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## Higher levels of mental wellbeing predict lower risk of common mental disorders in the Danish general population

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### ABSTRACT

**Background:** Few studies have investigated the protective role of higher levels of wellbeing in relation to common mental disorders (CMDs). The objective of this study was to explore the protective role of mental wellbeing at baseline on CMDs during a 12–16 months follow-up period in the Danish general population.

**Methods:** Data stem from a Danish nationally-representative panel study of 6629 adults (aged 15+ years) conducted in 2019 and 2020, which was linked to Danish register data. A validated scale (SWEMWBS) was used to assess mental wellbeing, along with pre-defined cut-points for low/moderate/high mental wellbeing. Register-based outcomes were 1) onset of ICD-10 CMDs, and 2) onset or recurrence of antidepressant use. The survey-based outcome was case depression based on a screening tool (PHQ-8 score  $\geq 10$ ). Register-based analyses ( $N = 6624$ ) were conducted with Cox regression, and the survey-based analysis ( $N = 5000$ ) was conducted with logistic regression.

**Results:** Mental wellbeing was negatively associated with all outcomes, both continuously and dose-dependently. Notably, as compared to low mental wellbeing, moderate mental wellbeing was associated with a 55–68% reduction in risk for all outcomes (onset of ICD-10 CMDs; onset or recurrence of antidepressant use; onset or recurrence of case depression based on the PHQ-8), while high mental wellbeing was associated with a 69–90% reduction in the same outcomes.

**Conclusions:** Higher levels of mental wellbeing are protective against onset or recurrence of CMDs. Future studies are warranted to investigate the effectiveness of universal and targeted approaches to promote mental wellbeing and prevent CMDs.

### 1. Introduction

According to recent estimates, mental disorders affect more than 1 billion people worldwide, causing 7% of the global disease burden (measured by disability-adjusted life years abbreviated as DALYs), and

19% of years lived with disability (Rehm & Shield, 2019). In other words, mental disorders are a major issue and affect a substantial proportion of the global population. This is particularly true in high- and upper-middle income countries (Rehm & Shield, 2019). DALYs attributable to mental disorders are overwhelmingly caused by common

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mental disorders (CMDs), i.e. depression, anxiety, and stress-related disorders (Rehm & Shield, 2019; WHO, 2017). Moreover, CMDs are associated with both a marked overall excess of deaths and with premature mortality from injuries and chronic diseases (Charlson et al., 2016; Prince et al., 2007; Plana-Ripoll et al., 2019). Apart from the suffering experienced by affected individuals and their families, CMDs are costly from a societal perspective. In Europe, costs associated with mental disorders have been estimated to be more than 4% of its GDP – or over €600 billion – across the 28 EU countries (OECD/EU, 2018), with 1.6% accounted for by loss to productivity, 1.2% accounted for by money spent on social security programs, and the remainder accounted for by direct healthcare expenditure. The number of people affected by CMDs appears to increase worldwide (WHO, 2017), and in specific settings, such as Denmark (PwC, 2021). The increase in Denmark is also suggested in national studies using measures for poor mental health rather than diagnosis (Christensen et al., 2017). There is a pressing need to identify factors that can prevent the onset or recurrence of CMDs in the general population (Solmi et al., 2021; Herrman et al., 2022).

There is now a growing interest in the promotion of mental wellbeing or good mental health (Fusar-Poli et al., 2019; Fusar-Poli et al., 2020; Salazar de et al., 2020), which focuses on positive aspects of mental health and resilience (WHO, 2004). Promotion of mental wellbeing by both universal and targeted approaches has the potential to prevent CMDs (Fusar-Poli et al., 2021; Forsman et al., 2015), but universal approaches have greater potential from a wider public health perspective (as they may reach a larger proportion of people in a population). In this study, mental wellbeing is conceptualized as covering both hedonic (feeling good) and eudaimonic (functioning well) aspects, with both aspects being integral parts of the overall construct (Regan et al., 2016; Stewart-Brown, 2015).

Mental illnesses are diagnosed based on individuals feeling unwell and functioning poorly, positioning mental illness or lower levels of mental wellbeing at one end of a continuum, with higher levels of mental wellbeing at the opposite end. This is also reflected in moderate to strong negative correlations between continuous measures of CMDs and mental wellbeing (Koushede et al., 2019; Shah et al., 2021). However, since scores on mental wellbeing and symptoms of CMDs are not perfectly correlated, substantial variation exists, meaning that mental wellbeing may or may not necessarily be the inverse of CMD symptoms. For example, individuals with a low level of mental wellbeing may score high or low on symptoms of CMDs, and individuals with a high level of mental wellbeing may also score high or low on symptoms of CMDs (Huppert & Whittington, 2003). An advantage of using a mental wellbeing scale is to extend the range of measurement in the positive direction, i.e., making it possible to capture higher levels of mental wellbeing rather than simply the absence of symptoms. Further, categories for mental wellbeing have been defined, with the majority of the general population having moderate mental wellbeing, a small group having high mental wellbeing, and yet another small group having low mental wellbeing (Santini et al., 2020; Stewart-Brown et al., 2015). Given the negative correlations between mental wellbeing and symptoms of CMDs, distributions would generally reflect that most individuals currently suffering from a mental disorder (diagnosed or undetected) would have low or moderate mental wellbeing (Huppert & Whittington, 2003). Other advantages of mental wellbeing scales are that scores tend to be normally distributed, the scales are sensitive to capturing change over time, and that some studies have indicated a user preference for positively framed measures (Shah et al., 2021).

