








Agreement between survey- and register-based measures of depression in Denmark

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Abstract

Background: Register-based studies of major depressive disorder (MDD) do not capture all prevalent cases, as untreated cases and diagnoses made by general practitioners are not recorded in the registers. We examined the prevalence and agreement of survey- and register-based measures of depression, and explored sociodemographic and health-related factors that may have influenced this agreement.

Methods: All 32,407 participants in the 2017 Central Denmark Region *How are you?* survey were linked to hospital and prescription records. A checklist for depressive symptoms within the last 14 days (Major Depression Inventory; MDI) from the survey was compared with register-based assessment of hospital-diagnosed MDD and/or prescriptions for antidepressants. We estimated agreement between survey-based and register-based measures for depression and used logistic regression models to explore selected associated factors.

Results: In total, 5.9% of *How are you?* survey participants screened positive for current depression on the MDI. Of these, 51.3% (95% confidence interval (CI): 49.0–53.6) filled a prescription for an antidepressant medication during the 10 years prior or 2 years following the administration of the survey, and

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14.5% (95% CI: 12.9–16.2) were treated for MDD in a psychiatric hospital-based setting. When using a higher threshold of the MDI indicating more severe current depression, 22.8% (95% CI: 19.6–26.1) of those who screened positive also received an MDD diagnosis and 63.4% (95% CI: 59.7–67.2) were prescribed antidepressants during this 12-year period. Among those with current depression, female sex, older age, chronic diseases, hospital-treated self-harm, and being permanently outside the workforce were associated with having a register-based MDD diagnosis or antidepressant prescription. Among those with a register-based depression record, female sex, younger age, hospital-treated self-harm, stress, and severe loneliness were associated with current depression.

Conclusion: We found that as few as 15% of individuals with current depression in the general Danish population were captured by the psychiatric hospital register, while 51% of these individuals were identifiable in the prescription register. These findings demonstrate that register-based measures significantly underestimate the true prevalence of depression by identifying only the cases that are most severe.

KEYWORDS

concordance, diagnosis, epidemiology, major depressive disorder, register-based research

1 | INTRODUCTION

Major depressive disorder (MDD) is a common mental disorder associated with substantial morbidity and premature mortality worldwide.^{1,2} Globally, MDD is the fifth leading cause of years lived with disability.¹ The use of administrative health registers to study mental disorders has proved to be valuable—register data are collected prospectively over many years, and often cover the entire population, thus reducing selection bias. Register-based studies have elucidated risk factors and consequences of MDD, for example, extensive comorbidity between MDD and other mental and somatic disorders,^{3,4} the healthcare costs and income loss associated with MDD^{5,6} and its premature mortality.^{7,8}

In addition, register-based studies have been valuable sources of information on the treated incidence and prevalence of MDD, which can guide resource allocation for public health research and clinical resources. Pedersen et al. found that the lifetime risk of MDD treated at hospitals (i.e., inpatients, outpatient, accident, and emergency departments) in Denmark was 16% in women and 9% in men.⁹ However, in Denmark and many other countries, a large proportion of MDD cases are treated solely within primary care, and thus may not appear in register-based studies based on hospital registers. Since reasons for contact and diagnoses are not available from Danish primary care and therapists, including private psychiatrists, other

data sources are needed to identify depression cases treated outside the hospital setting. A study based on Danish registers found that the incidence rate of MDD estimated through the use of antidepressants prescribed for depression and redeemed at community pharmacies were six times higher compared with the incidence of MDD treated in hospital settings (8.8 [95% confidence interval (CI): 8.7–8.9] vs. 1.3 [95% CI: 1.3–1.4] per 1000 person-years, respectively).¹⁰ Additionally, this study reported that 85%–90% of the first identification of MDD was detected via prescription registers, indicating that studies based on MDD solely treated in hospitals underestimate the incidence and prevalence of depression in the Danish population.

Register-based studies including both visits to secondary care and antidepressant prescriptions are likely to provide a more comprehensive sample of MDD cases. However, these types of studies are also prone to misclassification of disease status as they still are restricted to the help-seeking population and often the more severe cases. In contrast, population-based surveys can assess the disease status in the total population by contacting individuals regardless of service use. For example, the multinational World Mental Health Survey found the lifetime prevalence of major depression measured by diagnostic interviews to be 12.8% (95% CI: 12.2–13.4), while the 12-month prevalence was 3.9% (95% CI: 3.6–4.2).¹¹ In Denmark, 13.2% of Danes reported a current episode of MDD or lasting consequences of the disorder

in the latest Danish National Health Survey.¹² Each of these data sources (registers and surveys) has strengths and limitations for use in psychiatric epidemiology.¹³ While surveys can provide more details about case status, such studies are costly and time-consuming, and often experience difficulties in recruiting participants resulting in low participation rates and potential selection bias.^{14–16}

