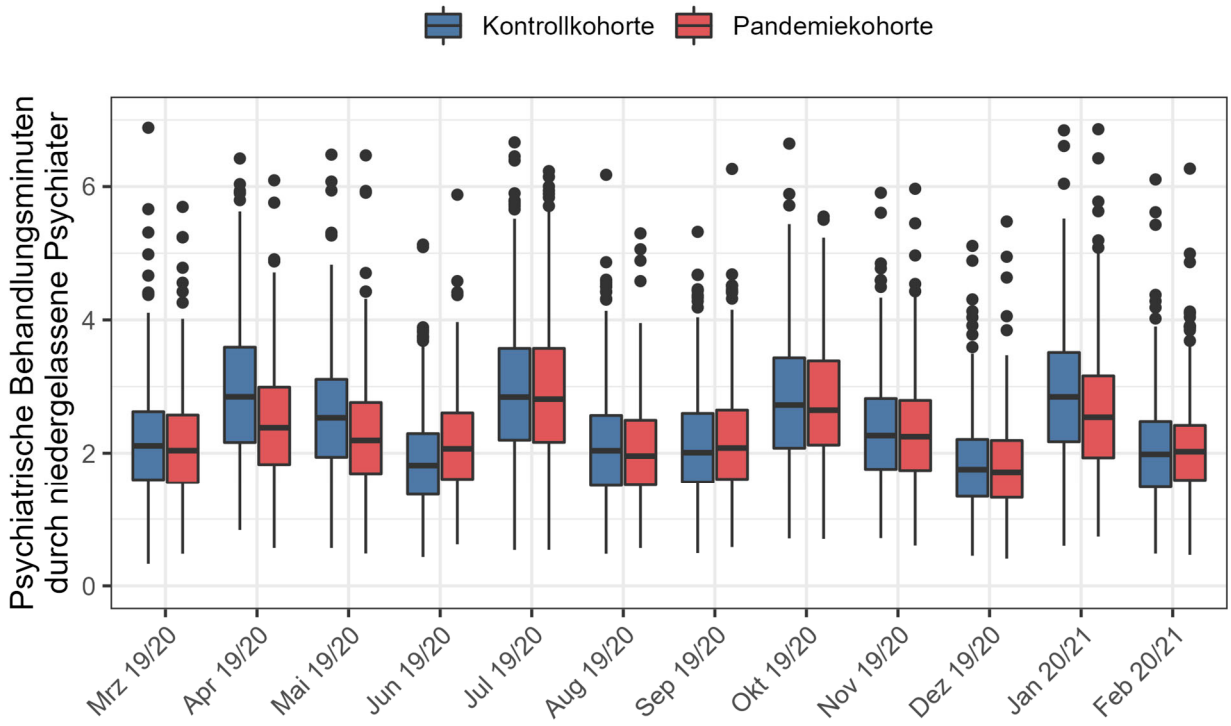

Abbildung 3: Entwicklung der Behandlungsminuten durch niedergelassene Psychiater.

Die letzte Abbildung 4 zeigt die Verteilung der durchschnittlichen Anzahl an Therapiestunden je Kohorte und Kalendermonat. Die Anzahl der abgerechneten Therapiestunden war lediglich von März bis Mai 2020 leicht im Vergleich zum Vorjahresmonat reduziert. Ansonsten zeigt sich für die Psychotherapiestunden, dass die Anzahl der abgerechneten Leistungen während der Pandemie im Vergleich zum Vorjahreszeitraum eher anstieg. Dies könnte darauf hindeuten, dass Patienten mit schweren psychischen Erkrankungen während der Pandemie vermehrt psychotherapeutische Angebote nachgefragt haben, um trotz des Wegfalls von Tageskliniken und psychotherapeutischen Angeboten in Kliniken psychosoziale Unterstützung zu erhalten.

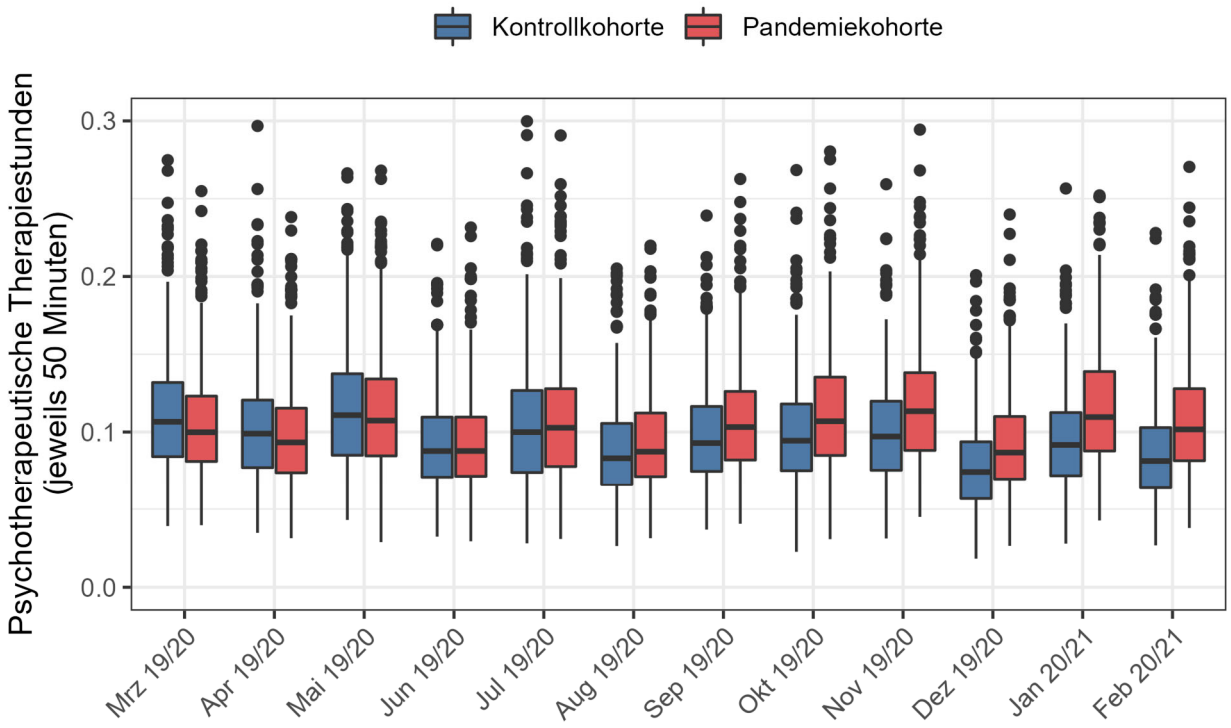

Abbildung 4: Entwicklung der durchschnittlichen Anzahl an Therapiestunden

5. Fazit:

Psychiatrische und psychosomatische Kliniken und Tageskliniken hatten während der Pandemie Schwierigkeiten die Routineversorgung aufrechtzuerhalten, während sich niedergelassene Psychiater und Psychotherapeuten wesentlich schneller an die neue Situation anpassen konnten. Die deutlich geringere Einschränkung der ambulanten Versorgung hängt hierbei vermutlich mit dem schnellen und breiten Einsatz von digitalen und telemedizinischen Angeboten zusammen. Insgesamt sind die Einschränkungen im stationären Sektor gravierend für Versicherte mit schweren psychischen Erkrankungen, da diese sehr stark von einer umfassenden und intensiven Behandlungsangeboten abhängig sind. In diesem Zusammenhang unterstreicht auch der spürbare Anstieg des Suizidrisikos für Patienten mit schweren psychischen Vorerkrankungen die Forderung nach zusätzlichen Anstrengungen zur Suizidprävention und zur Unterstützung der Patienten bei der Bewältigung ihrer psychischen Erkrankung nach der COVID-19-Pandemie.

6. Literatur

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7. Anhang

7.1. Anhang A: Manuskript zur Fragestellung A und B

Temporal and spatial changes in the provision of mental health care during the COVID-19 pandemic in Germany: a claims-based cohort study on patients with severe mental disorders

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Abstract

Purpose

Major lockdowns were imposed in Germany from March until May 2020 and from December 2020 until May 2021. We studied the influence of these lockdowns, the strain on intensive care units and the strictness of COVID-19 related containment strategies on the utilization of mental health care among patients with severe mental disorders.

