Clinical Epidemiology

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Variation in Psychometric Testing in General Practice – A Nationwide Cohort Study

Henrik Schou Pedersen[1,2], Kaj Sparle Christensen[1,2], Anders Prior[1,2]

[1]Research Unit for General Practice, Aarhus, Denmark; [2]Department of Public Health, Aarhus University, Aarhus, Denmark

Correspondence: Henrik Schou Pedersen, Research Unit for General Practice, Bartholins Allé 2, Aarhus, 8000, Denmark, Email henrikp@ph.au.dk

Objective: Most mental disorders are diagnosed and treated in general practice. Psychometric tests may help the general practitioner diagnose and treat mental disorders like dementia, anxiety, and depression. However, little is known about the use of psychometric tests in general practice and their impact on further treatment. We aimed to assess the use of psychometric tests in Danish general practice and to estimate whether variation in use is associated with the provided treatment and death by suicide in patients.

Methods: This nationwide cohort study included registry data on all psychometric tests performed in Danish general practice in 2007–2018. We used Poisson regression models adjusted for sex, age, and calendar time to assess predictors of use. We used fully adjusted models to estimate the standardized utilization rates for all general practices.

Results: A total of 2,768,893 psychometric tests were used in the study period. Considerable variations were observed among general practices. A positive association was seen between a general practitioner's propensity to use psychometric testing and talk therapy. Patients listed with a general practitioner with low use had an increased rate of redeemed prescriptions for anxiolytics [incidence rate ratio (95% confidence interval):1.39 (1.23;1.57)]. General practitioners with high use had an increased rate of prescriptions for antidementia drugs [1.25 (1.05;1.49)] and first-time antidepressants [1.09 (1.01;1.19)]. High test use was seen for females [1.58 (1.55; 1.62)] and patients with comorbid diseases. Low use was seen for populations with high income [0.49 (0.47; 0.51)] and high educational level [0.78 (0.75; 0.81)].

Conclusion: Psychometric tests were used mostly for women, individuals with a low socioeconomic status, and individuals with comorbid conditions. The use of psychometric tests depends on general practice and is associated with talk therapy, redemptions for anxiolytics, antidementia drugs, and antidepressants. No association was found between general practice rates and other treatment outcomes.

Keywords: psychometric tests, registries, general practice, mental disorders, treatment variation

Plain Language Summary

- Most mental disorders are diagnosed and treated in general practice. They are linked with adverse health outcomes; other mental disorders, somatic disorders, and death by suicide.
- Psychometric tests can be used in the diagnostic process and help monitor the treatment.
- This register-based study investigates variations in the use of psychometric tests in Danish general practice. It also estimates whether such variations affect the treatment of different patient populations and their outcomes, eg referral to secondary care and death by suicide.
- The study shows that the use of psychometric tests varies between general practices and is used mostly for women, patients with low socioeconomic status or comorbid conditions.
- A positive association was seen between a general practitioner's propensity to use psychometric testing and talk therapy.
- High rates of test use were associated with more prescriptions for antidementia drugs and antidepressants, whereas low rates were associated with more prescriptions for anxiolytics.
- We found no association for antipsychotics, psychological/psychiatric treatment, or suicide.

Received: 7 December 2022
Accepted: 3 March 2023
Published: 22 March 2023

Introduction

The majority of patients with mental disorders are diagnosed and treated in general practice.[1] In Denmark and many other countries, general practitioners (GPs) act as gatekeepers to secondary care and refer patients in need of specialized treatment. Thus, there is a need for ensuring a reliable diagnostic process and identifying optimal treatment regimens, eg, talk therapy, medication treatment, and outpatient care. Mental disorders are linked with adverse health outcomes, such as other mental disorders, somatic disorders, and death by suicide.[2–5] Psychometric tests (PTs) are instruments to aid the GP during the diagnostic process and help monitor treatment outcomes.[6,7] PTs may serve as screening devices, diagnostic instruments, or rating scales for measuring disease severity. Danish clinical guidelines recommend the use of PTs for a range of disorders, eg, dementia, anxiety, and depression,[6–8] and the GP is required to have performed a PT when referring a patient with depression to a psychologist. Since 2007, Danish GPs have used a specific service code and received remuneration when using clinically recognized PTs. A recent clinical trial showed that systematic use of a depression-related PT did not increase the diagnostic precision compared with usual clinical assessment in Danish general practice.[9] Variation in health care and their influence on treatment outcomes are well documented.[10,11] A recent Danish study found an excess variation between Danish general practices in terms of the chronic care services provided, eg, talk therapy.[12] However, little is known about the use of PTs in general practice. Therefore, we wanted to explore the rate of PT use in general practice by using methods applied for ranking health service providers in a broad unselected national setting.[13,14]

This study aimed to investigate the variation between general practices in the use of PTs, including variation related to patient characteristics, practice type, and geographical region. Further, this study aimed to explore whether variation in PT use modified the patients' rate of received talk therapy sessions, medication treatment for mental disorders (antidepressants, antipsychotics, antidementia drugs, and anxiolytics), referral to psychological or psychiatric treatment in the primary and the secondary sector, and death by suicide.

Methods

Setting and Participants

To explore time trends in the use of PTs in Danish general practice, we used Danish national registries to conduct a cohort study including all Danish residents above 18 years of age who were listed with a general practice in 2007–2018. We chose December 31, 2018, as the endpoint as this was the last date of fully available data. The majority (98%) of the Danish population is listed with a specific general practice.[15] We also used information from the patient list database, which holds monthly updated information on the patient population for each provider.[16] In a sub-cohort based on data for only 2017–2018, we investigated the variation in PT use among Danish general practices and associated patient-related treatment outcomes, regional variation, and variation in PT use for different subgroups of patients. Using the unique personal identification number assigned to all Danish residents at birth or immigration, we linked information across the included registers.[17] In both cohorts, we restricted to "active" general practices, ie, clinics with at least 500 patients affiliated throughout a calendar year.

Psychometric Tests

From the Danish National Health Insurance Service Register (NHISR), we obtained data on contacts to general practice. This register holds information on all contacts to GPs based on administrative data (used for remuneration purposes) on the services provided.[15] All consultations recorded in the register include information on provider number, personal identification number (patient), date, time and type of consultation, and provided service. PTs were identified through the service code 2149 for all general practice specialty codes (80–89). Only PTs performed in the daytime on weekdays were included.