Only a few studies have investigated the protective properties of higher levels of wellbeing against mental disorders. Generally, these studies have reported that a high level of wellbeing, specifically psychological flourishing (requiring a certain combination of hedonic and eudemonic wellbeing), is inversely associated with CMDs (Doré et al., 2020; Grant et al., 2013; Schotanus-Dijkstra et al., 2016; Keyes et al., 2010). First, Keyes et al. (2010) assessed the risk for developing major depressive episode, panic and generalized anxiety disorders among

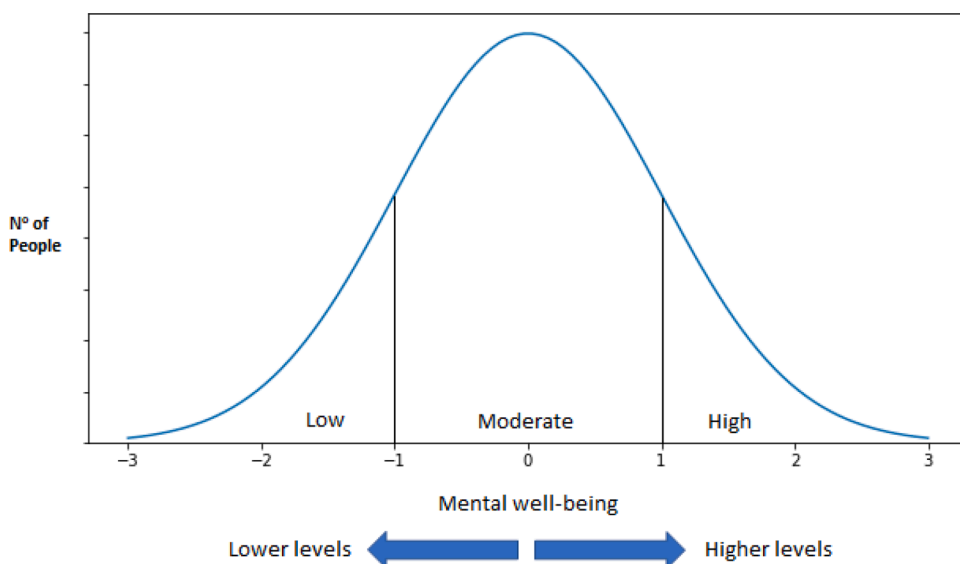
Americans in a community-based sample, and found that change in wellbeing (from flourishing to not flourishing and vice versa) was predictive of prevalence and incidence of CMDs (Keyes et al., 2010). Next, Grant et al. (2013) assessed the risk for depression symptoms among medical students, and found that low subjective wellbeing significantly predicted increased depression symptoms scores at a later time point (Grant et al., 2013). Next, Schotanus-Dijkstra et al. (2016) assessed the risk of mood, anxiety, and substance use disorders in the Dutch general population, and found that flourishing reduced the risk of mood and anxiety disorders, but did not significantly predict substance use disorders (Schotanus-Dijkstra et al., 2016). Finally, Doré et al. (2020) assessed the risk of anxiety and depression symptoms among college students, and found that those who were flourishing had a lower risk of developing anxiety and depression symptoms, as compared to those who were either not flourishing or those who were flourishing but subsequently declined to not flourishing (Doré et al., 2020). Only some of these studies were longitudinal and used large community-based samples (based on American or Dutch data) (Schotanus-Dijkstra et al., 2016; Keyes et al., 2010), with only one of them (the Dutch study) being nationally-representative (Schotanus-Dijkstra et al., 2016). To our knowledge, no such study has been conducted using longitudinal data representative of the Danish general population. Further, the clinical risk relevance of simple cut-points for continuous measures of mental wellbeing (as opposed to more complex operationalizations such as flourishing) has not been shown in prior research. In this study, we aimed to address this gap by investigating the extent to which mental wellbeing at baseline is associated with CMDs during a 12-16 months follow-up period in the Danish general population. Based on the evidence reviewed, we hypothesized that higher levels of mental wellbeing (continuously and as compared to low mental wellbeing) would be associated with lower risk for future mental disorders dose-dependently. In other words, we hypothesized a general inverse relationship, and that compared to low mental wellbeing, moderate mental wellbeing would be associated with lower risk for all CMD outcomes over the follow-up period, while high mental wellbeing would be associated with the lowest risk.

## 2. Methods

### 2.1. Sampling

The Danish Health and Wellbeing Survey (Rosendahl Jensen et al., 2021) is the Danish part of the European Health Interview Survey (EHIS). Everyone with residence in Denmark has a personal identification number which is used throughout administrative registers and stored in the Civil Registration System (Pedersen, 2011; Thygesen et al., 2011). From the Civil Registration System, 14,000 individuals aged 15 years or more were randomly selected and invited to complete a self-administered questionnaire (on paper or web-based) in 2019 (data collected between 5 September and December 31, 2019). In all, 6629 individuals (47.4%) completed the questionnaire. The total sample of 6629 individuals was used for analysis with register-based outcomes. Subsequently, all individuals from the 2019 survey, who were still alive and living in Denmark in mid-August 2020, were invited to participate in a follow-up survey (data collection between 4 September and November 8, 2020). Thus, 13,474 eligible individuals were invited to the follow-up survey in 2020. In all, 6712 individuals completed the self-administered questionnaire in 2020, out of which 5000 had also completed the questionnaire in 2019 (resulting in 75.4% participating in the follow-up survey). The sample of 5000 individuals was used for the prospective survey analysis. The study design and the data collection methods have been described in detail elsewhere (Rosendahl Jensen et al., 2021).