Methods

We used health insurance claims data to identify n=736,972 patients with severe mental disorders shortly before the pandemic and n=735,816 patients a year earlier. We applied entropy balancing to adjust for baseline differences by district. For a 12-month follow-up, we modelled monthly changes in utilization through meta-analytic models using both the COVID-19 stringency index and intensive care unit cases per 100,000 inhabitants as predictors. Our outcomes were changes in psychiatric hospital days and time treated by outpatient psychiatrists.

Results

Psychiatric hospital days declined by at least 7.7 % in all calender month during the pandemic. Peak reduction rates were observed in April (-27.9%), May (-22.3%) 2020 and January 2021 (-18.3%). Utilization changes were associated with the stringency index and the second lockdown. Time treated by psychiatrists was shorter in April (-16.2%) and May (-11.5%) 2020 and in January 2021 (-10.5%), which was partially offset by higher utilization in June and September 2020. These utilization changes were associated with the stringency index and the strain on intensive care units during both lockdowns.

Conclusion

Hospitals had difficulties to maintain routine care during the pandemic, while outpatient psychiatrists adapted much more quickly, presumably due to digital and telemedical care.

Keywords: Germany, Mental health care, Mental health services, COVID-19 pandemic, Administrative claims, Utilization

Introduction:

In Germany and other European countries, we observed a substantial increase in symptoms of depression and anxiety in the general population during the COVID-19 pandemic (König *et al.*, 2023; Bäuerle *et al.*, 2020). This increase in mental health-related symptoms was even more pronounced in patients with pre-existing conditions (Gobbi *et al.*, 2020; Carlin *et al.*, 2021b; Skoda *et al.*, 2021; Yao *et al.*, 2020). For the general population, the increase in mental health-related symptoms might be explained by occupational and financial changes (Dragano *et al.*, 2022b), COVID-19-related fear (Bäuerle *et al.*, 2021) and increased loneliness due to contact restrictions (Antonelli-Salgado *et al.*, 2021). In addition, the influence of the pandemic on mental health is mediated by how well people have adopted effective coping strategies such as positive thinking and social support (Budimir *et al.*, 2021; Ho *et al.*, 2020). However, for patients with pre-existing mental disorders, the burden was exacerbated by the decreased availability of formal psychiatric and psychosocial services due to restrictions. This aspect disproportionately affects patients who are the most reliant on formal health services for support (i.e. patients with severe mental disorders). Unfortunately, few studies are available on how mental health care for patients with severe mental disorders was debilitated through the course of the pandemic (Scheidt-Nave *et al.*, 2021).

Earlier studies found that inpatient utilization of psychiatric services was reduced drastically during the first lockdown in Germany and again in December 2020 (Engels *et al.*, 2022a; Hoyer *et al.*, 2021a; Zielasek *et al.*, 2021; Adorjan *et al.*, 2021; Fasshauer *et al.*, 2021). The first and the second lockdown in Germany comprised far-reaching restrictions (e.g. social distancing, contact restrictions, school closures, closure of retail and service companies), which were introduced from March 22 until May 5, 2020 and mostly reimposed from December 16, 2020 until May 2021. Even though the highest recorded death rate due to COVID-19 in Germany was recorded during the second lockdown, we know relatively little about the impacts of the second wave of infections on mental health care. Furthermore, all available studies concentrate on inpatient utilization, which means that we cannot assess whether outpatient mental health care may have compensated the limited availablility of inpatient services. For somatic disorders, there is some evidence that volumes of hospital admissions dropped more sharply than the number of physician consultations during the first lockdown (Michalowsky *et al.*, 2021). One reason for the stronger decline of inpatient cases is that hospitals postponed elective operations to increase the capacity for COVID-19 related emergencies that would require mechanical ventilation. In addition, doctors' offices can more easily reduce the risk of an infection for their patients by switching to remote telephone and video consultations, which were broadly and extensively used after the onset of the pandemic (Mangiapane *et al.*, 2021).

In this study, we want to analyze claims data to show trends in inpatient and outpatient utilization of mental health care during the first year of the pandemic comprising two lockdowns. We focus on patients with severe mental disorders, because this patient group is highly reliant on the formal health system and was strongly affected by the lack of its availability. Another aspect we want to analyze are regional differences

in the course of the pandemic and how these affected changes in utilization. In an earlier analysis, we found substantial regional differences in the decline of case numbers in psychiatric and psychosomatic hospitals during the pandemic (Engels *et al.*, 2022a). However, it remained unclear why hospital care in some regions was more drastically affected than in others, although an obvious explanation could be that those regions either implemented stricter measures or suffered from higher infection rates. In 2020, the western and southern regions of Germany as well as Saxony in the east were more strongly affected in terms of disease burden due to substantially higher infection rates (Rommel *et al.*, 2021). Therefore, we want to explore whether proxies for the strictness of containment strategies and differences in intensive care unit cases can explain temporal and regional differences in changes in utilization.

Through the comparison of a control cohort that was observed before the pandemic and a pandemic cohort that was diagnosed shortly before the pandemic, we want to answer the following research questions:

1. How did the utilization of inpatient and outpatient mental health care for patients with severe mental disorders change during the first year of the pandemic in Germany?
2. Is there an association between the regional variation in utilization changes and the strain on intensive care units?
3. Is there an association between temporal variation in utilization changes and the strictness of containment strategies?

Methods:

Study design and data sources:

We analyzed health insurance claims data of the "Wissenschaftliches Institut der AOK" ("WIdO") for the period from January 1, 2018 to February 28, 2021. WIdO is the scientific institute of the AOK, which is the largest association of statutory health insurance companies in Germany. In total, the eleven autonomous companies of the AOK cover 26.8 million insurants (reference year 2019). This corresponds to about one third of the German population. To determine the effects of the pandemic, we compared a control cohort diagnosed between October 1, 2018 and February 28, 2019 with an exposed pandemic cohort diagnosed closely before the pandemic between October 1, 2019 and February 29, 2020. Subsequently, we tracked the utilitation of psychiatric inpatient and outpatient services for a 12 month follow-up period starting from March, 2019 (control cohort) and March, 2020 (pandemic cohort).

Inclusion and exclusion criteria:

We restricted the sample to patients with severe mental disorders who were diagnosed with either schizophrenia (ICD-10: F20.x), schizoaffective disorder (F25.x), bipolar disorder (F31.x), severe depression (F32.2, F32.3, F33.2 or F33.3) or a personality disorder (F60.x). Given that physicians are legally obligated to encode 'treatment diagnoses' for accounting purpose in claims data, documented diagnoses may be less

reliable than interview- or survey-based diagnoses (Klauber *et al.*, 2014). Therefore, we focused on verified claims data diagnoses from university outpatient clinics, dayclinics, hospitals or mental health specialists (i.e. psychiatrists, psychotherapists and neurologists). Patients diagnosed by regular outpatient physicians were only included if the diagnosis was recorded as verified in two consecutive quarters. We excluded patients who died before the beginning of the follow-up period (n= 14,581) and patients with missing information in one of the relevant covariates (n=925).

Aggregation at the regional level:

We chose to aggregate the data by district and month, because we were mainly interested in predictors that varied regionally and across time (e.g. intensive care unit cases per 100,000 inhabitants or strictness of government policies). Hence, we used patient-level variables solely to account for potential baseline difference between the two cohorts. Germany consists of 294 rural districts and 107 urban districts. For each individual district, we employed entropy balancing (Hainmueller, 2012; Hainmueller and Xu, 2013) to reweight the control cohort, so that the covariate moments of potential confounders (i.e., mean, variance and skewness) mirror the moments of the pandemic cohort in that particular district. Subsequently, we calculated the weighted average utilitation by cohort for each calender month and district.

Outcomes and predictors of interest:

We were interested in both inpatient and outpatient utilization of mental health care. Regarding inpatient care, we compared the number of hospital days due to a psychiatric discharge diagnosis (Fx.xx). Regarding outpatient care, we determined the time in minutes a patient was treated by psychiatrists. To that end, we took all psychiatric outpatient services into account that define a specific time requirement to be reimbursed. For psychiatric services this approach should achieve reasonably high accuracy, because each completed 10 minutes of psychiatric consultations and interviews is reimburseable.