The combination of data from both surveys and registers can provide valuable information in settings in which such a combination is possible. In the Nordic countries, individuals have a unique identification number, and in many instances, individual-level data from surveys can be complemented with administrative information. Such linkage allows for exploring the agreement between survey-based and register-based measures of depression, which is typically low. For example, a Danish study found that only 4.3% (95% CI: 1.2–10.7) of males and 11.5% (95% CI: 6.1–19.3) of females who screened positive on a survey instrument of depression also had an in- or outpatient contact of MDD in the previous and following 2 years of the survey.¹⁷ However, this study only included adults aged 40 and 50 years, and therefore did not capture early- or late-onset depression. Hence, there is a need to understand the extent to which the various registers capture individuals with depression in a more representative, population-based sample.

In Denmark, the *How are you?* survey (original Danish title *Hvordan har du det?* and also referred to as the Danish National Health Survey¹⁸) is a population-based survey describing trends in health and morbidity, in which the respondents can be linked to administrative registers. The self-reported data in the survey provide accurate estimates of individuals with certain chronic diseases (e.g., diabetes and cancer); however, sensitivity varied between diseases.¹⁹ The present study uses information from the 2017 Central Denmark Region *How are you?* survey to (1) estimate the prevalence of depression according to survey and register-based measures of depression, (2) investigate the agreement between survey-based and register-based measures of depression, and (3) explore whether selected sociodemographic and health-related factors are associated with the agreement between these different measures of depression.

2 | MATERIALS AND METHODS

Data were drawn from the 2017 *How are you?* survey from the Central Denmark Region, which is one of the five Danish regions and includes approximately 23% of the 5.7 million inhabitants in Denmark in 2017. Every person in Denmark is registered in the Civil Registration System (CRS)²⁰ with a unique identification number that allows a complete and continuous identification of the

Significant outcomes

- Among individuals who screened positive for current depression based on the self-reported MDI, 51% had an antidepressant prescription and 15% had a hospital based MDD diagnosis during the 10 years prior and 2 years following the survey.
- Among those who screened positive on the MDI, female sex, older age, chronic diseases, hospital-treated self-harm, and being permanently outside the workforce were associated with having greater odds of having a register-based MDD diagnosis or antidepressant prescription.
- Among those with a register-based record of depression, female sex, younger age, hospital-treated self-harm, severe loneliness, and stress were associated with greater odds of being screen positive on the MDI.

Limitations

- The survey instrument measures depression within the last 14 days, while the hospital and prescription registers capture depression cases in a 12-year period.
- Those treated in primary care are not recorded in the registers if the general practitioner does not prescribe antidepressants.

Danish population. A stratified random sample of 52,000 individuals aged 16 years or older who on 10th January 2017 were residing in the Central Denmark Region was drawn from the CRS and invited to participate in the survey in February 2017. In total, 32,417 agreed to participate, but 10 individuals answered only questions about their sex and date of birth and were excluded from our study population. The final sample was thus 32,407 participants (participation rate 62.3%).¹⁸ The survey included weights constructed by Statistics Denmark to correct for differences in participation probabilities because of survey design and non-response. These weights were estimated using a model-based calibration approach²¹ and are based on socio-demographic characteristics, income, social benefits, and healthcare utilization. Previous studies have shown that these sampling weights lead to minor differences between participants and non-participants in relation to primary health care use²² and previous diagnosis of mental disorders.²³

2.1 | Measures of depression

2.1.1 | Survey-based measure of depression

The 2017 Central Denmark Region *How are you?* survey included the Major Depression Inventory (MDI). The MDI is a widely used self-rating scale for depression, and has been shown to have high sensitivity and specificity, compared with the Schedule for Clinical Assessment in Neuropsychiatry.²⁴ The MDI consists of 10 items assessing the frequency of depressive symptoms during the past 2 weeks.^{24,25} Thus, the MDI represents those with a current episode of MDD. Three questions reflect the core symptoms of MDD, while the remaining questions reflect associated symptoms. The questions were rated on a six-point scale ranging from “At no time” to “All the time”. Following the International Classification of Diseases, 10th version (ICD-10) diagnostic criteria,²⁴ those with at least two core symptoms and two associated symptoms were considered to screen positive for depression. For the purposes of this manuscript, we will refer to those who score positive on at least two core symptoms and two associated symptoms as “screen positive” for depression, although a clinical diagnosis needs to be confirmed with a diagnostic interview. The MDI can also categorize cases into mild, moderate, or severe depression.