For the register-data analysis, survey data were linked on an individual level to registers at Statistics Denmark, which allows for the merging of data on employment status, household income, healthcare



**Fig. 1.** Conceptual figure of the mental health continuum based on a normal distribution of mental wellbeing. Note: The figure illustrates a normal distribution of mental wellbeing (x-axis) and the number of people in a population (y-axis). The x-axis represents standard deviations above and below the mean. Cut-points for SWEMWBS have been defined for three population groups in the general population, a low mental wellbeing category corresponding to the bottom 15<sup>th</sup> percentile (approximately one standard deviation away from the mean towards lower scores), a high mental wellbeing category corresponding to the top 15<sup>th</sup> percentile (approximately one standard deviation away from the mean towards higher scores), and a moderate mental wellbeing category corresponding to the 16<sup>th</sup> to 84<sup>th</sup> percentile. The cut-points for SWEMWBS (on the transformed metric score) are as follows: low mental wellbeing (7.00–19.98); moderate mental wellbeing (19.99–29.30); high mental wellbeing (29.31–35.00).

utilization, and social service use, among other variables. All data are pseudonymized, to hinder the possibility of tracing it back to specific participants. The study was approved by SDU RIO (ID 11.107). SDU RIO examines and approves all scientific and statistical projects at the University of Southern Denmark according to the Danish Data Protection Regulation. Ethical approval is not required for surveys according to Danish legislation.

## 2.2. Outcome 1: diagnosed common mental disorders

Diagnosed CMD was defined as having a CMD diagnosis: major depressive disorders (ICD-10: F32–33), phobic anxiety disorders (ICD-10: F40), other anxiety disorders (ICD-10: F41), obsessive–compulsive disorders (ICD-10: F42) and reaction to severe stress, and adjustment disorders (ICD-10: F43) (Bjørkenstam et al., 2021). CMD was categorized as present in the case of any diagnosed common mental disorder being listed in the period Jan 2020–Apr 2021. Data on diagnosed mental disorders were extracted from the National Patient Register (both somatic and psychiatric) (Lyngé et al., 2011). The data pertains to individuals that had hospital contact for health problems (secondary and tertiary facility data), and thus represent cases that may be considered relatively severe as compared to primary care treatment.

## 2.3. Outcome 2: use of antidepressant medication

The use of antidepressant medication was based on the Anatomical Therapeutic Chemical (ACT) Classification System code MN06A (antidepressants), for which patients require a prescription from a medical doctor. Antidepressants are often prescribed to patients with mood as well as anxiety disorders, and the reason for including data on medication was to be able to also identify participants who received treatment for mental disorders (for example through a primary care physician) without hospital contact (i.e. the data is based on community pharmacies). Hence, antidepressant use was considered to be a proxy that also captures milder forms of CMDs that are treated within the primary sector (which do not appear in databases that only include higher level hospital care) (Bjørkenstam et al., 2021; Schmidt et al., 2013; Nielsen et al., 2020). The use of antidepressant medication was categorized as present if the participant had at least two dispensed

prescriptions of antidepressants (indicating prolonged mental health problems) in the period Jan 2020–Dec 2020. Data on the dispensed prescription medicines were extracted from the Danish National Prescription Registry (Kildemoes et al., 2011).

## 2.4. Outcome 3: case depression based on the PHQ-8 screening tool

The eight-item Patient Health Questionnaire depression scale (PHQ-8) was developed to screen for core symptoms of depression and has been validated with satisfactory sensitivity and specificity in terms of capturing depressive disorders (Kroenke et al., 2009). The PHQ-8 was used to be able to capture (1) current depression symptoms (as opposed to diagnoses where the level of symptoms could have changed since the diagnosis was made), and (2) to be able to also capture those with depression symptoms who are not in contact with hospitals or primary care physicians. The total scale ranges from 0 to 24, with higher scores indicating more depression symptoms. The suggested cut-point is  $\geq 10$ , which indicates clinically significant depression (Kroenke et al., 2009). The outcome variable, i.e. case depression came from the 2020 survey.

## 2.5. Exposure: mental wellbeing

The Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) is a 14-item measure used to monitor mental wellbeing in the general population and is based on a conceptualization of mental wellbeing as feeling good and functioning well. This study uses the shorter 7-item version of the scale (SWEMWBS). Both Danish translations of the scales have been validated in Denmark (Koushede et al., 2019). SWEMWBS consists of 7 positively worded questions pertaining to mental wellbeing experienced within the past 14 days: (1) I've been feeling optimistic about the future, (2) I've been feeling useful, (3) I've been feeling relaxed, (4) I've been dealing with problems well, (5) I've been thinking clearly, (6) I've been feeling close to other people, and (7) I've been able to make up my own mind about things. Response options were: none of the time 1; rarely 2; some of the time 3; often 4; all of the time 5. Summing item scores leads to a score between 7 and 35; the higher the score, the higher mental wellbeing. The final scores are then commonly transformed to a metric score to enhance scaling properties (for more information, see 37). Finally, cut-points for SWEMWBS have been proposed in prior research (Santini

et al., 2020; Stewart-Brown et al., 2015) for three population groups in the Danish general population: a low mental wellbeing category corresponding to the bottom 15th percentile (approximately one standard deviation away from the mean towards lower scores), a high mental wellbeing category corresponding to the top 15th percentile (approximately one standard deviation away from the mean towards higher scores), and a moderate mental wellbeing category corresponding to the 16th to 84th percentile (see Fig. 1). This prior categorization has led to fixed cut-points for SWEMWBS (on the transformed metric score), which are utilized in the current study, as follows: low mental wellbeing 7.00–19.98 (or 7–22 without conversion to metric score); moderate mental wellbeing 19.99–29.30 (or 23–31 without conversion to metric score); high mental wellbeing 29.31–35.00 (or 32–35 without conversion to metric score). SWEMWBS was included in the EHIS survey, and in this study, we utilized as our predictors: (1) the SWEMWBS continuous variable (metric score) measured in 2019, and (2) the SWEMWBS categorical variable measured in 2019 (low as reference category).