As predictors, we considered the burden on intensive care units and the strictness of containment strategies. The former was measured as the average number of intensive care unit patients per 100,000 inhabitants by calender month and district during the pandemic. The latter was quantified with the stringency index. The stringency index is a composite score that quantfies a country's strategies to stop the spread of COVID-19 through closure of institutions (school or workplace closures) and containment (e.g. stay-at-home requirements and restrictions on mobility) (Hale *et al.*, 2021). Notably, the stringency index is only reported at a national level and therefore does not vary across regions.

Covariates:

As described, we employed entropy balancing for each district to adjust for confounding covariates. These covariates were determined based on the 9 month period before the index diagnosis. We considered sex,

age on the date of diagnosis, the disease group (e.g. schizophrenia, severe depression or bipolar disorder) and the source of the diagnosis (i.e. mental health specialists, psychiatric hospitals, dayclinic etc.). Regarding health care utilization, we controlled for the number of hospital days due to a psychiatric disorder (Fx.xx), the daily defined doses of antidepressants and antipsychotics, and the number of outpatient visits to psychiatrists. Somatic comorbidities were taken into account by calculating the 22 subscales of the medication-based comorbidity score (Huber *et al.*, 2013). However, we excluded rare comorbidities with few cases in our cohort. Otherwise, the inbalance between cohorts in entropy balancing may require assigning extremely high weights to individual patients, in order to achieve convergence, which might make the analysis more prone to outliers. Therefore, we excluded subscales if less than 30 patients in one of the cohorts were afflicted with the corresponding comorbidity in at least one district.

Modelling approach:

Given that all relevant predictors are related to COVID-19 and therefore only vary during the pandemic, we modelled changes in utilization at the district level as opposed to the absolute utilization in each cohort. First, we determined ratios of means (RoMs), which measure the relative difference in utilization between the pandemic cohort in a specific month and district and the control cohort a year earlier in the same district. RoMs greater than 1 would indicate that the utilization increased during the pandemic in a particular district and month, whereas RoMs below 1 would signify a reduction. Then, we employed meta-anayltic mixed-effect models to analyze the logarithmic RoMs. Considering that restrictions due to high infection rates persist to some extent across time, we assumed autoregressive temporal autocorrelation in the changes in utilization. In addition, we tested for spatial autocorrelation by calculating Moran's I for each outcome by month (Moran, 1950). The observed spatial autocorrelation was mostly close to zero (see supplemental figure 1). Therefore, we chose statistical models that assumed independence of the residuals of close districts.

Results:

We balanced for 12 of the 22 comorbities as measured by the comorbidity subscales (see supplemental table 1 for the included and excluded subscales) and entropy balancing was successfully applied for 399 of the 401 German districts. Patients who lived in the German districts that did not converge (i.e. Bottrop and Salzgitter) were excluded (n=4,165). The final analysis included n=735,816 patients with severe mental disoders in the control cohort and n=736,972 in the pandemic cohort. At the district level, we included between a minimum of n=604 from one of the smallest cities called Zweibrücken and a maximum of 50,542 patients from the capital city Berlin. This large range can be explained by both the substantial variation in the population size by district and the varying market share of the AOK as an insurer. The average sample size was n=3,691 patients per district. The control cohort had an unbalanced

average age of 55.4 years (SD: 17.1), 60.4% were female and most patients were included due to severe depression (46.1 %), personality disorders (18.5%) or schizophrenia (17.1 %). The pandemic cohort had an average age of 55.6 years (SD: 17.0), 60.3% were female and most patients were again mostly included due to severe depression (46.6 %), personality disorders (18.3%) or schizophrenia (16.9 %). Supplemental table 2a-c shows a comparison of both cohorts with regard to a range of additional covariates including the region of residency, the source of the diagnosis, utilization during the preperiod and all comorbidity subscales.

To quantify the association of the pandemic and healthcare utilization, we determined RoMs by district and month. These RoMs already take the entropy balancing weights into account by dividing the average utilization of the pandemic cohort for each month by the weighted average utilization of the control cohort a year earlier. In Figure 1, we weighted each RoM based on the total sample size of each district to estimate the monthly change in the utilization of psychiatric inpatient and outpatient care, respectively, at a national level.

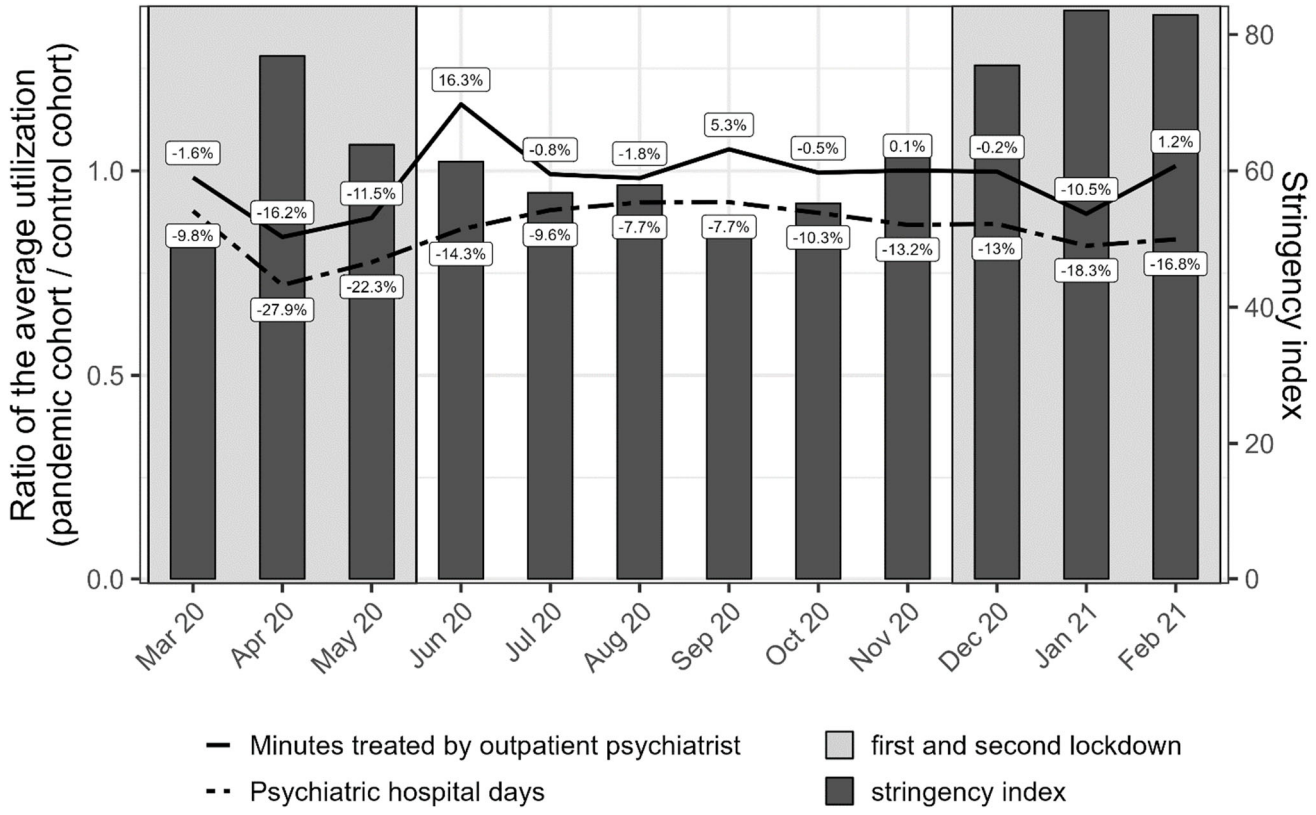

Fig. 1: We compare the pandemic cohort's utilization of mental health care during each calender month of the first 12 month of the pandemic with the control cohort's utilization a year earlier. The two lines represent the relative change in utilization in both the time treated by outpatient psychiatrists and the number of psychiatric hospital days. The dark bars depict the strictness of the COVID-19 related containment strategies during that calender month as measured by the stringency index.