2.1.2 | Register-based measures of depression

Through the unique personal identification number from the CRS, we obtained register-based information for all survey respondents from the Danish Psychiatric Central Research Register²⁶ and the Danish National Prescription Register²⁷ for the period February 2007 to December 2018 (i.e., from 10 years prior to the survey until 1 year and 11 months after the first invitation to the survey). We were unable to examine register-based diagnoses/prescriptions more than 2 years after the administration of the survey because the versions of the registers used in this study were only complete through December 2018. The Danish Psychiatric Central Research Register contains individual-level information on primary and secondary diagnoses, date of contact, and type of contact (inpatient, outpatient, or emergency room visit) for the entire period used in this study. Diagnoses of MDD were retrieved based on ICD-10 codes F32-F33 registered as a main or secondary diagnosis at a psychiatric hospital contact.

We retrieved data on any filled prescription of antidepressants identified by the Anatomic Therapeutic Chemical (ATC) classification system code N06A in the Danish National Prescription Register. The register

includes ATC codes, dispensation dates, and treatment indications for all prescriptions dispensed in community pharmacies in the study period. An indication is required when issuing an electronic prescription and the prescriber (any doctor in general practice or at hospital) may select an indication code from a drop-down menu, or they can include the indication as free text, in which case no code is recorded. Antidepressants can be prescribed for depression, but also for other conditions (e.g., anxiety, obsessive compulsive disorder, and pain). In this study, only prescriptions with “depression” as indication code were included (62% of all antidepressant prescriptions).

In keeping with prior publications,^{9,28} the minimum possible age for antidepressant prescription and a diagnosis of MDD was set to 10 years.

2.1.3 | Other demographic and depression-related variables

Date of birth and sex were retrieved from the CRS. Educational attainment was classified according to the framework of the International Standard Classification of Education (primary/early childhood, secondary, above secondary) and was obtained from Statistics Denmark, as were income (quintiles) and employment status (employed, permanently outside the workforce, temporarily outside the workforce). These variables were measured in 2016, i.e., the year prior to the survey. In respondents <25 years, we used the highest level of parental education, income, and employment status in 2016 as indicators of socioeconomic status. Hospital-treated self-harm was identified in the Central Psychiatric Research Register and Danish National Patient Register²⁹ using an algorithm from Nordentoft et al.³⁰ which uses information on suicide attempts, poisoning, psychiatric disorders and deliberate self-harm (Supplementary Material, p.2). Information on perceived stress, chronic diseases, loneliness, health-related quality of life, and smoking was obtained from the 2017 Central Denmark Region *How are you?* survey. Perceived stress was assessed by the Perceived Stress Scale in which stress relies upon the person's perception of the stressor as stressful or not.³¹ The 10 items ask how often in the past month life was appraised as unpredictable, uncontrollable, and overloaded and were scored from “Never” to “Very Often”. Persons scoring in the highest decile were considered to have high levels of perceived stress. Chronic diseases were measured by an affirmative answer to the question “Do you have any chronic diseases, long term impact of an accident, disability or disease? Long term is longer than six months”. Loneliness (no, moderate, severe) was measured using the Three-Item Loneliness Scale consisting of three questions rated on a 3-point scale (“Hardly ever”, “Sometimes”, “Often”).³²

Health-related quality of life was measured by the Short-Form 12-item (SF-12), which consists of eight domains (general health, psychical functioning, social functioning, role psychical, role emotional, mental health vitality and bodily pain) summarized into two scores assessing physical and mental health.³³ Anyone answering “Yes” to the question “Do you smoke? Not including e-cigarettes” was classified as a current smoker.

2.1.4 | Statistical analysis

Statistical analyses were carried out in R Studio using R 4.1.3.³⁴ Prevalence of depression was estimated for each of the three measures (MDI, prescriptions, and MDD diagnosis) for three age groups (16–34, 35–54, 55+ years), sex and educational level and, if an individual was ascertained to be a case by more than one measure, cases were placed in the most severe category (in descending order of severity: Diagnosis of depression, prescription of antidepressants, or MDI). Agreement between the survey-based measure and the register-based measures was calculated as (i) the percentage of individuals who screened positive on the MDI who also had a MDD diagnosis or antidepressant prescription, and (ii) the percentage of individuals who screened negative on the MDI and had no MDD diagnosis or antidepressant prescription. This analysis was repeated with increasing thresholds for current depression according to the MDI (moderate and severe depression).

Factors predicting agreement were investigated using logistic regression models in two phases. First, we examined predictors of having a register-based record of depression (either an MDD diagnosis or an antidepressant prescription) within the 10 years prior or 2 years following after the survey among individuals who screened positive for current depression. Second, we examined predictors for current depression at the time of the survey among individuals with a register-based record of depression 10 years prior or 2 years after the survey. We used logistic regression univariate models to study each predictor separately and multivariate models adjusting for all other predictors. Results are presented as odds ratios (OR) with corresponding 95% confidence interval (CI). All analyses were adjusted for survey design and non-response by using the sampling weights provided by Statistics Denmark.