Outcomes

The NHISR holds information on talk therapy performed by the GP and information on publicly subsidized psychological and psychiatric treatment (following GP referral), which was identified through specialty codes *63*

and *24*, respectively. Psychologist contacts were restricted to referral for depression or anxiety. Redemption of prescriptions for antidepressants, antipsychotics, anxiolytics, or antidementia drugs was identified in the Danish National Prescription Registry (DNPR) through ATC codes *N06A* (not including *N06AX12), N05A, N05B*, and *N06D*, respectively. DNPR holds information on all prescriptions redeemed at any pharmacy in Denmark.[18] Contacts with public mental health hospitals were identified in the Danish National Patient Register (NPR), which holds continuously updated information on all contacts to the secondary health-care sector.[19] Using the Danish Register of Causes of Death,[20] we identified all deaths by suicide in the study period by using the ICD-10 codes X60-X84 and Y87 (Supplementary Table 4).

Calendar Time

Calendar time was divided into categories of year and season. Season was categorized into four groups: 1 (December, January, and February), 2 (March, April, and May), 3 (June, July, and August), and 4 (September, October, and November).

Sociodemographic Variables

Information on sex and age was extracted from the Danish Civil Registration System (DCRS).[17] The DCRS contains continuously updated information on date of birth, immigration and emigration, sex, and vital status of all Danish residents.

Socioeconomic Status

Information on the highest attained education level, income, cohabitation status, and region of residence was obtained from the annually updated registers at Statistics Denmark.[21] We divided educational status into four categories based on the United Nations Educational, Scientific, and Cultural Organization's International Standard Classification of Education (0–10 years, 11–15 years, ≥16 years, or unknown).[22,23] Household income was divided into decile sets by year; negative income was partly explained by business loss under self-employment, and these cases were put in a separate category. Cohabitation status was divided into single, living with a partner, or married (Supplementary Table 5).

Comorbidity

Data on comorbidity originated from NPR and DNPR. Included data were selected through an algorithm developed by Prior et al. This algorithm identifies 39 disorders in the circulatory system, endocrine system, pulmonary and respiratory system, gastrointestinal system, urogenital system, musculoskeletal system, hematological system, neurological system, cancers, and mental health conditions treated in both primary and secondary care (Supplementary Table 6).[24]

GP Information

Information on each general practice was based on two data sources: the Patient List Database and the Danish National Provider Registry comprising information on all public health providers.[16,25] This enabled us to identify type of practice (solo practice or non-solo practice), number of GPs employed, and size of patient population. It also allowed us to identify the geographical region of each general practice based on the most prevalent region of residence in the patient population.

Statistical Analysis

Use Over Time

To provide a crude overview of PT use during the entire follow-up period from 1 January 2007 through 31 December 2018, we calculated the PT rate for each GP as the total number of PTs performed over the general practice affiliated person-time in that year. The rates were presented as per 1000 person-years (Table 1).

In the sub-cohort based on data from 1 January 2017 through 31 December 2018, we assessed the characteristics associated with PT use and the variation in PT use between general practices (Table 2).

Table 1 PT Use in Danish General Practice in 2007–2018

Year	Median Rate (IQI)[c]	Person-Years	PTs[b]	General Practices (no PTs)[a]
2007	18 (6; 41)	4,970,025	158,673	2235 (151)
2008	21 (8; 48)	4,951,283	181,511	2182 (103)
2009	25 (9; 50)	4,903,790	194,858	2148 (116)
2010	31 (13; 62)	4,866,519	232,803	2138 (78)
2011	35 (16; 69)	4,830,258	258,107	2113 (77)
2012	37 (17; 70)	4,807,781	264,307	2088 (64)
2013	35 (17; 63)	4,759,908	238,525	2075 (59)
2014	36 (19; 65)	4,733,175	242,210	2038 (41)
2015	38 (20; 68)	4,711,646	252,914	1997 (38)
2016	36 (19; 65)	4,703,050	239,533	1945 (35)
2017	37 (19; 66)	4,659,775	246,526	1914 (41)
2018	39 (20; 69)	4,625,658	258,926	1881 (39)
Total		57,522,867	2,768,893	

Notes: [a]Restricted to practices with more than 500 patients listed per year. [b]Number of PTs differs between Table 1 and Table 2 due to minor differences in the definition of "active" general practices in the two cohorts. [c]Rates are calculated as number of PTs per 1000 person-years.
Abbreviations: IQI, Interquartile interval; PT, psychometric test.

Table 2 Variables of Interest and Their Association with PT Use

Variable	PTs[b]	Person-Years	PT Rate[c]	IRR[a] (95% CI)
Gender				
Men	174,600	4,111,875	42	1.00 (ref.)
Women	288,741	4,261,666	68	1.58 (1.55; 1.62)
Age, years				
18–24	56,049	880,697	64	1.00 (ref.)
25–34	89,263	1,296,834	69	1.08 (1.05; 1.10)
35–44	75,588	1,322,252	57	0.89 (0.87; 0.92)
45–54	73,533	1,507,975	49	0.76 (0.74; 0.79)
55–64	58,152	1,311,237	44	0.69 (0.66; 0.72)
65–74	46,861	1,195,587	39	0.61 (0.58; 0.64)
75–84	43,951	638,823	69	1.05 (0.99; 1.11)
85-	19,944	220,135	91	1.32 (1.23; 1.42)

(*Continued*)

Table 2 (Continued).