The average number of psychiatric hospital days declined by at least 7.7 % in all calender month during the pandemic when compared to the previous year. The highest reduction was observed during the lockdown periods in April (27.9%) and May (22.3%) 2020 and January 2021 (18.3%). For the average number of minutes treated by outpatient psychiatrists, we observed lower reduction rates across the entire follow-up period when compared to inpatient utilization. Substantial reductions in utilization were only observed in April (16.2%) and May (11.5%) 2020 and in January 2021 (10.5%). Contrary to the inpatient sector, we observed effects that offset this decline after the first lockdown in June and September of 2020, where the average utilization increased by 16.3% and 5.3%, respectively.

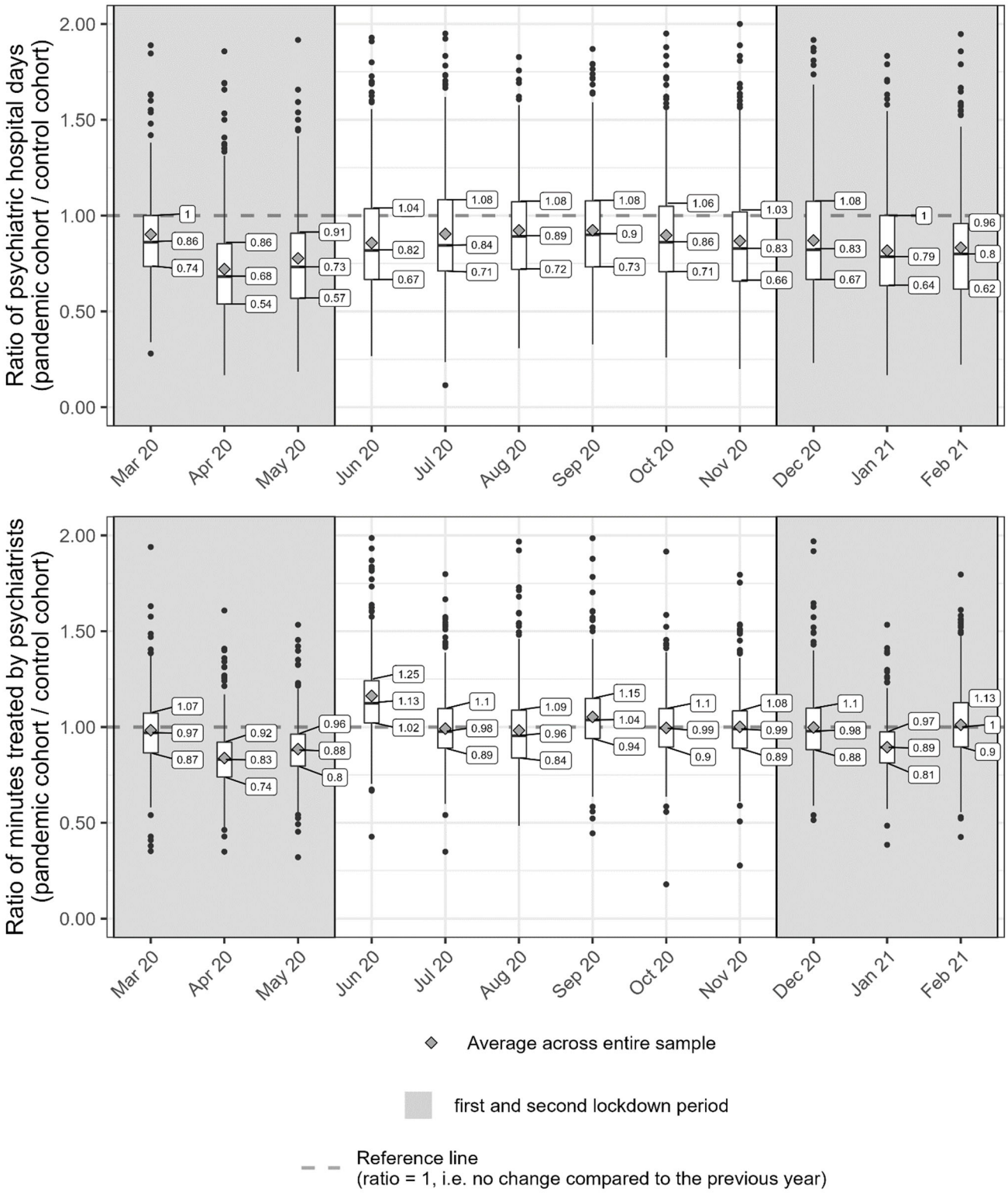

Fig. 2: We compare the pandemic cohort's utilization of mental health care during each calender month of the first 12 month of the pandemic with the control cohort's utilization a year earlier by district. The boxplots in the top panel show the distribution of the relative change in psychiatric hospital days across the 399 included districts. The boxplots in the bottom panel show this distribution for the relative change in the time treated by outpatient psychiatrists.

Table 1: Results of the metaanalytic model to explain changes in the average utilization

		without covariates			with covariates		
outcome	**predictor**	**β**		**std. error**	**β**		**std. error**
Inpatient sector: ratio of psychiatric hospital days	Intercept	0.298	***	(0.037)	0.028		(0.315)
	Lockdown 1 (L1)	-0.058	***	(0.013)	-0.506		(0.358)
	Lockdown 2 (L2)	0.182	***	(0.030)	1.128	**	(0.379)
	Stringency index	-0.008	***	(0.001)	-0.008	***	(0.001)
	Intensive care unit cases per 100,000 inhabitants	-0.001		(0.004)	0.000		(0.004)
	Intensive care unit cases per 100,000 inhabitants in L1	-0.015		(0.011)	-0.015		(0.011)
	Intensive care unit cases per 100,000 inhabitants in L2	-0.012	*	(0.006)	-0.008		(0.006)
Outpatient sector: ratio of minutes treated by psychiatrists	Intercept	0.300	***	(0.019)	0.591	***	(0.141)
	Lockdown 1 (L1)	-0.120	***	(0.008)	-0.216		(0.214)
	Lockdown 2 (L2)	0.135	***	(0.016)	-0.008		(0.220)
	Stringency index	-0.005	***	(0.000)	-0.005	***	(0.000)
	Intensive care unit cases per 100,000 inhabitants	0.002		(0.002)	0.002		(0.002)
	Intensive care unit cases per 100,000 inhabitants in L1	-0.015	**	(0.006)	-0.015	*	(0.006)
	Intensive care unit cases per 100,000 inhabitants in L2	-0.017	***	(0.003)	-0.018	***	(0.003)

N=1,472,788, standard error (std. error), the model estimates the coefficients using logarithmic ratios of means as an outcome, in the model with covariates we included the following control variables: German Index of Social Deprivation, average age of the district, population density, hospital density, general practitioner and psychiatrist density. We included an interaction effect with each lockdown for each control variable, respectively, to allow for deviating effects in the two lockdown periods.

In Figure 2, we used boxplots to show the distribution of RoMs for each calender month. We found substantial regional variation in the change in utilization during the pandemic. The largest interquartile range (IQR) in the RoMs for psychiatric hospital days was observed in December 2020 with 41%. This IQR means that the lower 25% of the districts (with an reduction of at least 33%) compared to the upper 25%

of the districts (with an increase of at least 8%) differed by at least 41% in their absolute change in utilization. In contrast, we observed a low IQR in March 2020 with 26%, and IQRs between 32% and 37% for all other calender months. The IQRs for the monthly changes in utilization for the number of minutes treated by psychiatrists were lower than for hospital days and ranged between 16% in January 2021 and 25% in August 2020.

In Table 1, we summarised the results of the metaanalytic models. We reported the results with and without covariates, but focused on the model with covariates in this paragraph. For psychiatric hospital days, we observed a significant negative effect for the stringency index, $\beta = -0.008$, $t=-12.6$, $p<0.001$ and a positive effect for the second lockdown, $\beta = 1.128$, $t= 2.97$, $p<0.01$. To clarify, the positive effect of the second lockdown does not indicate that the utilization of psychiatric hospitals increased during the second lockdown, but that the utilization was higher than expected in view of the high stringency of the containment strategies during this period. We found no significant interaction between intensive care unit cases per 100,000 inhabitants and the first, $\beta = -0.015$, $t= -1.39$, $p=0.17$, or the second lockdown, $\beta = -0.008$, $t= -1.35$, $p=0.18$. Most covariates had no signifcant effect (see supplemental table 3a). However, we found an association with the average age of the district's population, $\beta = -0.026$, $t= -3.16$, $p<0.01$.