2.1.5 | Missing values

Missing values were imputed either as the mean of non-missing values or using multivariate imputation by

chained equations following previous publications.^{35–37} Specific details are available in the supplement.

2.1.6 | Secondary analysis

We performed a secondary analysis examining only those with register-based records of depression (MDD diagnosis or antidepressant prescription) occurring between 6 months prior to and 6 months after the first invitation to the survey (2nd August 2016 to 27th July 2017). The secondary analyses included the proportion of overlap between survey-based and register-based measures as well as univariate and multivariate logistic models. In addition, a complete case analysis of the logistic regression was performed.

3 | RESULTS

The characteristics of the survey participants are presented in Table 1. Among the 30,186 respondents that had a valid MDI score, 5.9% screened positive for current depression on the MDI. The 12-year period prevalence for antidepressant prescription was 16.0%, while 2.9% had an MDD diagnosis in the hospital register during the same period.

Prevalence estimates for the survey and register-based measures of depression by sex, age group and educational level are shown in Figure 1 and Table S1. Across all measures, depression was more common in women relative to men, and in those with primary education relative to those with secondary education or above. Although MDD diagnosis and current depression were more common among younger individuals (ages 16–34), antidepressant prescriptions were less common in this group.

Figure 2 shows the overlap among the three separate measures of depression. Among individuals who screened positive for current depression on the MDI, 51.3% (95% CI: 49.0–53.6) also filled an antidepressant prescription during the 10 years prior or 2 years following the administration of the survey, and only 14.5% (95% CI: 12.9–16.2) received an MDD diagnosis in a psychiatric hospital-based setting. Among individuals with an MDD diagnosis during the 12-year study period, 91.9% also filled an antidepressant prescription in the same time-frame, and almost a third (30.3%) met the criteria for current depression at the time of the survey. In contrast, only 16.5% of individuals with an antidepressant prescription had an MDD diagnosis, while 19.1% met the criteria for current depression.

Table 2 compares the proportion of individuals with current depression who also had register-based measures

TABLE 1 Characteristics of respondents to the 2017 Central Denmark Region *How are you?* survey included in this study (n = 32,407). Estimates were weighted according to sampling weights provided by Statistics Denmark.

	Frequency	Crude estimate	Weighted estimate
Females	17,307	53.4%	50.2%
Males	15,100	46.6%	49.8%
Age			
16–34	7185	22.2%	30.1%
35–54	10,525	32.5%	32.3%
55+	14,697	45.4%	37.6%
Major Depression Inventory	30,186	93.1%	91.9%
Mild depression	478	1.6%	1.7%
Moderate depression	535	1.8%	2.1%
Severe depression	539	1.8%	2.1%
Depression diagnosis	796	2.5%	2.9%
Antidepressant prescription	5075	15.7%	16.0%
Self-harm	137	0.4%	0.5%
Loneliness	29,829	92.0%	90.8%
Mean (SD)		3.9 (1.4)	4.1 (1.5)
Chronic diseases	30,101	93.0%	92.0%
Present	10,922	36.3%	34.9%
Perceived stress score	31,023	95.7%	95.0%
Mean (SD)		11.8 (7.1)	12.2 (7.23)
SF-12 mental health, mean (SD)		49.9 (9.18)	49.4 (9.36)
SF-12 physical health, mean (SD)		49.9 (9.42)	49.9 (9.52)
Education	31,865	98.3%	96.8%
Primary/early childhood	6608	20.7%	22.2%
Secondary	14,351	45.0%	42.7%
Above secondary	10,906	34.2%	35.1%
Job status	32,308	99.7%	99.2%
Employed	20,358	63.0%	63.5%
Temporarily outside workforce	474	1.5%	1.8%
Permanently outside workforce	11,476	35.5%	34.7%
Income	32,130	99.0%	98.0%
Median (IQR)		258,132 (134,755)	248,617 (138,446)
Smoking	30,761	94.9%	94.0%
Current smoker	5940	19.3%	20.9%