Variable	PTs[b]	Person-Years	PT Rate[c]	IRR[a] (95% CI)
Cohabitation status				
Single	214,470	3,162,902	68	1.00 (ref.)
Married	174,406	3,950,657	44	0.71 (0.69; 0.73)
Cohabiting	74,465	1,259,982	59	0.86 (0.84; 0.88)
Immigration status				
Danish	412,314	7,325,498	56	1.00 (ref.)
Western immigrant	17,981	398,523	45	0.75 (0.71; 0.80)
Non-western immigrant	33,046	649,520	51	0.85 (0.81; 0.89)
Educational level, years				
≤10	132,977	2,096,820	63	1.00 (ref.)
10–15	212,838	3,903,133	55	0.90 (0.88; 0.92)
≥16	105,996	2,072,534	51	0.78 (0.75; 0.81)
Unknown (no education registered)	11,530	301,054	38	0.57 (0.54; 0.60)
Family income category (annual)				
1st quintile	99,388	1,254,727	79	1.00 (ref.)
2nd quintile	100,028	1,452,678	69	0.89 (0.87; 0.91)
3rd quintile	99,173	1,671,148	59	0.79 (0.77; 0.81)
4th quintile	91,726	1,916,697	48	0.65 (0.63; 0.67)
5th quintile	71,607	2,035,905	35	0.49 (0.47; 0.51)
Negative/no income	1419	42,386	33	0.45 (0.41; 0.48)
Year				
2017	223,680	4,154,648	54	1.00 (ref.)
2018	239,661	4,218,893	57	1.05 (1.04; 1.07)
Season				
Spring	118,122	2,116,239	56	1.00 (ref.)
Summer	98,500	2,113,307	47	0.84 (0.82; 0.85)
Fall	131,960	2,086,340	63	1.13 (1.12; 1.15)
Winter	114,759	2,057,654	56	1.00 (0.99; 1.01)
Region				
North Denmark Region	47,222	835,336	57	1.00 (ref.)
Central Denmark Region	130,103	1,909,830	68	1.20 (0.98; 1.45)
Region of Southern Denmark	95,181	1,819,054	52	0.93 (0.76; 1.12)

(*Continued*)

Table 2 (Continued).

Variable	PTs[b]	Person-Years	PT Rate[c]	IRR[a] (95% CI)
Capital Region of Denmark	135,705	2,611,923	52	0.89 (0.75; 1.07)
Region Zealand	55,130	1,197,399	46	0.82 (0.67; 1.01)
Comorbidity				
Circulatory system				
Hypertension	114,508	1,884,908	61	1.25 (1.23; 1.28)
Dyslipidemia	62,836	1,015,893	62	1.28 (1.25; 1.31)
Ischemic heart disease	31,294	462,952	68	1.38 (1.35; 1.42)
Atrial fibrillation	16,061	244,620	66	1.22 (1.19; 1.25)
Heart failure	6106	93,568	65	1.24 (1.19; 1.29)
Peripheral artery occlusive disease	11,642	167,788	69	1.33 (1.28; 1.38)
Stroke	18,358	232,632	79	1.50 (1.46; 1.55)
Endocrine system				
Diabetes mellitus	30,282	491,223	62	1.23 (1.20; 1.26)
Thyroid disorder	26,611	370,517	72	1.19 (1.17; 1.22)
Gout	7683	140,372	55	1.16 (1.12; 1.21)
Pulmonary system and allergy				
Chronic pulmonary disease	73,953	1,010,573	73	1.35 (1.33; 1.37)
Allergy	75,376	1,070,522	70	1.31 (1.29; 1.34)
Gastrointestinal system				
Ulcer/chronic gastritis	11,165	140,333	80	1.49 (1.43; 1.54)
Chronic liver disease	5257	73,824	71	1.44 (1.36; 1.53)
Inflammatory bowel disease	6732	106,230	63	1.15 (1.11; 1.20)
Diverticular disease of intestine	12,346	171,714	72	1.31 (1.26; 1.37)
Urogenital system				
Chronic kidney disease	3883	64,519	60	1.11 (1.05; 1.17)
Prostate disorders	17,207	272,265	63	1.52 (1.48; 1.57)
Musculoskeletal system				
Connective tissue disorders	12,195	178,681	68	1.16 (1.12; 1.20)
Osteoporosis	22,134	315,912	70	1.11 (1.08; 1.14)
Painful condition	123,276	1,594,556	77	1.67 (1.63; 1.70)

(*Continued*)

Table 2 (Continued).

Variable	PTs[b]	Person-Years	PT Rate[c]	IRR[a] (95% CI)
Hematological system				
HIV/AIDS	464	9187	51	1.09 (0.93; 1.28)
Anemias	11,401	143,407	80	1.34 (1.29; 1.39)
Cancers				
Cancer	30,231	500,742	60	1.13 (1.10; 1.15)
Neurological system				
Vision problem	39,401	554,407	71	1.20 (1.17; 1.23)
Hearing problem	30,724	432,767	71	1.29 (1.26; 1.32)
Migraine	25,808	313,122	82	1.42 (1.39; 1.45)
Epilepsy	10,759	118,138	91	1.68 (1.61; 1.76)
Parkinson's disease	1357	16,765	81	1.51 (1.36; 1.66)
Multiple sclerosis	1668	29,485	57	1.03 (0.95; 1.11)
Neuropathies	21,168	288,242	73	1.38 (1.34; 1.42)
Mental health conditions				
Mood, stress-related, or anxiety disorders	69,873	438,713	159	3.08 (3.01; 3.17)
Psychological distress	166,951	1,109,088	151	3.91 (3.80; 4.03)
Alcohol problems	12,345	102,879	120	2.67 (2.58; 2.78)
Substance abuse	4452	38,667	115	2.13 (2.00; 2.27)
Anorexia/bulimia	3381	24,049	141	1.87 (1.76; 1.98)
Bipolar affective disorder	7172	54,593	131	2.38 (2.25; 2.51)
Schizophrenia or schizoaffective disorder	4327	62,917	69	1.28 (1.17; 1.42)
Dementia	8362	68,502	122	1.84 (1.74; 1.95)

Notes: [a]Adjusted for age, sex, and calendar period. [b]Number of PTs differs between Table 1 and Table 2 due to minor differences in the definition of "active" general practices in the two cohorts. [c]Rates are calculated as number of PTs per 1000 person-years.

Abbreviations: PT, psychometric test; IRR, incidence rate ratio; CI, confidence interval.

Predictors of PT Use

First, we wanted to investigate the crude association between patient variables and general practice variables and the use of PTs. This was done by mutually adjusting for sex, age, year, and season. As the number of PTs is a discrete non-negative count variable, we used generalized linear models with a log-link assuming Poisson distributed errors (ie, Poisson regression) and each person's at-risk time as the offset to analyze the number of PTs. This approach yielded incidence rate ratios (IRRs). To consider apparent clustering at general practice level, we used cluster-robust variance estimation.[26] All estimates with 95% confidence intervals (CIs) (Table 2).