## 2.6. Covariates

The selection of covariates was based on well-known correlates of mental wellbeing and common mental disorders, including comorbidity with other mental disorders (Plana-Ripoll et al., 2019; Santini et al., 2020; Ohayon and Schatzberg, 2003; Steel et al., 2014; Kramer, 1980). The sociodemographic variables were as follows: age; sex (female, male); country of origin (Denmark; other); marital status (never married or in a registered partnership; married or registered partnership; widowed; divorced); education (primary/10th grade; high school or vocational; tertiary education); employment status (employed or studying; unemployed or absent from work due to illness or disability; retired; other - employment status not defined).

Four variables pertaining to health status were included. To classify the presence of chronic conditions, we used the Charlson Comorbidity Index (CCI). It is based on 19 different medical conditions (myocardial infarction; congestive heart failure; peripheral vascular disease; cerebrovascular disease; dementia; chronic pulmonary disease; connective tissue disease; ulcer disease; mild liver disease; diabetes mellitus; hemiplegia; moderate/severe renal disease; diabetes mellitus with chronic complications; any tumour; leukaemia; lymphoma; moderate/severe liver disease; metastatic solid tumour; AIDS), each weighted and assigned 1–6 points according to its potential impact on mortality, derived from relative risk estimates (Thygesen et al., 2011). According to previous literature (Raedkjaer et al., 2018; Grann et al., 2013; Tuty Kuswardhani et al., 2020; Deleuran et al., 2013) and because the distribution of the 1–6 point scale was highly skewed, the CCI score was categorized into three comorbidity levels: CCI=0, CCI=1–2, CCI≥3.

Activity limitations were assessed by asking participants whether (and to which degree) they had a health problem or disability that hampered their daily activities. Response categories were “not limited in any way”, “limited to some extent”, and “severely limited”. Participants were also asked the extent to which they had experienced physical pain within the past 4 weeks. Responses ranged from 1–6 and were as follows: 1 “no pain”, 2 “very light pain”, 3 “light pain”, 4 “moderate pain”, 5 “severe pain”, and 6 “very severe pain”. Finally, mental disorders other than CMDs (ICD-10 codes F00–F99 except those specified as CMDs) were coded as present if any of the diagnoses were listed in the period 1992–2019. Data on sex, marital status, education, occupation, activity limitations, and pain came from the baseline survey, while data on age, country of origin, chronic conditions (CCI), and other mental disorder came from register data.

## 2.7. Statistical analysis

STATA version 16 was used to perform all analyses. First, a descriptive analysis was conducted to demonstrate the characteristics of the sample. These analyses included frequencies, proportions, means, and standard deviations (SD). Second, Cox regression models to assess onset of CMDs (period Jan 2020–Apr 2021) and onset or recurrence of use of antidepressants (period Jan 2020–Dec 2020) was conducted (the censoring date in both models was the end of follow-up or death). Third, a logistic regression model assessing onset or recurrence of case depression (survey data) was conducted. The key predictor was mental wellbeing (continuous and categorical measure), which was measured at baseline (2019 survey). The outcomes were (1) diagnosed CMD; (2) antidepressant use; (3) case depression based on the PHQ-8 (measured in the 2020 survey). In the analyses, we restricted to the population free of the outcome at baseline, as follows: In analyses to estimate the onset of CMDs, we restricted to individuals that did not have a CMD listed in the period 1992–2019 - ( $N = 6188$ ).

In analyses to estimate the onset of antidepressant use, we restricted to individuals that had not used a prescription for antidepressants within 100 days leading up to the 2019 survey (episodes were defined as continuous prescription fills with medication gaps no longer than 100 days. If medication gaps of more than 100 days occurred, we assumed that the individual had stopped the treatment and treatment after that was considered a new episode) (Madsen et al., 2021) - ( $N = 6256$ ). In analyses to estimate the onset of case depression based on the PHQ-8, we restricted to those not screening positive for depression in the 2019 survey - ( $N = 4413$ ). We made these restrictions to obtain estimates for onset or new occurrence of the respective mental health outcome. In order to establish a dose-response relationship between the predictor and the outcomes, we conducted additional analyses (test for Trends), where we entered the categorical mental wellbeing variable as a continuous variable in the models, i.e., instead of having a categorical variable with the low category as the reference category, we entered the variable as a simple continuous variable (1 low - 3 high).

All models were adjusted for age, gender, country of origin, education, other mental disorder (other than those defined as common mental disorder), marital status, employment status, chronic conditions, activity limitations, and pain. We also conducted an additional sensitivity analysis for the logistic regression, where we included the number of depression symptoms (0–9) on the PHQ-8 (below the clinical cut-point) as a covariate. We did this because we wanted to establish that mental wellbeing would predict PHQ-8 case depression independently, regardless of depression symptoms experienced at baseline, i.e., we wanted to confirm that the association was not confounded by simply having fewer depression symptoms. Finally, we checked for interaction effects with gender and age (below 65 years old vs 65 years old or above, which is generally considered standard retirement age, cf Herzog et al., 1991). In all analyses, a survey non-response and attrition statistical weight based on age and gender was taken into account to attenuate selection bias (Rosendahl Jensen et al., 2021).