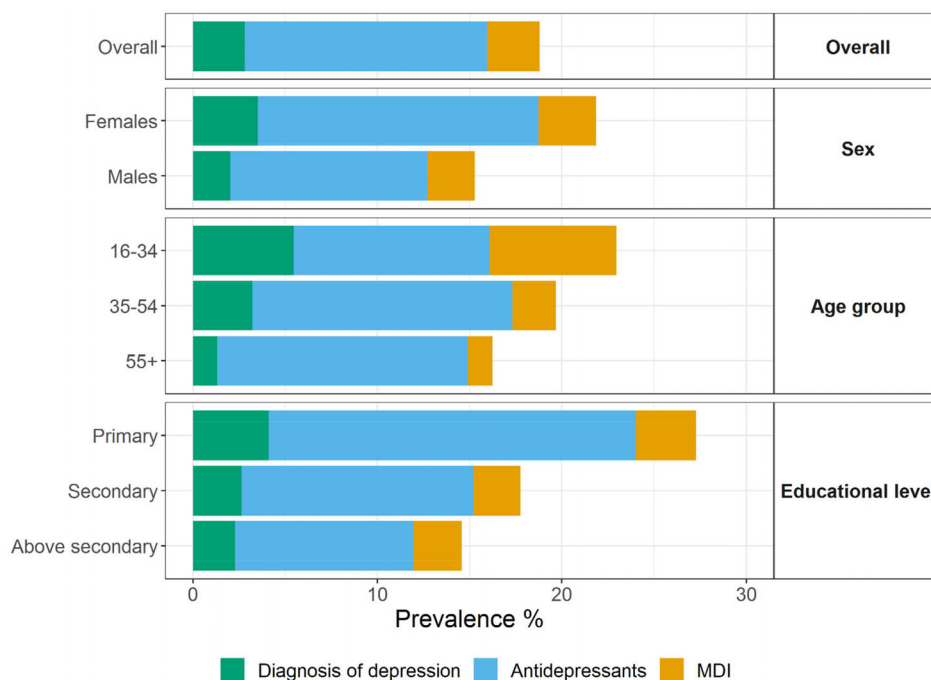
Abbreviations: IQR, interquartile range; SD, standard deviation.

of depression stratified by severity. When using a higher threshold of the MDI indicating more severe current depression, 22.8% (95% CI: 19.6–26.1) of those who screened positive also received an MDD diagnosis and 63.4% (95% CI: 59.7–67.2) filled an antidepressant prescription. In contrast, only around 2% of individuals who scored negative for current depression had an MDD diagnosis during the study timeframe, while 14%–15% of

those who scored negative had a history of antidepressant prescriptions.

Logistic regression models were used to estimate the associations between various sociodemographic and health-related factors and having a register-based depression record among those with current depression, or current depression among those with a register-based record of depression (Table 3). In those with an MDD diagnosis

FIGURE 1 The point prevalence of current depression and 12-year prevalence of major depressive disorder diagnosis and antidepressant prescriptions by sex, age group and educational level. Cases identified by more than one measure were placed in the most severe category (in descending order of severity: diagnosis of depression, prescription of antidepressants, or Major Depression Inventory [MDI]). Percentages are estimated using sampling weights provided by Statistics Denmark. Point estimates and confidence intervals are available in Table S1.



or antidepressants prescriptions, an association between lower odds of screening positive on the MDI was observed for males, those older than 35 years, and those with better mental health in the fully adjusted model. Those with a history of self-harm, severe levels of loneliness, and high levels of perceived stress were more likely to screen positive on the MDI.

In those who screened positive for current depression on the MDI, male sex and having better mental health were associated with a lower likelihood of having a depression diagnosis or filling a prescription for antidepressants. In contrast, people who had a history of hospital-treated self-harm, a chronic disease, were older than 35 years, or were permanently outside the workforce were more likely to have an MDD diagnosis or antidepressants prescription.

3.1 | Secondary analysis

The prevalence of depression according to the survey-based measure and the two register-based measures within the 6 months before and after the survey is shown in Figure S1 and Table S1. Current depression was the most common of the three measures, particularly among individuals aged 16–34, followed closely by antidepressant prescriptions (Figure S2). Hospital-based diagnosis was rare. Among those who screened positive for current depression, 3.8% also received a hospital-based diagnosis (8.0% for severe cases), and 24.7% also filled an antidepressant prescription (32.5% of severe cases), during the

6 months before and after the survey (Table S2). Because of the low number of cases, the results of the logistic regression investigating sociodemographic and health-related factors' association with the agreement could not be reported.

Results from complete case logistic regression analyses showed similar results to the logistic regression analyses based on multiple imputation.

4 | DISCUSSION

In this study, we examined the overlap between two register-based and one survey-based measure of depression in the Danish population. While many individuals could only be identified in one of the three measures, there were some overlap between the MDI and the register-based measures. Of the 6% of the surveyed population that screened positive for current depression on the MDI, around half also filled an antidepressant prescription for depression during the 10 years prior and 2 years following the survey, and 14.5% were diagnosed with MDD in a hospital-based setting during that 12-year timeframe. Among those with current depression, females, older individuals, those with chronic diseases and those permanently outside the workforce were more likely to have a register-based diagnosis/prescription. Among those with a register-based diagnosis/prescription, females, younger individuals, those with a history of hospital-treated self-harm, those who reported severe loneliness or stress were likely to screen positive for current depression on the survey.