Variation Among General Practices

To assess the variation in PT use between general practices, we calculated the standardized PT rate (sPT rate) for each general practice in the study population. This was done in several steps. First, we used a Poisson regression model, which was fully adjusted for all non-provider variables, ie, age, sex, year, season, cohabitation, immigration status, educational

status, income, and comorbidity, to predict the expected number of psychometric tests per person during follow-up. Covariates for the prediction model were selected prior to the analyses. This enabled us to calculate the number of PTs that we would expect a given general practice to perform during follow-up, given its patient population. Second, we counted the observed number of PTs performed for each general practice and compared this number with the expected number of PTs in an observed over expected (OE) ratio. Finally, we calculated the crude overall national PT rate during follow-up and multiplied this rate with the OE ratio, which yielded the sPT rate for each general practice. The sPT rate was depicted graphically, ordered from the lowest rate to the highest rate. To comply with the legal data regulations on anonymity, all practice rates were combined into clusters of five practices. The mean rate within each cluster was plotted. This was done for all practices and for the general practice-related subgroups: region, number of doctors, size of patient population, and solo practice (or not). We estimated the number of doctors and the size of the patient population in a specific general practice for a given time period by using the frequency weighted average for that period (Table 3 and Figure 1). To test for excess variation between general practices, we first fitted a mixed Gaussian model with a random component for general practice and afterward fitted a Gaussian model without the random component and performed a likelihood ratio test of the hypothesis of no random component for general practice.[27]

Treatment Outcomes and Suicide

To investigate the association between being affiliated with a general practice with a certain OE ratio and being referred to a certain treatment regimen in the primary or secondary health-care sectors and the risk of suicide, we randomly divided the study population into two groups: a training sample (70%) and a test sample (30%). The division was made in each general practice to ensure enough observations per general practice to be able to analyze the association for the time period when the OE ratio was calculated. In the training sample, we once again fitted the full model and calculated the OE ratio for each general practice. In the test sample, we used the OE estimate (categorized into decile sets) as an independent variable in regression analyses. The seventh decile group was considered the reference category since this group comprised the empirical OE ratio of 1 and thus had a PT rate as expected based on the model. For the four medication outcomes, we conducted two separate types of analyses. In one type, we looked at the number of redeemed prescriptions. In the other type, we restricted to

Table 3 General Practice Characteristics and Standardized PT Rates

Variable	Level	N Practices (%)	Median sPT (IQI)
Region	North Denmark Region	142 (8.7%)	45 (21; 74)
	Central Denmark Region	341 (21%)	49 (29; 81)
	Region of Southern Denmark	334 (20.6%)	39 (24; 61)
	Capital Region of Denmark	587 (36.1%)	40 (20; 69)
	Region Zealand	220 (13.5%)	35 (20; 61)
GP number	1	186 (13.5%)	44 (21; 76)
	2–5	677 (49.3%)	38 (21; 70)
	6-	510 (37.1%)	42 (28; 64)
Patient population	500–1599	576 (35.5%)	38 (17; 75)
	1600–3199	588 (36.2%)	42 (23; 71)
	3200–4799	282 (17.4%)	41 (29; 63)
	4800-	178 (11%)	47 (30; 67)
Solo practice	No	875 (53.9%)	42 (27; 65)
	Yes	749 (46.1%)	39 (17; 75)

