Mental Health & Prevention 24 (2021) 200222

Contents lists available at ScienceDirect

Mental Health & Prevention

journal homepage: www.elsevier.com/locate/mhp

Mental health economics: A prospective study on psychological flourishing and associations with healthcare costs and sickness benefit transfers in Denmark

Ziggi Ivan Santini [a,*], Line Nielsen [a,b], Carsten Hinrichsen [a], Malene Kubstrup Nelausen [a], Charlotte Meilstrup [b], Ai Koyanagi [c,d], David McDaid [e], Sonja Lyubomirsky [f], Tyler J. VanderWeele [g,h], Vibeke Koushede [b]

[a] The National Institute of Public Health, University of Southern Denmark, Studiestræde 6, Copenhagen 1455, Denmark
[b] Department of Psychology, University of Copenhagen, Øster Farimagsgade 2A, Copenhagen 1353, Denmark
[c] Parc Sanitari Sant Joan de Déu, Universitat de Barcelona, Fundació Sant Joan de Déu, CIBERSAM, Dr Antoni Pujadas, 42, Barcelona, Sant Boi de Llobregat 08830, Spain
[d] ICREA, Pg. Lluis Companys 23, Barcelona, Spain
[e] Care Policy and Evaluation Centre, Department of Health Policy, London School of Economics and Political Science, London, UK
[f] Department of Psychology, University of California, Riverside, Riverside, CA 92521, USA
[g] Departments of Epidemiology and Biostatistics, Harvard T. H. Chan School of Public Health, Boston, MA 02115, USA
[h] Human Flourishing Program, Institute for Quantitative Social Science, Harvard University, Cambridge, MA 02138, USA

ARTICLE INFO

Keywords:
Health economics
Healthcare utilization
Mental health
Flourishing
Well-being

ABSTRACT

Background: Escalating healthcare expenditures highlight the need to identify modifiable predictors of the use and costs of healthcare and sickness benefit transfers. We conducted a prospective analysis on Danish data to determine the costs associated with flourishing as compared to the below threshold level of flourishing.
Methods: We used data from a 2016 Danish survey of 3508 adults, which was linked to Danish register data. Flourishing was assessed with a validated psychological well-being scale. A two-part regression model was used to predict 2017 costs while adjusting for 2016 costs, demographic variables, and health status, including psychiatric morbidity and health behaviours. Costs are expressed in USD PPP.
Results: Applying criteria from prior literature, the prevalence of flourishing in Denmark (measured in 2016) was 34.7%. Flourishing was associated with significantly lower healthcare costs ($-687.7, 95% CI = $-1295.0, $-80.4) and sickness benefit transfers ($-297.8, 95% CI = $-551.5, $-44.0) per person in 2017, as compared to the below threshold level of flourishing. Extrapolated to the Danish population (4.1 M people aged 16+ years), flourishing was associated with lower healthcare costs and sickness benefit transfers amounting to $-1.2bn (95% CI = $-2.3 bn, $-149.0 M).
Conclusions: Flourishing is associated with considerably lower health-related government expenditure. Substantial reductions could potentially be achieved by increasing the number of people who are flourishing in the population.

1. Introduction

In Denmark, public healthcare expenditure, at constant prices, has increased 46% from 2000 to 2017 (Rasmussen & Kristensen, 2019). In 2017, healthcare accounted for 16.4% of all government expenditure (Dam, 2019). With escalating healthcare expenditures, there is a pressing need to identify factors that may reduce costs - in particular, modifiable factors that are predictive of health and disease, and by extension, healthcare utilization and costs. Well-being is one such modifiable predictor, with previous research suggesting that enhancing population levels of well-being is economically worthwhile in the short as well as the long term (Knapp et al., 2011; Nurse et al., 2014; Kim et al., 2021; Trudel-Fitzgerald et al., 2019). According to a number of reviews (Kim et al., 2021; Trudel-Fitzgerald et al., 2019; De Neve et al.,

* Corresponding author.
E-mail address: ziggi.santini@gmail.com (Z.I. Santini).

https://doi.org/10.1016/j.mhp.2021.200222
Received 18 June 2021; Received in revised form 25 September 2021;
Available online 30 September 2021

2013; Diener & Chan, 2011; Diener et al., 2017; Lyubomirsky et al., 2005; Walsh et al., 2018), states of elevated psychological well-being have been found to be protective of physical health, as well as mental health and longevity—for example, through improved cardiovascular, immune, and endocrine system functioning; reduced risk of heart disease, stroke, and infection; better health behaviours, as well as enhanced resilience and recovery from illness. All of these mediating factors may curb healthcare expenditure.