## 3. Results

Information regarding the distributions of the study samples is shown in Table 1. The mean age of the study sample was 50.4 years, and 52.8% were females. At time 1 (2019), continuous mental wellbeing scores were negatively correlated with continuous PHQ-8 depression symptom scores ( $r = -0.50$ ,  $p < 0.05$ ;  $r$ -squared = 0.25). Of those with PHQ-8 case depression at time 1 (2019), 352 (71.1%) were in the low mental wellbeing category; 136 (28.9%) were in the moderate mental

**Table 1**  
Characteristics of the study samples.

	Characteristic	Category	Register-	Survey-
			analyses	analysis
			N (weighted %)	N (weighted %)
Baseline	Unweighted N		6,629	5,000
Age	Mean (SD)	Mean (SD)	53.2 (19.0)	50.4 (18.9)
		Missing	0 (0.0)	0 (0.0)
Gender	Female	Female	3,768 (50.5)	2914 (52.8)
		Missing	0 (0.0)	0 (0.0)
Marital status	Never married/ registered partnership	Married or in registered partnership	1145 (23.2)	692 (18.4)
		Widowed	4436 (63.6)	3498 (67.7)
		Divorced	385 (4.7)	295 (4.84)
		Missing	663 (8.5)	515 (9.0)
		Other (not Denmark)	0 (0.0)	0 (0.0)
		Missing	545 (9.0)	352 (7.0)
		Missing	0 (0.0)	0 (0.0)
Education	Primary-10th grade	Primary-10th grade	1080 (16.6)	756 (15.4)
		High school or vocational	2791 (42.5)	2020 (40.3)
		Tertiary	2758 (41.0)	2224 (44.3)
Occupational status	Working or studying	Working or studying	0 (0.0)	0 (0.0)
		Unemployed or sick leave	3562 (60.5)	2681 (60.8)
		Retired	217 (3.7)	146 (0.03)
		Other	2244 (25.2)	1834 (28.4)
		Missing	606 (10.6)	339 (7.6)
Activity limitations	Not limited	Not limited	339 (5.1)	146 (2.9)
		Limited to some extent	292 (4.1)	3273 (69.2)
		Severely limited	1905 (26.1)	1475 (27.1)
Chronic comorbidity index (CCI)	CCI=0	CCI=0	4333 (69.8)	193 (0.04)
		CCI=1-2	99 (1.5)	59 (1.2)
		CCI>3	6008 (92.1)	4529 (90.6)
		Missing	551 (7.1)	422 (8.4)
		Missing	70 (0.8)	49 (0.1)
Pain	Mean (SD)	Mean (SD)	0 (0.0)	0 (0.0)
		Missing	2.4 (1.3)	2.4 (1.3)
Other mental disorder <sup>b</sup>	Present	Present	135 (2.0)	60 (1.2)
		Missing	51 (0.8)	32 (0.7)
Mental well- being <sup>c</sup>	Mean (SD)	Mean (SD)	0 (0.0)	0 (0.0)
		Missing	25.1 (5.6)	25.1 (5.3)
Mental wellbeing categories	Low	Low	582 (8.8)	337 (6.7)
		Moderate	1033 (18.0)	722 (16.7)
		High	3614 (61.5)	2788 (61.3)
		High	1400 (20.6)	1533 (22.1)
Follow- up	Common mental disorder <sup>a</sup>	Present	75 (1.2)	-
		Missing	0 (0.0)	-
	Use of antidepressants <sup>c</sup>	Present	309 (4.2)	-
		Missing	0 (0.0)	-
	Case depression <sup>d</sup>	Present	-	416 (10.2)
Missing		-	447 (9.5)	

Data are n (weighted %) unless otherwise specified.

<sup>a</sup> Based on the ICD-10 codes for specified common mental disorders.

<sup>b</sup> Based on the ICD-10 codes for mental disorders other than those specified as common mental disorders.

<sup>c</sup> Based on the ACT code N06A for antidepressants.

<sup>d</sup> Based on the PHQ-8 depression screening tool.

<sup>e</sup> Based on the Short Warwick-Edinburgh Mental Wellbeing Scale (range 7–35).

wellbeing category, and none were in the high mental wellbeing category. Of those with low mental wellbeing in 2019, 352 (37.4%) screened positive for depression (using the PHQ-8) in 2019. 106 (10.8%) in the low mental wellbeing group did not have any depression symptoms (based on the PHQ-8) in 2019.

At follow-up, there were 27 (0.4%) new cases of CMDs, 121 (2.4%) new or recurrent cases of antidepressant use, and 212 (4.2%) new or recurrent cases of PHQ-8 case depression. Table 2 shows the Cox regression models estimating onset of mental disorders and onset or recurrence of use of antidepressants by mental wellbeing status at

**Table 2**

Mental wellbeing predicting the onset or recurrence of common mental disorders or use of antidepressants (based on register-data) or depression (based on survey-data) at follow-up in the Danish general population.

	Cox regression (register-based outcomes)		
	HR	95% CI	p-value
	Common mental disorder <sup>a</sup> (Jan 2020-Apr 2021)		
Mental wellbeing continuous (2019)	0.91	0.85, 0.97	0.003
Mental wellbeing categories (2019)			
Low	1		
Moderate	0.32	0.13, 0.66	0.003
High	0.11	0.02, 0.49	0.004
	Any antidepressant use <sup>b</sup> (Jan 2020-Dec 2020)		
Mental wellbeing continuous (2019)	0.95	0.92, 0.98	0.002
Mental wellbeing categories (2019)			
Low	1		
Moderate	0.45	0.28, 0.72	0.001
High	0.31	0.15, 0.62	0.001
	Logistic regression (survey data)		
	OR	95% CI	p-value
	PHQ-8 case depression <sup>c</sup> (2020)		
Mental wellbeing continuous (2019)	0.88	0.84, 0.90	< 0.001
Mental wellbeing categories (2019)			
Low	1		
Moderate	0.30	0.20, 0.44	< 0.001
High	0.10	0.05, 0.20	< 0.001

HR: hazard ratio; OR: odds ratio; CI: confidence interval. All models were adjusted for age, gender, country of origin, education, other mental disorder (other than those defined as common mental disorder), marital status, employment status, chronic conditions, activity limitations, and pain.

<sup>a</sup> Restricted to the sample with no common mental disorder in the period 1992-2019 (2019), N = 6188. The assumption for proportional hazards was met (Chi<sup>2</sup>=17.9, p = 0.394).