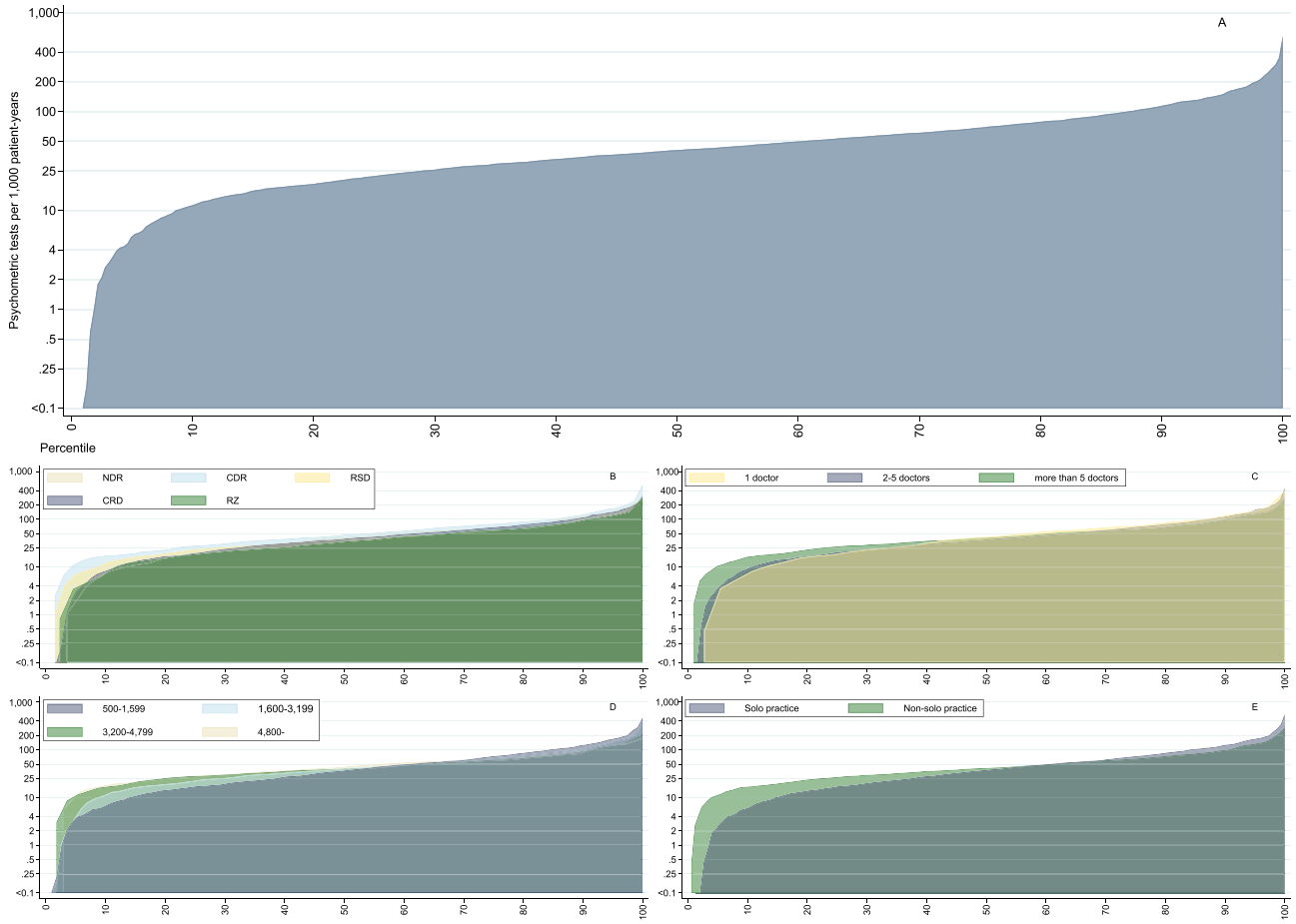

Figure 1 Standardized rates of PT use. Overall (**A**), regions (**B**), number of doctors (**C**), patient population size (**D**), practice type (**E**).
Abbreviations: NDR, North Denmark Region; CDR, Central Denmark Region; RSD, Region of Southern Denmark; CRD, Capital Region of Denmark; RZ, Region Zealand.

never users and investigated the risk of a first-time redemption. The analyses of prescriptions for antidementia drugs were restricted to individuals above 75 years of age. The other outcomes considered were number of talk therapy sessions, number of contacts with publicly subsidized psychological or psychiatric treatment, number of contacts with public mental health hospitals, and the risk of death by suicide. These analyses were conducted in four prespecified nested adjustment models. Model 0 (m0) was unadjusted. Model 1 (m1) was adjusted for age, sex, and calendar time. Model 2 (m2) was adjusted as m1 + immigration status, cohabitation status, educational level, income, and somatic comorbidities. Model 3 (m3) was adjusted as m2 + mental health conditions. In the analyses of antidepressants, antipsychotics, and antidementia drugs, m3 did not include the variables for psychological distress, bipolar disorder, and dementia, respectively, due to overlap in the coding definitions. M3 was considered the main model (Figure 2). To assess differences between combinations of OE group and train and test samples, we calculated the proportion of risk time spent for each variable used in the regression analyses.

In all analyses, all variables, except for sex and immigration status, were considered to be time- dependent, ie, a person being diagnosed with a specific disease during the follow-up period contributed with risk time in the no-disease category until the date of diagnosis, whereafter this person contributed with risk time in the disease category. In the sub-analyses, we restricted to persons below 75 years of age.

All analyses were performed with Stata, version 17.

Results

Use Over Time

Throughout the study period, a total of 2,768,893 PTs were used in a study population of 57.52 million person-years. From 2007 to 2012, a rise in the use was observed from about 160 thousand PTs in 2007 to about 260 thousand PTs in

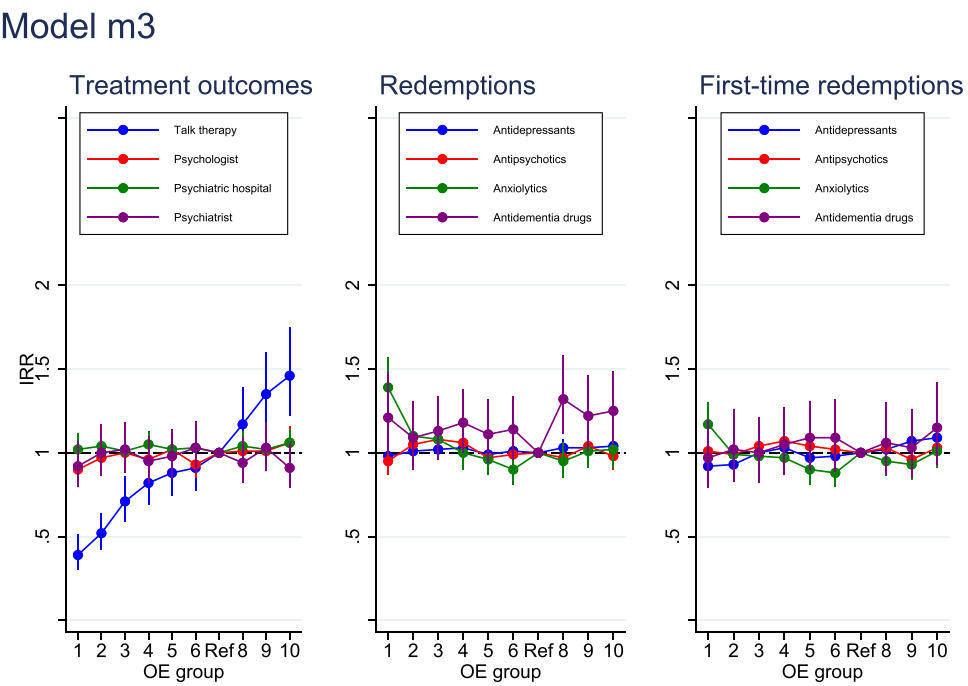

Figure 2 IRRs of treatment regimens and medicine redemption by decile groups of the observed over expected ratio.

2018 (Table 1). The median PT rate rose from 18 PTs per 1000 person-years in 2007 to 37 PTs per 1000 person-years in 2012. Thereafter, the rate plateaued. Throughout the study period, a steady variation in PT use was observed among GPs, with an interquartile range from 35 up to 53. Among eligible general practices, 6.8% used no PTs in 2007; this number decreased to 2.1 in 2018 (Table 1).

Predictors of PT Use

Sociodemographic Variables

Among the sociodemographic variables, we observed that women had 1.58 times higher PT rate than men (95% CI) (1.55; 1.62) (Table 2). The rate varied over age groups, with 1.32 times higher rate (1.23; 1.42) among those aged ≥85 years compared with those aged 18–24 years. Those aged 65–74 years had a 39% lower rate (0.58; 0.64) than those age 18–24 years. Compared with GPs in the North Denmark Region, GPs in the Central Denmark Region had the highest relative PT rate, IRR 1.20 (0.98; 1.45), whereas GPs in Region Zealand had the lowest, IRR 0.82 (0.67; 1.01).