For the minutes treated by psychiatrists, the model showed a significant negative association with the stringency index, $\beta = -0.005$, $t= -14.56$, $p<0.001$. Furthermore, it revealed a significant interaction between intensive care unit cases per 100,000 inhabitants and the first, $\beta = -0.015$, $t= -2.488$, $p<0.05$ and the second lockdown, $\beta = -0.018$, $t= -5.422$, $p<0.001$. Most covariates had no signifcant effect (see supplemental table 3b). However, we found an association with the district's general practitioner density, $\beta = -0.002$, $t= -2.866$, $p<0.01$.

Considering that these beta coefficients quantify the association between the predictor and the logarithmic ratio of means, it can be difficult to judge how exactly the expected changes in utilization are affected by the predictors. Therefore, we provide supplemental figure 2 and 3 to illustrate the models' predictions for each calender month – based on the lockdowns, the stringency index and a realistic range of values for intensiv care unit cases per 100,000 inhabitants.

Discussion:

In this study, we give an overview of the state of mental health care for patients with severe mental disorders during the first year of the COVID-19 pandemic. Contrary to existing studies that were restricted to inpatient cases (Engels *et al.*, 2022a; Zielasek *et al.*, 2021) or emergency hospital admissions (Fasshauer *et al.*, 2021; Hoyer *et al.*, 2021a), we compared a large cohort of patients diagnosed across sectors before the pandemic with a cohort that was diagnosed a year earlier. Subsequently, we controlled for various patient characteristics to obtain a reliable assessment of how utilization changed between the two comparable cohorts during the pandemic. This is the first study to assess the pandemic's associtation with

the utilization of psychiatrists in outpatient care and to model changes in utilization at a district level.

In the inpatient sector, we found a noticable decline of hospital days due to psychiatric disorders across the entire 12 month follow-up. Peak reduction rates were observed at the beginning of the pandemic in April (-27.9%) and May 2020 (-22.3%), because hospitals yet had to adapt to an unprecended and unclear situation. During the first lockdown, hospitals postponed or suspended elective surgeries and procedures to expand intensive care units and ventilator capacities for COVID-19 patients. Non-acute medical departments were commonly repurposed for the management of COVID-19 patients. In addition, dayclinics were often closed until appropriate hygiene and safety measures (e.g. special hygiene measures, restrictions in personal therapeutic contact and distance regulations) were implemented. Nevertheless, we assume that the reductions in January 2021 (-18.3%) and February 2021 (-16.8%) suggest that the overall impact of the second lockdown has been worse than the first lockdown due to its longer duration from December 2020 to May 2021.

In the outpatient sector, patients often cancelled doctor appointments, check-ups and preventive consultations to avoid the risk of an infection (Bruch *et al.*, 2021; Hajek *et al.*, 2020), but overall we observed less serious consequences for the utilization of services. The time treated by psychiatrists declined in April (-16.2%) and May 2020 (-11.5%), but over the remaining study period, we found almost pre-pandemic utilization rates – except for a noticable drop during the second lockdown in January 2021 (-10.5%). One reason for the relatively mild consequences for outpatient care could be that digital and telemedical care services were quickly implemented and increasingly used throughout the pandemic (Reitzle et al., 2021; Knörr et al., 2022).

Apart from the large temporal variation, we also observed substantial regional variation in the changes in utilizations in both sectors. The utilization of the 25% of the districts with the highest utilization of hospital care throughout the pandemic declined at most by -14% over the 12 months follow-up period, whereas the 25% with the lowest utilization declined by up to -46%. This fluctuation across districts was less pronounced in the outpatient sector, where the 25% of the districts with the highest utilization of psychiatrists declined at most by -8%, while the 25% with the lowest utilization declined by up to -26%.

We identified some factors that could explain the temporal and the regional variation. First, we found a relatively strong association between the decline in utilization and the stringency index (Hale *et al.*, 2021) in both sectors. The stringency index quantifies the governmental restrictions on mobility and social contacts during the pandemic. Therefore, it may not be surprising that the utilization of medical services was affected when public life was restricted or brought to a halt. In addition, we found a positive effect of the second lockdown on inpatient utilization. This positive effect of the second lockdown does not indicate that the utilization of psychiatric hospitals increased during the second lockdown, but that the utilization was higher than expected in view of the high stringency of the containment strategies during this period. So both lockdowns led overall to a decline in utilization, but the reduction was less pronounced during the

second lockdown. However, considering that the restrictions of the second lockdown persisted several months longer (December until May) compared to the first lockdown (March until May), we assume that the second lockdown still posed a greater threat to the patients mental health. The third factor was the strain on intensive care units, which was measured as intensive care unit cases per 100,000 inhabitants and variied at a district level. Regarding outpatient care, we found a stronger decline in utilization in districts with a high strain on intensive care units during the lockdown periods, but we did not observe any effect on psychiatric hospitals days. Contrary to the imposed restrictions that are directly enforced by institutions, we assume that the strain on intensive care units primarily reduces a patient's willingness to utilize services through increased fear of a COVID-19 infection. It seems plausible that this fear is at least less influential in the inpatient sector, because patients in psychiatric hospitals tend to experience an acute and severe crisis that can not be postponed despite the increased risk of an infection.

This explanation would also be supported by an earlier analysis, where we found smaller reductions in case numbers for patients with more severe disorders (e.g. schizophrenia) when compared to more common mental disorders (e.g. affective disorders) (Engels *et al.*, 2022a).

Strengths and limitations

We compared two large cohorts with more than 735,000 patients with severe mental disorders. Considering that we used health insurance claims data from the scientific institute of the AOK, we drew from a pool of about 27 million insurants. Therefore, we utilized claims data of about a third of the German population. In addition, we reweighted the control cohort in each district via entropy balancing. This means that we obtained relatively unbiased estimates of the changes in utilization due to the pandemic, because control and pandemic cohort were comparable in a large variety of control variables in each district. Another strength is that we modeled both the changes in the inpatient and the outpatient sector and developed a methodological rigor approach to explain these changes with COVID-19 related predictors.

Nonetheless, some limitations are worth noting. First, the AOK does not have the same market share in all federal states. Hence, the obtained estimates for each district may be more or less representative for the entire population in that district depending on the market share of the AOK. In addition, we chose to aggregate utilization and the strain on intensive care units by month, which might have resulted in imprecise estimates for months in which the incidence of COVID-19 cases changed rapidly. Lastly, we want to note that the stringency index is not available at the state or district level, although the federal states in Germany were largely autonomous in the implemented measures against infections. Consequently, the stringency index was not able to explain any regional variation, even though we assume that diverging containment strategies are responsible for some of the differences between districts.

Conclusions:

This study highlights the reduced availability of psychiatric and psychosomatic hospital care during the first and second lockdown of the pandemic, which may have long lasting consequences for patients whose mental health deteriorated due to the lack of its availability. On the positive side, we found that psychiatrists in the outpatient sector were mostly able to maintain the routine level of care, although regions with a high burden on intensive care units were more limited than others. The quick adaptation of psychiatrists may have helped to compensate the shortage of inpatient treatment options to some extent.

Declarations

Conflict of interest

None.

Ethical standards

Not applicable.

Availability of data and materials

The datasets supporting the conclusions of this article are owned by the German statutory health insurance AOK. Since public deposition of the data would breach ethical and legal compliance, data are only available upon formal request from the research institute of the AOK (WIdO). To request the data, please contact the institutional body of the WIdO (wido@wido.bv.aok.de). To fulfill the legal requirements to obtain that kind of data, researchers must obtain a permission for a specific research question from the German Federal (Social) Insurance Office. Additionally, researchers must conclude a contract with the statutory health insurance regarding data access, which can be requested from the “AOK-Bundesverband GbR” (Federal Association of Local Health Insurance Funds) under http://aok-bv.de/kontakt/. The licensee is permitted to use the data for the purpose of the research proposal within their company, exclusively. Thereby, a company is defined as an economical unit. Licensees are not allowed to pass the data to a third party, or to create Software or databases with the exception of scientific publications. Moreover, the study has to be approved by the data protection officer both at the statutory health insurance and the research institute.