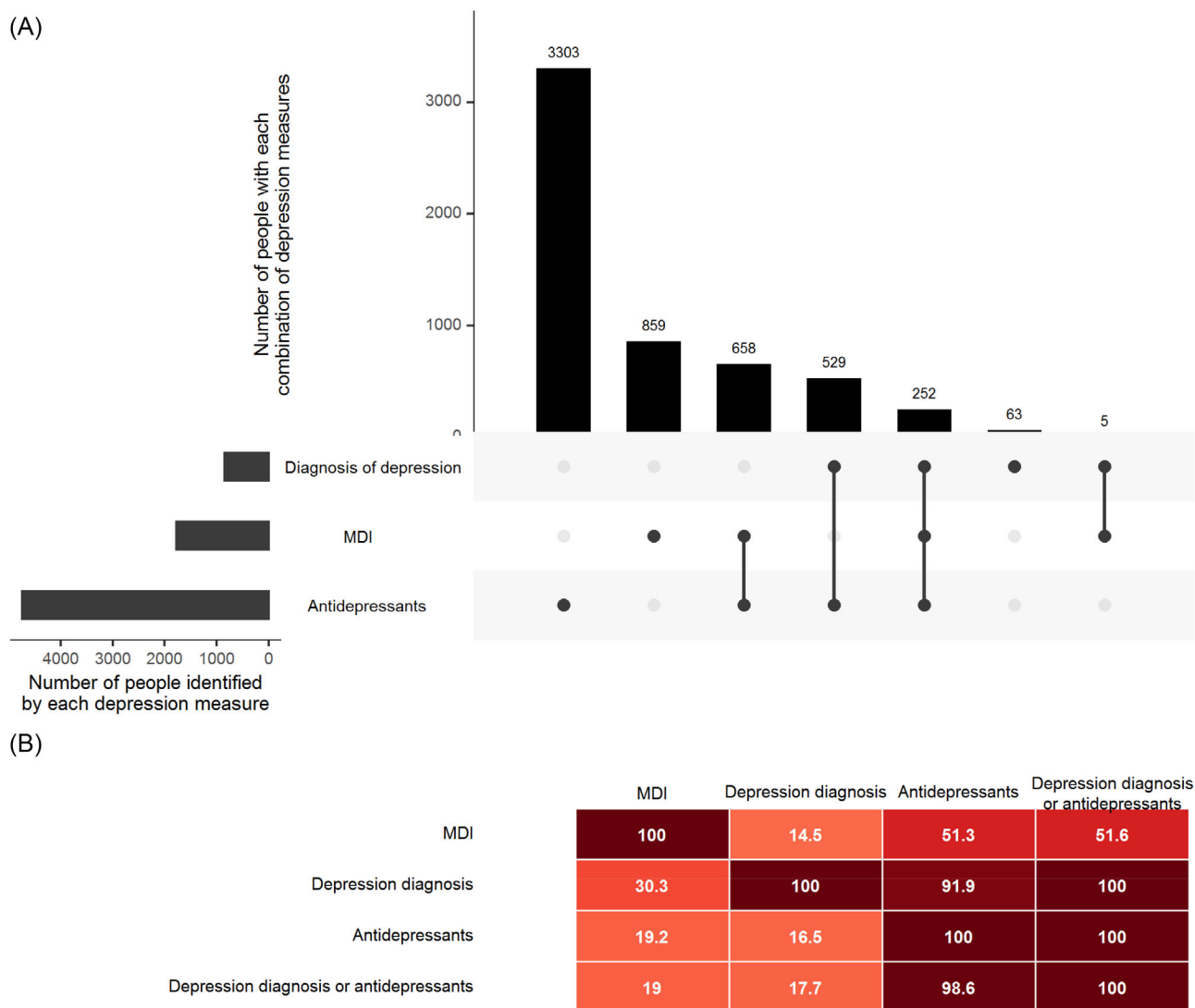


FIGURE 2 (A) Combinations of depression measures; number of people identified by each measure (horizontal bars); and number of people in independent combinations of measures (vertical bars). (B) Conditional probability of being a case in one depression measure given being a case in the other depression measure: given that one individual is identified in the measure on the y-axis, what is the probability of being identified in the measure on the x-axis. For example, the figure illustrates that 19.2% of those who had filled a prescription for antidepressants also screened positive on the MDI. Counts and percentages are estimated using sampling weights provided by Statistics Denmark.