Calendar Period

The summer season had the lowest rate of PTs, 16% lower than the winter season, whereas the fall season had the highest rate, 13% greater than the winter season (Table 2).

Socioeconomic Characteristics

Among the socioeconomic variables, being married or living with a partner, having completed a higher education, having a high income, or being an immigrant were negatively associated with PT use compared with their reference groups. For example, the PT rate was 51% lower among persons with an income in the highest category compared with persons in the lowest category (49%; 53%) (Table 2).

Comorbidity

Most disorders were positively associated with PT use compared with not having that disorder (Table 2). This was most apparent for mental health conditions. For example, those registered with psychological distress had 3.91 times higher PT rate than those without (3.80; 4.03), and those registered with a mood, stress-related, or anxiety disorder had 3.08 times

higher PT rate (3.01; 3.17) compared to those without. In addition, an increased PT rate was observed among the somatic disorders, eg, stroke, which resulted in a 50% increased rate (1.46; 1.55).

Variation Among General Practices

After adjustment for potential differences in the patient population between general practices, we found an excess variation in the sPT rates between the included practices (Chi-square=28294.05, p-value <0.0001) (Figure 1A). The ranked sPT rates across all practices, divided according to practice characteristics, are depicted graphically in Figure 1A–E. Among all practices, the (pooled) practice in the 10th percentile had an sPT rate of 12 PTs per 1000 patient-years, whereas the corresponding (pooled) practice in the 90th percentile had an sPT rate of 115 PTs per 1000 patient-years. In terms of the interquartile range (IQR) of the sPT rates, we found a greater IQR between the small practices compared with the large ones (Table 3 and Figure 1C–E). For example, the IQR was 58 for practices with 500–1599 patients affiliated and 37 for practices with more than 4800 patients affiliated. The practice type also influenced the variation; an IQR of 58 was found for solo practices, and an IQR of 38 was seen for other types of practices. The median level of sPT rates was highest in the Central Denmark Region [median sPT interquartile interval (IQI): 49 (29; 81)] and lowest in the Region Zealand [median sPT (IQI): 35 (20; 61)].

Treatment Outcomes and Suicide

The tendency among general practices to use PTs and offer talk therapy was associated in a dose–response manner. Compared with the seventh decile group, the tenth decile group showed an elevated rate [1.46 (1.22; 1.75)], whereas the first decile group showed a lowered rate [0.39 (0.30; 0.51)] (Figure 2, Supplementary Table 1). No apparent associations were found between PT tendency and publicly subsidized psychological or psychiatric treatment, contacts with psychiatric hospitals, treatments with antipsychotics, and the risk of suicide. However, patients listed with a general practice in the first decile group had an increased rate of anxiolytics use compared with the reference group. The difference persisted when we restricted to never users and first-time redemptions. Likewise, we found that patients listed with a general practice with a high PT tendency had an increased rate of redeemed antidementia drug prescriptions compared with the reference group. Though, an increased rate was also found for the group in the first and fourth deciles, the differences disappeared when we restricted to first-time users. No associations were found for a number of antidepressant redemptions. However, when restricting to first-time redemptions, we found an increased rate in patients listed with GPs with a high PT tendency. A similar picture was seen for persons younger than 75 years of age, except for antidementia drugs, which were infeasible (Supplementary Figure 1, Supplementary Table 2). The groups comprising combinations of OE group and training and test samples were similar in terms of the variables used in the analyses. However, the first OE decile group consisted of more men than women, and they tended to be older compared to the other decile groups (Supplementary Table 3).

Discussion

Key Results

In this nationwide register-based explorative cohort study, we observed that the use of PTs has become more frequent among Danish GPs since 2007 when the service code for PTs was introduced. Increased PT rates were seen for women, low income, low educational level, and comorbid disorders. However, an excess variation was seen in PT use among the included general practices. PT use was most common in the Central Denmark Region and least common in Region Zealand. A positive association was observed between the tendency of a general practice to use PT and the tendency to offer talk therapy. Patients listed with a general practice with low PT use had an increased rate of redeemed prescriptions for anxiolytics medication. Patients listed with a general practice with high PT use had an increased rate of redeemed prescriptions for antidementia drugs and first-time antidepressants. However, the difference for antidementia drugs disappeared when we restricted to never users and first-time redemptions. No apparent associations were observed for psychological and psychiatric treatment, redemptions of antipsychotics, and suicide.

Comparison with Other Studies

To our knowledge, this is the first study to investigate the variation in the use of PTs in general practice. A recent Danish clinical study on the value of systematic psychometric testing, ie, no variation in use, did not find the diagnosis of depression to be more precise when based on psychometric testing compared with usual clinical assessment.[9] This finding was somewhat confirmed in this study, as we found no significant difference between groups with varying propensity for PT use for most of the investigated treatment outcomes. The finding of increased variation in the provided services has also been reported in other studies, with indications that some variation is non-negligible due to derived outcomes, such as the need for immediate identification and treatment of patients at risk of suicidal behavior after the loss of a loved one.[12,28,29]

Strengths and Limitations

The Danish registers enabled us to combine health data, administrative data, and socioeconomic and demographic data at the personal level with no loss to follow-up. The continuous update of health databases allowed for construction of time-dependent variables and reduced the risk of potential biases from reverse causation and conditioning on the future, which might have introduced immortal time bias. The use of service codes enabled us to identify whenever a PT had been used, by which provider number, and to whom it was given. However, the NHISR held no information on the reason for contact with the GP (other than provided by the service code). For example, it could not be distinguished whether a PT had been used for dementia, depression, or anxiety. Hence, an important limitation was the lack of access to diagnoses in primary care. However, this limitation was addressed by the use of a multimorbidity algorithm incorporating disease-specific medication.[24] In sub-analyses, we restricted to a population under the age of 75 years to reduce the potential risk of selection bias from the use of dementia-indicated PTs, and we found no apparent differences compared with the overall results.