<sup>b</sup> Restricted to the sample with no use of antidepressants within 100 days leading up to the 2019 survey, N = 6256. The assumption for proportional hazards was met (Chi<sup>2</sup>=14.6, p = 0.749).

<sup>c</sup> Restricted to the sample that did not screen positive for depression (PHQ-8) at time 1 (2019), N = 4413. Model fit was tested by the Pearson Chi<sup>2</sup> goodness-of-fit test, which suggested good fit (Chi<sup>2</sup>=3291.9, p = 0.9995).

baseline. The continuous measure negatively predicted all outcomes, i. e., each point increase in mental wellbeing was significantly associated with reduced risk of developing CMDs at follow-up. Each higher category of mental wellbeing (compared to low mental wellbeing) was significantly associated with lower hazard ratios of both outcomes. As compared to low mental wellbeing, moderate mental wellbeing was associated with a 68% reduction in risk for CMD diagnoses, while high mental wellbeing was associated with a 89% reduction in risk for CMD diagnoses; similarly, moderate mental wellbeing was associated with a 55% reduction in risk for antidepressant use, while high mental wellbeing was associated with a 69% reduction in risk for antidepressant use. Overall, the results indicate a dose-response pattern, with lower risk of the outcomes at follow-up for each higher wellbeing category at baseline. The test for Trends test (shown in Appendix 1, Table A1) confirmed the dose-response pattern, with lower risk with each increase in mental wellbeing, from low to moderate to high ( $P < 0.05$ ).

Table 2 also shows the logistic regression model estimating onset or recurrence of case depression based on the PHQ-8 screening tool. The continuous measure negatively predicted the outcome, i. e., each point increase in mental wellbeing was significantly associated with reduced risk of developing PHQ-8 case depression at follow-up. Next, each higher category of mental wellbeing (compared to low mental wellbeing) at baseline was associated with significantly lower odds of case depression at follow-up. More specifically, as compared to low mental wellbeing, moderate mental wellbeing was associated with a 68% reduction in risk for PHQ-8 case depression, while high mental wellbeing was associated with a 90% reduction in risk for PHQ-8 case depression. A dose-response pattern was also indicated in these results and confirmed by tests for Trends ( $P < 0.05$ ), shown in Appendix 1, Table A1.

As an additional sensitivity analysis (Appendix 1, Table A2), we also conducted logistic regression models where we added the continuous PHQ-8 measure (adjusting for the number of depression symptoms below the clinical threshold). This led to some attenuation in the results, but the overall pattern of associations and statistical significance remained the same. Finally, the interaction terms (mental wellbeing x gender; mental wellbeing x age) were not significant (Appendix 1, Table A3).

## 4. Discussion

In this study, we set out to explore the association between levels of mental wellbeing and onset or recurrence of mental disorders in the Danish general population. Our results confirmed our hypothesis. We found that mental wellbeing at baseline was inversely associated with all outcomes (CMD diagnoses, antidepressant use, depression based on the PHQ-8) at follow-up (12–16 months). First, the continuous mental wellbeing measure negatively predicted all outcomes, i. e., each point increase in mental wellbeing was significantly associated with reduced risk of developing CMDs at follow-up. Next, as compared to low mental wellbeing, moderate mental wellbeing was associated with a 55–68% reduction in risk for all outcomes, while high mental wellbeing was associated with a 69–90% reduction.

### 4.1. Strengths and limitations

Some strengths and limitations should be kept in mind when interpreting the results. Major strengths include the nationally representative survey, the various different outcomes that may capture the presence of CMDs differently, the prospective design (including the adjustment for confounders such as chronic illness), the use of a validated scale for measuring mental wellbeing, and the link with national registers. This approach made it possible to make direct links between mental wellbeing and diagnosed mental disorders, as well as use of antidepressants. Also, since most outcomes were from the register rather than from the survey, common method bias due to single-source self-reported data is not an issue in the register-based analyses.

Some limitations are as follows: First, the response rate was 47.4%, and while this is relatively high for a web-based/paper-based survey, selection bias cannot be ruled out. Unit non-response was associated with male sex, younger age, being unmarried, and lower educational level (Rosendahl Jensen et al., 2021). In terms of the longitudinal survey-based analyses, the proportion of baseline participants that took part in the follow-up survey was relatively high (75.4%), but there is a possibility for attrition bias in this part of the study. We have applied non-response and attrition weights in all analyses, which has reduced bias to some extent.

Second, the follow-up period was short as compared to similar studies to estimate the risk of onset or recurrence of CMDs. Higher levels of mental wellbeing are likely to be protective especially when they are maintained over time. With our study design, we were not able to tease out the differences in risk between short-term and long-term high levels of mental wellbeing. Third, despite an overall decline in mental health in the general population during the course of the COVID-19 pandemic (Sønderskov et al., 2020; Sønderskov et al., 2021), Denmark also saw a decline in terms of visits to doctors and hospitals (both somatic and psychiatric) throughout the first half of 2020 (SST, 2020; Bogh et al., 2021), which would have resulted in fewer diagnoses, hospitalizations, and prescriptions for antidepressants as compared to pre-pandemic conditions. Altogether, similar to other global circumstances that have affected mental health (e.g., the global financial crisis of 2007–2008), we cannot exclude the possibility that the associations would differ if the assessment of CMDs at follow-up had taken place in times without a pandemic. On that note, given that our predictor in 2019 inversely predicted all outcomes during the COVID-19 pandemic (2020–21), it may be indicative of higher levels of mental wellbeing conferring resilience (i. e., coping well in the face of challenges) through the course of a global crisis. This in itself is an important finding.