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7.2. Anhang B: Manuskript zur Fragestellung C

The development of suicide risk in people with severe mental disorders during the first year of the COVID-19 pandemic: a claims-based cohort study

Short title: Trends in suicide risk during the COVID-19 pandemic in Germany

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Abstract

Purpose

In this study, we assess how the first and second wave of the COVID-19 pandemic influenced the suicide risk of patients with severe mental disorders in Germany.

Methods

We analyzed German health insurance claims data to compare the suicide risk of patients with severe mental disorders before and during the pandemic. We included n=690,845 patients between October 2019 and March 2020 and n=693,457 patients the corresponding period of the previous year and applied entropy balancing to adjust for confounding covariates. Given that the cause of death was unknown, we defined suicides as deaths of patients with a history of intentional self-harm whose passing could not be explained by COVID-19. Suicides were tracked in both cohorts over one year and compared using logistic regression.

Results

128 suicides were identified in the period during and 101 suicides before the pandemic. This corresponded to a significant increase in the risk for suicide of 27.4% compared to the control period ($\beta = 0.24$, $z= 1.82$, $p<0.05$).

Conclusion

The noticable increase in the risk for suicide for patients with severe pre-existing mental disorders emphasizes the call for additional efforts to prevent suicide and to help patients cope with their mental illness in the aftermath of the COVID-19 crisis.

Keywords: Germany, Suicide, COVID-19 pandemic, administrative claims

Introduction:

To reduce the spread of COVID-19, the government in Germany – like in many other countries – imposed numerous restrictions on social contacts. The first lockdown from March 22 until May 5, 2020 encompassed far-reaching measures (e.g. social distancing, contact restrictions, school closures, closure of retail and service companies), which were mostly reimposed on December 16, 2020 until May 2021. It quickly became apparent that patients with pre-existing mental disorders would be particular vulnerable during these prolonged periods of reduced social contacts, self-isolation and economic losses (Antonelli-Salgado *et al.*, 2021; Taylor and Asmundson, 2020). While the general population mostly proved to be resilient to the effects of the pandemic (Prati & Mancini, 2021), the mental health of a large proportion of patients with pre-existing conditions worsened considerably (Carlin *et al.*, 2021a; Ahrens *et al.*, 2021; Bäuerle *et al.*, 2020; Fiorillo and Gorwood, 2020; Gobbi *et al.*, 2020).

One reason for this heterogenous response to social distancing and isolation could be the interpersonal differences in the appraisal of the situation. Multiple studies support the assumption that the negative impact of community mitigation strategies is mediated by the cognitive appraisal (e.g. feeling in control or overwhelmed) and the emotional evaluation of the actions taken (e.g. feeling lonely due to the restrictions) (Antonelli-Salgado *et al.*, 2021; Müller *et al.*, 2021; Lee *et al.*, 2020). Furthermore, patients with pre-exisiting mental disorders rely to a greater extent on formal psychosocial and psychiatric services, which – at least in Germany – were severely restricted during the first months and the subsequent lockdowns of the pandemic (Engels *et al.*, 2022b; Hoyer *et al.*, 2021b; Zielasek *et al.*, 2021).

The most serious health threat for patients with deteriorating mental health is suicide and self-harm. Patients with severe mental disorders such as depression, bipolar disorder and schizophrenia have the highest absolute risk of suicide, ranging between 3.7-4.9% among women and 5.9-7.8% among men within a median follow up of 18 years (Nordentoft *et al.*, 2011). As a result, suicides contribute notably to the elevated mortality of about 10-20 potential life years lost among patients with mental disorders (Walker *et al.*, 2015; Nordentoft *et al.*, 2013). Given the noticable increase in suicide attempts (Carlin *et al.*, 2021a; Berardelli *et al.*, 2021), suicide ideation and self-harm (Dubé *et al.*, 2021; Farooq *et al.*, 2021) during the pandemic in several countries, it should be especially important to monitor suicide risk in this vulnerable population. In Germany it is difficult to determine the suicide rate of a particular patient group, because the national mortality database, which documents causes of death, does not contain information on the preceding medical history. Therefore, the German Federal Statistical Office only reports the annual trajectory of the number of suicides in the general population. In addition, little is known about trends in suicide beyond 2020, because the yearly reports of the Statistical Office are published with a considerable time lag. As a result, studies on the influence of the second wave of infections in winter 2020/2021 are lacking, although this period comprised the so far highest recorded death rate due to COVID-19 in Germany and a second restrictive lockdown. Therefore, we used health insurance claims data to compare two large

cohorts of patients with severe pre-existing mental disorders before and during the pandemic to determine whether the risk of suicide has increased in the first 12 month of the pandemic.

Methods:

Study design and data sources:

In this retrospective cohort study, we analyzed health insurance claims data for the period from January 1, 2018 to March 31, 2021 from the "Wissenschaftliches Institut der AOK" ("WIdO"). WIdO is the scientific institute of the AOK, which is the largest association of statutory health insurance companies in Germany. In total, the eleven autonomous companies of the AOK cover 26.8 million insurants (reference year 2019). This corresponds to about one third of the German population. To determine the effects of the pandemic, we compared a control cohort diagnosed between October 1, 2018 and March 31, 2019 with an exposed pandemic cohort diagnosed closely before the pandemic between October 1, 2019 and March 31, 2020. Subsequently, we tracked potential suicides for a 12 month follow-up period starting from April 1, 2019 (control cohort) and April 1, 2020 (pandemic cohort), respectively. The period of 9 months preceding the index diagnoses was used as baseline period in which various covariates were assessed.

Identification of suicides:

The outcome of interest was the number of suicides in each cohort. Considering that the cause of death is not documented in claims data, we defined suicides as deaths of insurants who had a documented history of intentional self-harm (ICD-10: X60.x – X84.x) between January 1, 2018 and their date of death for the control cohort, or between January 1, 2019 and their date of death for the pandemic cohort . This strategy is based on the empirical evidence that suicide attempts and self-induced injuries occur frequently before fatal suicide attempts and are therefore the best predictor for future suicides (Franklin *et al.*, 2017). Notably, this strategy does not eliminate the possibility of natural causes of death. Hence, we had to account for factors that could explain excess mortality in the pandemic cohort to obtain unbiased estimates for risk changes. To that end, we employed two different approaches. In our main analysis, we solely excluded deaths of patients who died during a hospital stay due to COVID-19 (ICD-10: U07.1). In addition, we conducted a sensitivity analysis to exclude all deaths due to natural causes by not counting deaths within 30 days after a hospitalization due to anything other than a mental disorder or an injury (ICD-10: Fxx.x, Sxx.x or Txx.x). Nonetheless, we presumably underestimated the actual number of suicides, because not all suicides are preceded by a documented history of self-harm. Primarily, we disregarded suicidal patients who already perished on their first attempt (Bostwick *et al.*, 2016).

Inclusion and exclusion criteria:

We restricted the sample to patients with severe mental disorders who were diagnosed with either schizophrenia (ICD-10: F20.x), schizoaffective disorder (F25.x), bipolar disorder (F31.x), severe depression

(F32.2, F32.3, F33.2 or F33.3) or personality disorder (F60.x). Given that physicians are legally obligated to encode 'treatment diagnoses' for accounting purpose in claims data, documented diagnoses may be less reliable than interview- or survey-based diagnoses (Klauber *et al.*, 2014). Therefore, we focused on verified claims data diagnoses from university outpatient clinics, dayclinics or hospitals. Patients diagnosed by mental health specialists (i.e. psychiatrists, psychotherapists and neurologists) and other outpatient physicians were only included if the diagnosis was recorded as verified in two consecutive quarters. We excluded patients who died before the beginning of the follow-up period (n=11,072) and patients with missing information in one of the relevant covariates (n=802).