When computing the observed over expected ratio, small general practices with a small number of expected PTs had an inherent ability to be noisier than large practices. One more or one less PT performed will move the ratio more substantially for practices with few numbers of expected PTs compared with those with large numbers of expected PTs. The finding that small practices had greater ratio variations compared with large practices could result from this. However, this potential limitation was alleviated by restricting to practices with at least 500 listed patients. Another limitation of NHISR was that it provided only data on practice level. Thus, if a practice comprised several GPs, the sPT rate for that provider number would be a weighted average of all the GPs' sPT rates.

To standardize PT rates, it is crucial to choose the correct variables and the right predictors for PT use. However, not all predictors were available due to the lack of diagnosis data from general practice. Yet, as shown in Table 2, the a-priori chosen variables do appear to be associated with PT use. Still, residual confounding and unmeasured confounding cannot be ruled out. For the analyses regarding Figure 2, we presented the fully adjusted estimates from m3. This model might have overadjusted the association of interest. Thus, the presented estimates might be conservative. Nevertheless, the estimates from m0, m1, and m2 did not alter the conclusions.

Interpretation

We found a higher PT rate among patients with a low socioeconomic status, eg, low education and low income. Higher prevalence of mental disorders has previously been reported in this group.[30] The observed high PT rate for comorbid disorders was expected because of the association between physical and mental disorders.[2] We also found a lower PT rate among immigrants, which could be explained by a limited number of available PTs in other languages than Danish. The low rate in the summer is likely to be related to the holiday period with fewer open hours in general practice.

Variation in the services provided by Danish GPs has previously been investigated by examining variations in chronic care consultations, including talk therapy sessions.[12] In our study, we found a clear positive dose–response association between PT rate and talk therapy rate. Specifically, we observed the greatest variation in the propensity for PT use among the smallest practices. One reason for this could be lack of communication with other peers, but random variation due to smaller sample sizes might also be an explanation.

The observation that some general practices had a different PT rate than expected (based on the standard rate) does not per se mean that they need to change their rate, since the standard rate is not a gold standard.[31] When we categorized on propensity for PT use, minor differences were observed for treatment-related outcomes. We found that patients listed with a GP with low PT use had elevated rates of anxiolytics compared with those with a standard rate of PT use; this could indicate that some GPs have a different attitude towards diagnosis and treatment of mental disorders or that the characteristics of their patient populations vary significantly, which might explain the predisposition towards anxiolytics medication. One should bear in mind that these exploratory analyses cannot give a causal explanation, and some differences between the patient populations were evident.

As mentioned above, unmeasured confounding on the person level cannot be ruled out. The same holds for indication for PT use. Thus, the (excess) variation between GP-related sPT rates might be contaminated. We tried to address the lack of information on indicated PT use by including redemptions for antidementia drugs, and we saw that patients listed with a GP with a high tendency for PT use had a higher rate of redemptions for these drugs. However, when we restricted to those under age 75 years, the differences remained for talk therapy and anxiolytics redemptions.

Generalizability

In Denmark, the healthcare system is mainly publicly funded, and all residents have access to universal healthcare. As Danish GPs are remunerated for using clinically recognized PTs, GPs have a financial incentive to use PTs. Therefore, we would expect the differences to be more pronounced in payment-based health-care systems.

Conclusion

PTs are common tools in Danish general practice. PTs are mostly used for women, those with a low socioeconomic status, and comorbid conditions. The use of PTs depended on GP affiliation and was positively associated with use of talk therapy. High sPT rates were associated with high redemption rates for antidementia drugs and incident redemptions for antidepressants, whereas low sPT rates were associated with high redemption rates for anxiolytics. The tendency to use PTs was not associated with psychological or psychiatric treatment or antipsychotics, or suicide.

Abbreviations

ATC, Anatomical therapeutic chemical; CDR, Central Denmark Region; CI, Confidence interval; CRD, Capital Region of Denmark; DCRS, Danish Civil Registration System; DNPR, Danish National Prescription Register; GP, General practitioner; ICD-10, International Classification of Diseases, 10th revision; IQI, Interquartile interval; IQR, Interquartile range; IRR, Incidence rate ratios; m, Model; NHISR, (Danish) National Health Insurance Service Register; NDR, North Denmark Region; NPR, (Danish) National Patient Register; OE, Observed over expected; PT, Psychometric test; RSD, Region of Southern Denmark; RZ, Region Zealand; sPT rate, Standardized psychometric test rate.

Data Sharing Statement

Due to restrictions related to Danish law and protection of patient privacy, the data used in this study can only be made available through a trusted third party, Statistics Denmark, which holds the data records for this study. Research groups based in a Danish scientific setting can be authorized to work with data within Statistics Denmark. Access to individual scientists inside and outside of Denmark may be authorized upon request directed to Statistics Denmark.

Ethics Statement

The study required no approval from the Committee on Health Research Ethics in the Central Denmark Region as it was based on register data, and all patient information was anonymized and de-identified prior to analysis by Statistics Denmark.

Acknowledgments

The authors would like to thank Lone Niedziella for language editing, and Statistics Denmark for providing the data infrastructure.