TABLE 2 Agreement between survey- and register-based measures of depression by severity of major depressive episode measured by Major Depression Inventory (MDI).

Outcome	Severity of current depression as measured by the MDI	Percentage of individuals with current depression who also had a register-based record	Percentage of individuals without current depression who did not have a register-based record
Depression diagnosis	All	14.5 (12.9–16.2)	97.9 (97.7–98.0)
	Moderate or severe	16.8 (14.7–18.9)	97.8 (97.6–97.9)
	Severe	22.8 (19.6–26.1)	97.6 (97.4–97.8)
Antidepressants	All	51.3 (49.0–53.6)	86.3 (85.9–86.7)
	Moderate or severe	56.9 (54.2–59.7)	85.9 (85.5–86.3)
	Severe	63.4 (59.7–67.2)	85.1 (84.7–85.5)
Either depression diagnosis or antidepressants	All	51.6 (49.3–53.9)	86.1 (85.7–86.5)
	Moderate or severe	57.2 (54.5–60.0)	85.6 (85.2–86.1)
	Severe	63.8 (60.1–67.5)	84.9 (84.5–85.3)

TABLE 3 Odds ratios (OR) and 95% confidence intervals (CI) to assess sociodemographic and health-related factors associated with agreement between current depression measured in the survey (Major Depression Inventory; MDI) and in the registers (depression diagnosis and/or antidepressant prescription). In models with MDI as outcome, analyses were restricted to those who had a depression diagnosis or antidepressant prescription. In models with diagnosis/prescription as outcome, analyses were restricted to those who screened positive in the MDI. Both crude and adjusted estimates were weighted using sampling weights provided by Statistics Denmark, and all factors were included in the models simultaneously for the adjusted estimates.

Covariate	MDI as outcome		Diagnosis/prescription as outcome	
	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
Sex				
Male	0.80 (0.66–0.97)	0.75 (0.58–0.98)	0.71 (0.56–0.91)	0.60 (0.45–0.79)
Age group				
35–55	0.62 (0.49–0.77)	0.68 (0.49–0.93)	2.11 (1.59–2.80)	2.02 (1.46–2.80)
55+	0.42 (0.33–0.52)	0.60 (0.42–0.85)	2.23 (1.68–2.97)	1.56 (1.06–2.28)
Self-harm	3.65 (2.26–5.88)	1.96 (1.07–3.59)	3.84 (1.55–9.49)	2.98 (1.22–7.31)
Loneliness				
Moderate	3.36 (2.61–4.33)	1.22 (0.89–1.67)	1.14 (0.82–1.58)	1.22 (0.86–1.74)
Severe	11.02 (8.52–14.26)	1.84 (1.28–2.63)	1.50 (1.10–2.06)	1.17 (0.82–1.66)
Chronic diseases	2.14 (1.75–2.62)	0.93 (0.68–1.26)	2.91 (2.27–3.74)	2.20 (1.62–2.99)
Perceived stress	18.16 (14.14–23.31)	2.91 (2.13–3.97)	1.85 (1.36–2.51)	1.03 (0.71–1.49)
SF-12 Mental health	0.83 (0.81–0.84)	0.83 (0.81–0.85)	0.92 (0.91–0.94)	0.93 (0.91–0.95)
SF-12 Physical health	0.93 (0.93–0.94)	1.03 (1.01–1.05)	0.96 (0.95–0.97)	1.03 (1.01–1.05)
Educational level				
Middle	0.77 (0.62–0.95)	0.91 (0.68–1.22)	0.63 (0.46–0.84)	0.92 (0.66–1.28)
High	0.74 (0.58–0.95)	0.97 (0.67–1.42)	0.46 (0.33–0.64)	0.83 (0.57–1.22)
Labor market affiliation				
Temporary out of workforce	2.12 (1.29–3.49)	1.34 (0.72–2.50)	1.55 (0.84–2.85)	1.04 (0.52–2.07)
Permanent out of workforce	1.42 (1.18–1.71)	0.87 (0.63–1.20)	3.33 (2.59–4.27)	2.27 (1.63–3.16)
Income quintile				
2	0.57 (0.45–0.72)	0.74 (0.53–1.02)	0.71 (0.51–0.99)	0.70 (0.48–1.01)
3	0.53 (0.40–0.70)	0.98 (0.66–1.45)	0.47 (0.33–0.68)	0.69 (0.45–1.05)
4	0.58 (0.44–0.76)	0.87 (0.59–1.28)	0.50 (0.35–0.71)	0.83 (0.55–1.25)
5	0.54 (0.40–0.72)	1.06 (0.68–1.63)	0.49 (0.34–0.73)	0.91 (0.57–1.44)
Current smoker	1.55 (1.28–1.87)	1.02 (0.79–1.32)	1.19 (0.93–1.52)	1.02 (0.78–1.34)