Covariates:

Even though the cohorts mainly varied in the date of their diagnosis, we decided to control for a large number of covariates to adjust for potential differences at baseline. All covariates were determined for the baseline period of 9 month before the index diagnosis. We controlled for sex, age on the date of the index diagnosis as well as urbanization degree (Bundesinstitut für Bau- Stadt- und Raumforschung) and the federal state of the region of residency. To adress the severity of the disorder and health care utilization, we controlled for the disease groups based on the first established diagnosis during the index period (e.g. schizophrenia, severe depression or bipolar disorder) due to the heterogeneity of the included disorders. In addition, we assessed the number of days at dayclinics or psychiatric clinics, the daily defined doses of antidepressants and antipsychotics, and the number of outpatient visits to psychotherapists and psychiatrists during baseline as well as the number of psychotherapy sessions. Somatic comorbidities were considered by calculating the 21 subscales of the medication-based Huber score (Huber *et al.*, 2013).

Statistical methods:

We employed entropy balancing (Hainmueller, 2012; Hainmueller and Xu, 2013) to reweight the control cohort, so that its covariate moments (i.e., mean, variance and skewness) mirror the moments of the pandemic cohort in a large range of possible confounding covariates that were determined for the baseline period. Subsequently, we applied logistic regression to compare the suicide risk between the control and the pandemic cohort. We tested the one-sided hypothesis that the pandemic increased suicide risk and used weighted maximum likelihood as the estimation technique in order to incorporate the entropy balancing weights.

Results:

Sample characteristics:

Table 1 depicts the unbalanced sample characteristics for the n=693,457 patients in the control cohort and the n=690,845 patients in the pandemic cohort. The baseline characteristics based on the 9 month prior to the index diagnosis were similar in both cohorts. Approximately 60% of all patients were female and the average age was 55.5 years. Both cohorts consisted of approx. 46% patients with severe depression, 18% with schizophrenia and 18% with a personality disorder. Schizoaffective or bipolar disorders as well as the simultanous diagnosis of multiple severe conditions were observed less frequently. Among those patients who potentially comitted suicide, we found higher rates of severe depression, higher numbers of dispensed antidepressant and antipsychotic prescriptions, and longer inpatient stays when compared to the total sample. Additional characteristics as well as the adjusted sample characteristics after entropy balancing can be found in supplemental table 1a to 2c.

Table 1: Descriptive sample statistics of the most relevant covariates

		Total sample		Suicides	
Category	**Outcome**	**Control: n=693,457**	**Pandemic: n=690,845**	**Control: n=101**	**Pandemic: n=128**
Socio-demo-graphics	Female	60.24%	60.15%	50.50%	39.06%
	Age	55.52 (17.13)	55.52 (17.06)	59.99 (18.90)	59.99 (20.58)
Region of residency	Major city	27.42%	27.52%	32.67%	28.12%
	Smaller city	36.76%	36.73%	35.64%	33.59%
	Rural area (dense)	18.65%	18.56%	12.87%	15.62%
	Rural area (sparse)	17.17%	17.19%	18.81%	22.66%
Index diagnosis	Bipolar disorder	4.64%	4.70%	6.93%	0.78%
	Multiple diagnoses	9.87%	9.86%	8.91%	11.72%
	Severe depression	45.93%	46.25%	56.44%	54.69%
	Personality disorder	18.36%	18.19%	10.89%	10.16%
	Schizophrenia	17.62%	17.44%	10.89%	18.75%
	Schizoaffective disorder	3.58%	3.56%	5.94%	3.91%
Utilization during baseline	Antidepressants (ddd)	149.08 (230.04)	149.08 (232.11)	211.41 (248.79)	211.41 (282.85)
	Antipsychotics (ddd)	94.78 (235.09)	94.78 (231.06)	134.74 (214.28)	134.74 (396.44)
	Psychiatrist visits	2.56 (6.78)	2.56 (6.49)	2.50 (3.53)	2.50 (4.56)
	Psychotherapy sessions	0.92 (3.96)	0.92 (3.93)	0.37 (2.04)	0.37 (2.84)
	Psychotherapist visits	1.28 (5.15)	1.28 (5.04)	0.58 (2.45)	0.58 (3.41)
	Days in dayclinic	0.93 (7.67)	0.93 (7.85)	1.16 (8.91)	1.16 (13.10)
	Hospital days	4.19 (17.70)	4.19 (18.51)	39.51 (55.10)	39.51 (48.41)

ddd: daily defined dosis, all numbers were rounded to two decimal places. We report the percentage of each value for categorical variables and the mean (standard deviation) for all interval-scaled variables.

Deaths during the follow-up period:

In table 2 we report descriptive statistics on suicides, COVID-19-related deaths and total deaths in both cohorts. We observed a small increase in the mortality rate from 3.01% to 3.25% in the year of the pandemic. In total numbers, an additional 1,633 patients died in the pandemic cohort of which 632 died in the hospital with a COVID-19 infection. Regarding the number of potential suicides, we report numbers for two separate definitions of suicide. In the main analysis (excluding deaths during COVID-19-related inpatient stay), we found that n=101 patients met our criteria for suicide in the control cohort compared to n=128 patients in the pandemic cohort. Therefore, the incidence of suicides increased from 14.56 per 100,000 patients to 18.53 per 100,000 patients In the sensitivity analysis (additionally excluding patients with a recent inpatient stay unrelated to mental disorders or injury), we observe n=91 potential suicides in the pandemic and n=61 potential suicides in the control cohort.

Table 2: Number, incidence and percentage of potential suicides / deaths related to COVID-19 compared between cohorts

Outcome	**Cohort**	**Suicides***		**Covid-related deaths**	**Total deaths**
Incidence per 100,000 patients with SMD	Control	14.56	(8.80)	2.60	3,006.39
	Pandemic	18.53	(13.17)	91.48	3,254.13
Percentage	Control	0.02 %	(0.01%)	0.00 %	3.01 %
	Pandemic	0.02 %	(0.01%)	0.09 %	3.25 %
Number of cases	Control	101	(61)	18	20,848
	Pandemic	128	(91)	632	22,481

*Given that we cannot use claims data to identify suicides with absolute certainty, we report the number of cases for two separate definitions of suicide. The main definition counted deaths of patients with a documented history of self-harm whose death was not related to a recent hospital stay due to COVID-19. The second definition further excluded deaths that could be attributable to any hospital stay related to a physical illness. The numbers for the second definition are reported in round brackets; SMD severe mental disorders.

Figure 1 displays the number of potential suicides in each month from April 2020 to March 2021 compared to the respective month of the previous year. The most noticable differences can be observed in December 2020 and January 2021, which can be characterized by the onset of the second lockdown in Germany starting from the 16th of December.