Funding

HSP was funded by an unrestricted grant from the General Practice Research Foundation of the Central Denmark Region (Region Midtjyllands Praksisforskningsfond). AP was funded by the Novo Nordisk Foundation (grant no. NNF18OC0031194). The funders had no role in the study design, data collection, data analysis, data interpretation, or writing of the paper.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Musliner KL, Liu X, Gasse C, Christensen KS, Wimberley T, Munk-Olsen T. Incidence of medically treated depression in Denmark among individuals 15–44 years old: a comprehensive overview based on population registers. *Acta Psychiatr Scand*. 2019;139(6):548–557. doi:10.1111/acps.13028
2. Momen NC, Plana-Ripoll O, Agerbo E, et al. Association between mental disorders and subsequent medical conditions. *N Engl J Med*. 2020;382(18):1721–1731. doi:10.1056/NEJMoa1915784
3. Momen NC, Plana-Ripoll O, Agerbo E, et al. Mortality associated with mental disorders and comorbid general medical conditions. *JAMA Psychiatry*. 2022;79(5):444–453. doi:10.1001/jamapsychiatry.2022.0347
4. Plana-Ripoll O, Pedersen CB, Holtz Y, et al. Exploring comorbidity within mental disorders among a Danish national population. *JAMA Psychiatry*. 2019;76(3):259–270. doi:10.1001/jamapsychiatry.2018.3658
5. Nock MK, Hwang I, Sampson NA, Kessler RC. Mental disorders, comorbidity and suicidal behavior: results from the national comorbidity survey replication. *Mol Psychiatry*. 2010;15(8):868–876. doi:10.1038/mp.2009.29
6. Sundhed.dk. Depression guideline (in Danish); 2021. Available from: https://www.sundhed.dk/sundhedsfaglig/laegehaandbogen/psykiatri/tilstande-og-sygdomme/depressioner/depression/. Accessed February 17, 2023.
7. Danish College of General Practitioners. Anxiety guideline (in Danish); 2012. Available from: https://vejledninger.dsam.dk/angst/. Accessed February 17, 2023.
8. Sundhed.dk. Dementia guideline (in Danish); 2022. Available from: https://www.sundhed.dk/sundhedsfaglig/laegehaandbogen/geriatri/tilstande-og-sygdomme/demensudredning/demensudredning-laege/. Accessed February 17, 2023.
9. Brinck-Claussen UO, Curth NK, Christensen KS, et al. Improving the precision of depression diagnosis in general practice: a cluster-randomized trial. *BMC Fam Pract*. 2021;22(1). doi:10.1186/s12875-021-01432-w
10. Wennberg JE. Unwarranted variations in healthcare delivery: implications for academic medical centres. *BMJ*. 2002;325(7370):961–964. doi:10.1136/bmj.325.7370.961
11. Dartmouth Atlas Project. The Dartmouth atlas of health care; 2023. Available from: https://www.dartmouthatlas.org/. Accessed February 17, 2023.
12. Prior A, Vestergaard CH, Ribe AR, et al. Chronic care services and variation between Danish general practices: a nationwide cohort study. *Br J Gen Pract*. 2022;72(717):e285–e292. doi:10.3399/BJGP.2021.0419
13. Ash AS, Fienberg SE, Louis TA, Normand S-LT, Stukel TA, Utts J. Statistical issues in assessing hospital performance; 2012. Available from: https://www.hhs.gov/guidance/document/statistical-issues-assessing-hospital-performance. Accessed February 17, 2023.
14. Lenzi J, Pildava S. Tips for calculating and displaying risk-standardized hospital outcomes in Stata. *Stata J*. 2019;19(2):477–496. doi:10.1177/1536867X19854021
15. Andersen JS, De Fine Olivarius N, Krasnik A. The Danish national health service register. *Scand J Public Health*. 2011;39(7 Suppl):34–37. doi:10.1177/1403494810394718
16. Kjaersgaard MIS, Vedsted P, Parner ET, et al. Algorithm linking patients and general practices in Denmark using the Danish national health service register. *Clin Epidemiol*. 2016;8:273–283. doi:10.2147/CLEP.S108307
17. Schmidt M, Pedersen L, Sørensen HT. The Danish civil registration system as a tool in epidemiology. *Eur J Epidemiol*. 2014;29(8):541–549. doi:10.1007/s10654-014-9930-3
18. Kildemoes HW, Sørensen HT, Hallas J. The Danish national prescription registry. *Scand J Public Health*. 2011;39(7 suppl):38–41. doi:10.1177/1403494810394717
19. Schmidt M, Schmidt SAJ, Sandegaard JL, Ehrenstein V, Pedersen L, Sørensen HT. The Danish National Patient Registry: a review of content, data quality, and research potential. *Clin Epidemiol*. 2015;7:449–490. doi:10.2147/CLEP.S91125
20. Helweg-Larsen K. The Danish register of causes of death. *Scand J Public Health*. 2011;39(7 Suppl):26–29. doi:10.1177/1403494811399958
21. Statistics Denmark. Data for Research. Available from: https://www.dst.dk/en/TilSalg/Forskningsservice. Accessed February 17, 2023.
22. United Nations' Educational, Scientific and Cultural Organization (UNESCO). International standard classification of education. Available from: https://www.uis.unesco.org. Accessed February 17, 2023.
23. Jensen VM, Rasmussen AW. Danish Education Registers. *Scand J Public Health*. 2011;39(7 Suppl):91–94. doi:10.1177/1403494810394715
24. Prior A, Fenger-Grøn M, Larsen KK, et al. The association between perceived stress and mortality among people with multimorbidity: a prospective population-based cohort study. *Am J Epidemiol*. 2016;184(3):199–210. doi:10.1093/aje/kwv324
25. The Provider Registry (*Yderregisteret*) (in Danish). The Danish health data agency. Available from: https://sundhedsdatastyrelsen.dk/da/registre-og-services/om-de-nationale-sundhedsregistre/personoplysninger-og-sundhedsfaglig-beskaeftigelse/yderregisteret. Accessed February 17, 2023.
26. Williams RL. A note on robust variance estimation for cluster-correlated data. *Biometrics*. 2000;56(2):645–646. doi:10.1111/j.0006-341X.2000.00645.x
27. Gutierrez RG, Carter S, Drukker DM. On boundary-value likelihood-ratio tests. *Stata Technical Bulletin*. 2001;60:15–18.
28. Fenger-Grøn M, Kjaersgaard MIS, Parner ET, Guldin M-B, Vedsted P, Vestergaard M. Early treatment with talk therapy or antidepressants in severely bereaved people and risk of suicidal behavior and psychiatric illness: an instrumental variable analysis. *Clin Epidemiol*. 2018;10:1013–1026. doi:10.2147/CLEP.S157996

29. Ribe AR, Christensen LD, Vestergaard CH, et al. Potentially inappropriate medications (PIMs): frequency and extent of GP-related variation in PIMs: a register-based cohort study. *BMJ Open*. 2021;11:7. doi:10.1136/bmjopen-2020-046756
30. Hashmi R, Alam K, Gow J, March S. Prevalence of mental disorders by socioeconomic status in Australia: a cross-sectional epidemiological study. *Am J Health Promot*. 2021;35(4):533–542. doi:10.1177/0890117120968656
31. Mercuri M, Gafni A. Medical practice variations: what the literature tells us (or does not) about what are warranted and unwarranted variations. *J Eval Clin Pract*. 2011;17(4):671–677. doi:10.1111/j.1365-2753.2011.01689.x