These results from a population-representative survey are broadly consistent with findings from prior studies that used more selected samples. For example, in a Danish study of 40- and 50-year old individuals who screened positive for depression, 4.3% of males and 11.5% of females were diagnosed with MDD in an inpatient or outpatient hospital setting during a 5-year period, while 44.1% of males and 54.8% of females filled prescriptions for antidepressants during that same period.¹⁷ Likewise, in a Norwegian study of 2272 twins, among depression cases identified in diagnostic interviews, only 15% received specialist care and 36% primary care for the depression in the 3 years preceding the interviews.³⁸

These low levels of overlap reflect how treatment for depression is organized in the national health care sectors. In Denmark, the presence of depressive symptoms may not indicate a need for medical care, and national guidelines for treatment of the disorder do not recommend routine drug treatment for persons with mild depression.³⁹ Our study found that a higher proportion of those with more depressive symptoms appeared in one of the two registers, compared with those with fewer symptoms – suggesting that people with more severe types of depression are more likely to receive medical care and/or referrals to specialist care. This finding supports the work of another study in this area linking

treatment with severity of MDD.⁴⁰ Consequently, these findings confirm that using hospital and prescription registers to identify depression cases underestimates the prevalence of the disorder and consequently, results from these studies may be biased toward more severe depression cases. Thus, in countries where primary healthcare data is available, studies using this data are needed, as primary healthcare is often a low threshold health service offered to individuals with depression.

We found that women were more likely than men to be identified as depression cases in both the health registers and in the survey. This could be because of the higher prevalence of depression in women found in this and other studies^{9,11,12,41} and more help-seeking behavior in women.^{40,42,43} Persons with high levels of perceived stress, hospital-treated self-harm, lower levels of mental health on the SF-12, or chronic diseases, which could indicate a more severe disorder, were also more likely to be identified in both the MDI and the register-based measures of depression. These findings suggest that underlying differences in prevalence, disorder severity, and help-seeking behavior could explain the differential agreement between the health-related and sociodemographic factors.

A strength of the study was the representative sample of the population in the Central Denmark Region, and the unique identifier that allowed for individual-level linkage between the survey and the hospital and prescription registers. We also considered delayed entry into treatment by identifying register-based outcomes both before and after the survey. Additionally, both the MDI and the hospital diagnosis were based on ICD-10 criteria. Overall, the respondents were similar to the eligible population in terms of a diagnosis of any mental disorder.²³ However, men aged 35–54 and both sexes older than 55 years with a history of mood disorders were slightly underrepresented among the respondents.²³ Another limitation is that the use of antidepressant prescription as a proxy for depression cases in non-hospital settings does not consider individuals treated solely by psychotherapy, thus underestimating the number of cases treated in primary care and by clinical psychologists. Additionally, indication codes were unavailable in 25% of all antidepressant prescriptions in the study period, which could underestimate the number of cases using antidepressants. Furthermore, the MDI considers depressive symptoms within the last 14-days while the register-based measures capture depression over a 12-year period. This means that successfully treated individuals who recover might not screen positive on the MDI, which would result in lower specificity. Finally, the MDI can identify people who might have a depression episode, but a clinical interview is needed to confirm the diagnosis.

To conclude, our findings support the conclusion that survey- and register-based measures are identifying different

groups of people with depression in the Danish population. The hospital and prescription registers mainly capture help-seeking persons with more severe depression, while the MDI captures any level of self-reported depressive symptoms in the population. Given the low agreement between the measures, depression-related studies that rely solely on registers should be interpreted cautiously. Future studies should quantify the direction and size of this bias in relation to, for example, mortality and risk of other disorders. This bias should be taken into account when developing new policies and guidelines for depression.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

PEER REVIEW

The peer review history for this article is available at <https://www.webofscience.com/api/gateway/wos/peer-review/10.1111/acps.13555>.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Central Denmark Region, the Danish Data Protection Agency and Statistics Denmark. Restrictions apply to the availability of these data, which were used under license for this study. Data are available directly from such organisations.

ETHICS STATEMENT

The study was approved by the Danish Data Protection Agency, and data access was approved by Statistics Denmark and the Danish Health Data Authority. The survey was reported to the Register of Research Projects of the Central Denmark Region (record number 1 16 02 593 16). Information about the survey was provided to potential participants in writing and via the web. All survey participants were informed that their survey data would be linked to the registers, and the respondents' voluntary fully or partially completion of the survey constituted implied consent. Linkage between survey data and register data was carried out by Statistics Denmark.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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