### 4.2. Contextualization of findings

Our results showed that the categories for mental wellbeing are inversely associated with all outcomes. Our results are especially robust since we used three different outcomes for CMDs. Each of these outcomes have limitations on their own, but including all of these outcomes in the same study has strengthened our findings. For example, diagnosed mental disorders are likely to capture more severe cases, while antidepressant use can be used as a proxy to capture less severe cases. On the other hand, although the PHQ-8 is a screening tool rather than a diagnostic tool, it captures current symptoms experienced at the time of the survey (it may capture current symptoms among individuals that are undetected or conversely lack of symptoms among diagnosed individuals in remission). Altogether, our results show the same overall pattern for these different outcomes. As compared to low mental wellbeing, moderate mental wellbeing was associated with lower risk for all outcomes, while the risk associated with high mental wellbeing was lowest.

We observed a dose-response relationship between mental wellbeing and all outcomes. This is important for two reasons: 1) the results align with previous research (Doré et al., 2020; Grant et al., 2013; Schotanus-Dijkstra et al., 2016; Keyes et al., 2010; Keyes et al., 2012), but we arrived at these results using simple cut-points on the SWEMWBS scale, and 2) they show that preventive public health and psychiatry should not focus only on preventing symptoms of psychopathology, but also on efforts to increase the prevalence of higher levels mental wellbeing, as higher levels are associated with reduced risk. Whilst prevention within mental health is concerned with avoiding mental illness, mental health promotion is concerned with improving positive aspects of mental health, often by enhancing the capacity of individuals, families, groups and communities to strengthen or support positive emotional, cognitive, behavioral, social, and environmental factors (Hodgson et al., 1996; WHO, 2002; Koushede & Donovan, 2022). Thus, mental health promotion, albeit being primarily focused on the positive aspects of mental

health, can have preventative properties (i.e., preventing mental illness through the promotion of mental wellbeing) and may be applied using different strategies (Fusar-Poli et al., 2021; Santini et al., 2020; Santini et al., 2021; Kalra et al., 2012). Such approaches may be considered indirect types of intervention (Cuijpers, 2021). Our findings also underscore the value of positive measures in supporting the monitoring of public mental health and mental health promotion interventions, i.e., such measures are needed to assess if population mental wellbeing is moving in a favorable direction (towards higher levels), and if interventions are successful in terms of increasing levels of mental wellbeing.

Our logistic regression results confirm the notion of mental wellbeing being protective in and of itself, and contributing to more than the mere absence of symptoms of psychopathology. Baseline mental wellbeing negatively predicted future case depression (based on the PHQ-8), and this held true when excluding individuals screening positive for depression at baseline (our main logistic regression model) and also adjusting for the number of depression symptoms (below the clinical cut-point) at baseline (our sensitivity analysis). Thus, higher levels of mental wellbeing are independently associated with lower risk of future depression beyond the mere presence or absence of depression symptoms at baseline. In other words, regardless of the degree of depression symptoms experienced at baseline (below the clinical cut-point), higher levels of mental wellbeing predict lower risk. Whilst this is an important finding in its own right, it also aligns with recent research showing that higher levels of mental wellbeing inversely predict future healthcare costs and sickness benefit transfers (government compensated sick leave), even with the adjustment for mental disorders at baseline (Santini et al., 2021a; Santini et al., 2021b). Overall, mental wellbeing is suggested to play an important role in the prevention of CMDs, and by extension, the curbing of wider health and social care costs.

According to meta-analytic research, multi-component and mindfulness-based positive psychological interventions have demonstrated the greatest efficacy in improving states of mental wellbeing, while singular positive psychological interventions, cognitive and behavioral therapy-based, acceptance and commitment therapy-based, and reminiscence interventions are also efficacious, but less so (van Agteren et al., 2021). Other meta-analytic research specifically among young people has also reported the most effective types of interventions on a number of core domains pertaining to good mental health (Salazar de et al., 2020). Relevant mental health campaigns to universally promote mentally healthy behaviors and lifestyles exist and are currently diffusing in various different countries and settings (Koushede and Donovan, 2022; Koushede et al., 2015; Santini et al., 2018; Donovan et al., 2021). In terms of future steps, research priorities for mental health promotion have recently been outlined (Fusar-Poli & Santini, 2021), such as a pressing need to monitor (e.g., through national surveys conducted annually) population mental wellbeing (alongside standard symptom screening tools that are already in use) (Shah et al., 2021), and also a need for further research to evaluate the effectiveness of novel and comprehensive interventions to promote mental wellbeing and, by extension, preventing CMDs (i.e. intervention studies that include the assessment of both mental wellbeing and CMDs).

## 5. Conclusion

Overall, higher levels of mental wellbeing (using both a continuous measure and fixed cut-points) are found to be associated with lower risk for onset or recurrence of common mental disorders (CMDs, antidepressant use, depression based on the PHQ-8). The results showed a dose-response pattern, i.e., lower risk with each increase in the level of mental wellbeing. As compared to low mental wellbeing, moderate mental wellbeing was associated with a 55–68% reduction in risk for all outcomes, while high mental wellbeing was associated with a 69–90% reduction. Future studies are warranted to investigate the effectiveness of universal and targeted approaches to promote mental wellbeing and prevent CMDs.

## Ethics

This study is a secondary data analysis with no human subject issues. Ethics statement is included in the paper.

## Data availability

We do not have permission to share data

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## Contributor statement

All authors have contributed to the work submitted.

## Transparency declaration

The manuscript is an honest, accurate, and transparent account of the study being reported. No important aspects of the study have been omitted. Any discrepancies from the study as planned (and, if relevant, registered) have been explained.

## Declaration of Competing Interest

No conflicts of interest declared.

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## Appendix 1

Tables A1–A3.