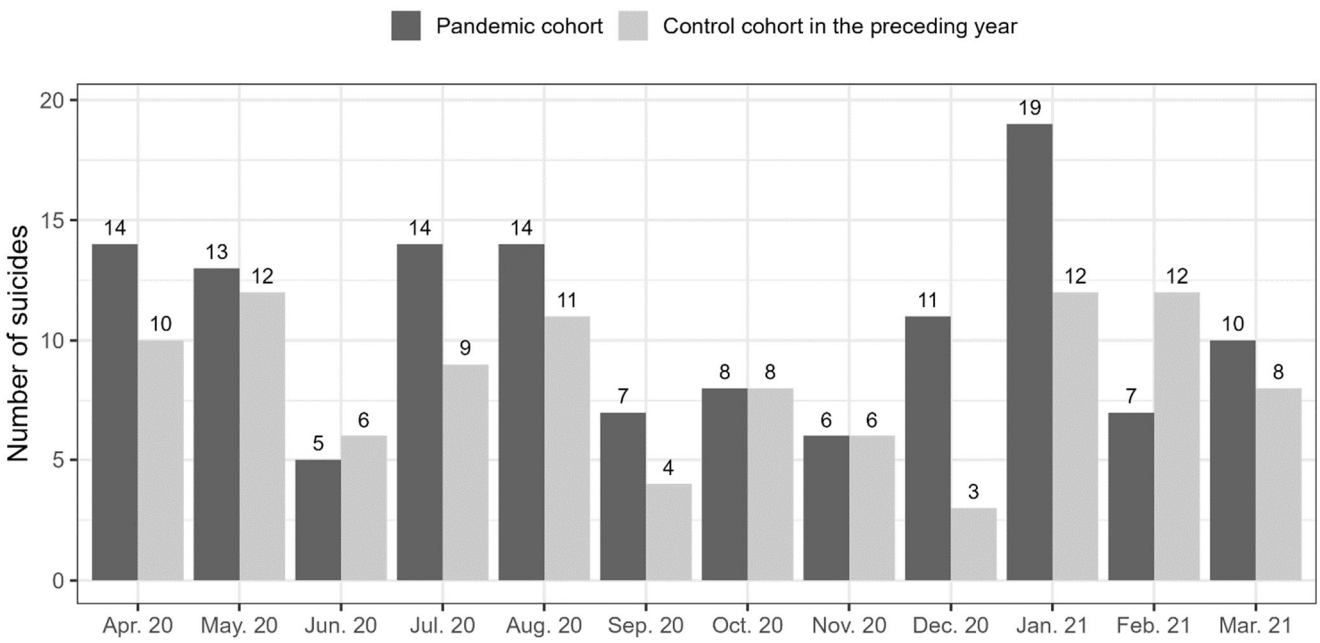

Figure 1) Number of potential suicides in the first year of the pandemic compared to the observed numbers in the year before the pandemic

Regression analysis:

Table 3 presents the findings of the logistic regression. In the main analysis, we found a signficant increase in suicide risk of 27.4%, $\beta = 0.24$, $z = 1.82$, $p<0.05$. In the sensitivity analysis, we found an even larger increase in suicide risk of about 50.3%, $\beta = 0.41$, $z = 2.46$, $p<0.01$.

Table 3: Logistic regression to determine the association of the pandemic and suicide risk

Condition	Term	OR	Estimate	Standard error	Z	p
Main analysis	(Intercept)		-8.84	0.10	-88.56	0.00
	Pandemic cohort	1.27	0.24	0.13	1.82	0.03
Sensitivity analysis	(Intercept)		-9.34	0.13	-72.70	0.00
	Pandemic cohort	1.50	0.41	0.17	2.46	0.01

N=1.384.302, OR Odds ratio (reference: control cohort), The main analysis excluded deaths during COVID-19-related inpatient stay whereas the sensitivity analysis excluded all deaths with a recent inpatient stay unrelated to a mental disorder or injury. We rounded all values to 2 decimal places. P values refer to a one-sided test.

Discussion:

This is the first study that analyzed the association of the COVID-19 pandemic during the first and second lockdown and the risk for suicide in a large cohort of patients with pre-existing severe mental disorders in the whole of Germany. We found an increase of at least 27% in the risk for suicide. In addition, our exploratory analysis by calender month suggests a particularly worrying spike in suicide risk during the second lockdown period in December 2020 and January 2021.

Given that we could not assess how various risk factors for suicide developed throughout the pandemic, we can only rely on previous studies to try to explain this increase. Undoubtedly, the COVID-19 pandemic affected a range of potential risk factors for suicide (Gunnell *et al.*, 2020). It seems plausible that the economic downturn due to the pandemic increased the risk for deteriorating mental health, alcohol abuse and suicide (Cooper, 2011; Zivin *et al.*, 2011; Stuckler *et al.*, 2009) because more people experienced financial problems, unemployment and worries about the future. This explanation is also supported by a recent study which demonstrated that the deterioration of mental health due to the pandemic could largely be accounted for by occupational and financial changes (Dragano *et al.*, 2022a). In addition, the barriers to access mental healthcare have increased. In the beginning of the pandemic, utilization of psychosocial and psychiatric services declined notably (Engels *et al.*, 2022b; Hoyer *et al.*, 2021b). Dayclinics were closed until appropriate hygiene and safety measures were implemented; and in the outpatient sector, patients often cancelled doctor appointments, check-ups and preventive consultations to avoid the risk of an infection (Bruch *et al.*, 2021; Hajek *et al.*, 2020). During the longer course of the pandemic, the mental health of many persons gradually decreased, which led to an increased demand for psychosocial services, longer waiting times and as a result a worsened access to care (Plötner *et al.*, 2022). Furthermore, the prolonged periods of loneliness (Antonelli-Salgado *et al.*, 2021) and the increase in domestic violence during the imposition of restrictions contributed to the deterioration of mental health (Gulati and Kelly, 2020; Kourti *et al.*, 2021). Lastly, it is possible that some patients have lost a family member, other kin or acquaintance due to COVID-19 during the second lockdown, as the January 2021 was characterized by the highest death rate due to COVID-19.

Prior studies found no indication of a systematic increase in the number of suicides in the German population due to the pandemic (Radeloff *et al.*, 2021; Wollschläger *et al.*, 2021). However, in contrast to our study, these studies were confined to smaller regions, were restricted to the year 2020 and did not focus on vulnerable patients groups.

Strengths and limitations

This study compared two large, representative cohorts that each consisted of almost 700.000 patients with severe mental disorders. The use of claims data allowed us to control for various potential confounders

because German claims data contain comprehensive information on sociodemographics, utilization of health services and medical history of each patient as long as it is relevant for billing and accounting purposes. Given that the cause of death is not transmitted to the statutory health insurance, we were only able to apply a proxy for suicide. However, we conducted thorough analyses to rule out other causes of death. We took the excess mortality due to COVID-19 into account, and additionally eliminated the possibility of almost all natural causes of death as long as they occured in hospital.

However, some limitations are worth noting. Given that we could not identity patients who perish on their first attempt to commit suicide, we may have undererstimated the absolute suicide risk in this vulnerable population. Another potential source of bias is that our definition of a suicide required that a previous suicide attempt had been documented. It is conceivable that suicide attempts are not always reported as such e.g. in cases of drug overdose (Plöderl *et al.*, 2011; Kidd, 2003). These factors could explain why we observed an indicidence rate of 18.53 per 100,000 for persons with severe mental disorders, which is only 1.7 times higher than the incidence rate of the general population in Germany in 2020 with 11.07 per 100,000 (Statistisches Bundesamt, 2021). We would expect that an unbiased estimate of the incidence rate should be substantially higher considering that we focused on patients with a drastically increased risk for suicide (Nordentoft *et al.*, 2011).

Future reseach:

Most limitations of this study are related to the unclear cause of death. Future studies could overcome these limitations by combining the mortality registry with claims data. At present, there are significant hurdles to overcome in order to link information from the mortality registry, which contains information on the cause of death, and health insurance claims data, which contains information on the medical history of an individual (Ohlmeier *et al.*, 2016; March *et al.*, 2020). However, an approach based on the mortality registry could be a much more detailed and reliable option to monitor suicides.

Conclusions:

This study highlights the importance of continous monitoring of suicides and mental health in vulnerable populations as the COVID-19 crisis progresses. Whereas suicides for the general population are in line with the trend in previous years, we observed a noticable increase in the risk for suicide for patients with severe pre-existing mental disorders. These findings support the call for additional efforts to prevent suicide and to help patients cope with their mental illness.

Declarations

Conflict of interest

None.

Ethical standards

Not applicable.

Availability of data and materials

The datasets supporting the conclusions of this article are owned by the German statutory health insurance AOK. Since public deposition of the data would breach ethical and legal compliance, data are only available upon formal request from the research institute of the AOK (WIdO). To request the data, please contact the institutional body of the WIdO (wido@wido.bv.aok.de). To fulfill the legal requirements to obtain that kind of data, researchers must obtain a permission for a specific research question from the German Federal (Social) Insurance Office. Additionally, researchers must conclude a contract with the statutory health insurance regarding data access, which can be requested from the "AOK-Bundesverband GbR" (Federal Association of Local Health Insurance Funds) under http://aok-bv.de/kontakt/. The licensee is permitted to use the data for the purpose of the research proposal within their company, exclusively. Thereby, a company is defined as an economical unit. Licensees are not allowed to pass the data to a third party, or to create Software or databases with the exception of scientific publications. Moreover, the study has to be approved by the data protection officer both at the statutory health insurance and the research institute.

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