**Table A1**

Test for Trends: Mental wellbeing (continuous, range 1–3) predicting the onset or recurrence of common mental disorders or use of antidepressants (based on register-data) or depression (based on survey-data) at follow-up in the Danish general population.

	Cox regression (register-based outcomes)		p-value
	HR	95% CI	
Common mental disorder <sup>a</sup> (Jan 2020-Apr 2021)			
Mental wellbeing (2019) Categories used a continuous (range 1-3)	0.31	0.16, 0.60	0.001
Any antidepressant use <sup>b</sup> (Jan 2020-Dec 2020)			
Mental wellbeing (2019) Categories used as continuous (range 1-3)	0.52	0.36, 0.75	< 0.001
Logistic regression (survey data)			
	OR	95% CI	p-value
PHQ-8 case depression <sup>c</sup> (2020)			
Mental wellbeing (2019) Categories used as continuous (range 1-3)	0.31	0.22, 0.42	< 0.001

HR: hazard ratio; OR: odds ratio; CI: confidence interval. All models were adjusted for age, gender, country of origin, education, other mental disorder (other than those defined as common mental disorder), marital status, employment status, chronic conditions, activity limitations, and pain.

<sup>a</sup> Restricted to the sample with no common mental disorder in the period 1992-2019 (2019), *N* = 6188. The assumption for proportional hazards was met ( $\text{Chi}^2=17.7, p = 0.341$ ).

<sup>b</sup> Restricted to the sample with no use of antidepressants within 100 days leading up to the 2019 survey, *N* = 6256. The assumption for proportional hazards was met ( $\text{Chi}^2=13.9, p = 0.738$ ).

<sup>c</sup> Restricted to the sample that did not screen positive for depression (PHQ-8) at time 1 (2019), *N* = 4413. Model fit was tested by the Pearson  $\text{Chi}^2$  goodness-of-fit test, which suggested good fit ( $\text{Chi}^2=3010.6, p = 0.838$ ).

**Table A2**

Sensitivity analysis: mental wellbeing predicting the onset or recurrence of depression (based on survey-data) at follow-up in the Danish general population.

	Logistic regression (survey data)		p-value
	OR	95% CI	
PHQ-8 case depression <sup>a</sup> (2020)			
Mental wellbeing continuous (2019)	0.92	0.89, 0.96	< 0.001
Mental wellbeing categories (2019)			
Low	1		
Moderate	0.56	0.38, 0.81	0.002
High	0.28	0.14, 0.56	< 0.001

HR: hazard ratio; OR: odds ratio; CI: confidence interval. All models were adjusted for age, gender, country of origin, education, other mental disorder (other than those defined as common mental disorder), marital status, employment status, chronic conditions, activity limitations, pain, and PHQ-8 depression symptoms below the clinical cut-point (range 0-9).

<sup>a</sup> Restricted to the sample that did not screen positive for depression (PHQ-8) at time 1 (2019), *N* = 4413. Model fit was tested by the Pearson  $\text{Chi}^2$  goodness-of-fit test, which suggested good fit ( $\text{Chi}^2=3291.9, p = 0.9995$ ).

**Table A3**

Interaction terms predicting the onset or recurrence of common mental disorders or use of antidepressants (based on register-data) or depression (based on survey-data) at follow-up in the Danish general population.

	Cox regression (register-based outcomes)		p-value
	HR	95% CI	
Common mental disorder <sup>a</sup> (Jan 2020-Apr 2021)			
Mental wellbeing continuous (2019) x gender	1.00	0.91, 1.10	0.983
Mental wellbeing continuous (2019) x age	1.08	0.85, 1.38	0.522
Mental wellbeing (2019)			
Low	1		
Moderate x gender	1.05	0.28, 4.01	0.938
High x gender	1.11	0.20, 3.49	0.856
Low	1		
Moderate x age	1.01	0.18, 5.73	0.995
High x age	0.98	0.15, 0.62	0.733
Any antidepressant use <sup>b</sup> (Jan 2020-Dec 2020)			

(continued on next page)

Table A3 (continued)

	Cox regression (register-based outcomes)			
	HR	95% CI	p-value	
Mental wellbeing continuous (2019) x gender	1.00	0.94, 1.06	0.925	
Mental wellbeing continuous (2019) x age	1.03	0.97, 1.09	0.371	
Mental wellbeing (2019)				
Low	1			
Moderate x gender	1.06	0.45, 2.52	0.895	
High x gender	0.92	0.45, 8.12	0.378	
Low	1			
Moderate x age	0.65	0.27, 1.60	0.352	
High x age	0.72	0.20, 2.54	0.606	
Logistic regression (survey data)				
	OR	95% CI		p-value
		PHQ-8 case depression <sup>c</sup> (2020)		
Mental wellbeing continuous (2019) x gender	0.97	0.92, 1.02	0.259	
Mental wellbeing continuous (2019) x age	0.98	0.88, 1.09	0.760	
Mental wellbeing (2019)				
Low	1			
Moderate x gender	0.74	0.32, 1.72	0.486	
High x gender	0.55	0.11, 2.66	0.457	
Low	1			
Moderate x age	1.22	0.52, 2.84	0.640	
High x age	0.17	0.10, 1.50	0.111	

HR: hazard ratio; OR: odds ratio; CI: confidence interval. All models were adjusted for country of origin, education, other mental disorder (other than those defined as common mental disorder), marital status, employment status, chronic conditions, activity limitations, and pain.

<sup>a</sup> Restricted to the sample with no common mental disorder in the period 1992-2019 (2019),  $N = 6188$ .

<sup>b</sup> Restricted to the sample with no use of antidepressants within 100 days leading up to the 2019 survey,  $N = 6256$ . <sup>c</sup> Restricted to the sample that did not screen positive for depression (PHQ-8) at time 1 (2019),  $N = 4413$ .

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