Researchers have become increasingly interested in the concept of psychological flourishing, a central concept in well-being science that represents optimal levels of psychological well-being. A person may be considered to be flourishing when well-being is maximized within a number of domains (Keyes, 2002; Huppert, 2009; Ryff & Singer, 1998). Although aspects of well-being have been studied individually with a focus on happiness (Lyubomirski et al., 2005), life satisfaction (Diener, 1989), or subjective well-being (Diener & Chan, 2011), psychological flourishing is a state that requires several aspects of one's psychological state to be good. More specifically, flourishing includes a combination of hedonic or "feeling good" facets (e.g. happiness and vitality) and eudaimonic or "functioning well" facets (e.g. purpose in life, competence, and social connectedness) of well-being (Keyes, 2002; Huppert & So, 2013; Schotanus-Dijkstra et al., 2016). In a similar way that a diagnosis of clinical depression requires a combination of symptoms of anhedonia and malfunctioning, the determination of flourishing requires a combination of hedonia (i.e. feeling good) and functioning well in life. This combination is important because many individuals may have high levels of one component – e.g., high hedonic well-being (positive feelings) – but lower levels of eudaimonic well-being (e.g., low purpose in life) or vice versa. Individuals who may be quite happy with life, but that are not functioning well have worse outcomes, such as higher rates of mental illness, compared to individuals who are flourishing (feeling good about life and functioning well) (Keyes & Annas, 2009). Flourishing has been found to be protective against premature mortality and morbidity, and is therefore a good candidate for reduced healthcare expenditure and other health-related social costs (e.g. costs relating to absence from work due to sick leave) (Keyes, 2015; Schotanus-Dijkstra et al., 2016; Keyes & Grzywacz, 2005; Keyes & Simoes, 2012).

Eight studies have previously investigated the relationship between well-being measures and healthcare utilization/expenditure (Keyes & Grzywacz, 2005; Shi et al., 2013; Sears et al., 2013;, Harrison et al., 2012; Gandy et al., 2014; Roy et al., 2019; Riley et al., 2018). Seven of those were studies from the U.S. and based on self-reported healthcare utilization or health insurance expenditure. Across all these studies, well-being was negatively related to (1) healthcare utilization and expenditure (Keyes & Grzywacz, 2005; Shi et al., 2013; Sears et al., 2013;, Harrison et al., 2012; Gandy et al., 2014; Roy et al., 2019; Riley et al., 2018), (2) productivity loss (Keyes & Grzywacz, 2005; Shi et al., 2013; Sears et al., 2013), and (3) job turnover (Shi et al., 2013; Sears et al., 2013). Most studies were non-prospective studies based on samples that were not randomized (Shi et al., 2013; Gandy et al., 2014; Roy et al., 2019). Two studies included samples that were nationally-representative but were not prospective studies (Keyes & Grzywacz, 2005; Riley et al., 2018), and two were prospective studies but not based on randomized samples (Sears et al., 2013; Harrison et al., 2012). More recently, we conducted a study on Danish population-based register data, in which we showed that a continuous measure of well-being (the Warwick-Edinburgh Mental Well-Being Scale - WEMWBS) in 2016 inversely predicted healthcare costs and sickness benefit transfers (note: the Danish government compensates long-term absence from work due to illness) in 2017 (Santini et al., 2021). The present study is similar in design, but it extends the previous work by estimating the potential reductions in costs associated with states of elevated well-being (i.e., psychological flourishing).

To the best of our knowledge, no studies to date have reported a comprehensive analysis of register-based data with flourishing as a predictor. Such studies are strongly needed to advance the field regarding the costs associated with flourishing and non-flourishing individuals in a population. This is important because whilst the European Commission and World Health Organization generally support the need for programs and policies to promote mental health and well-being (including flourishing), there is a research gap in terms of the potential return on investment that might be gained from successfully implementing such programs and policies (Forsman et al., 2015; EU, 2019; WHO, 2005). Moreover, it is important to analyze the associations between flourishing and economic outcomes from contexts other than the U.S., which have no federal statutory requirement for paid sick leave, and where even after the Affordable Care Act, 9.2% of adults still do not have health insurance coverage (based on data from 2019) (Keisler-Starkley & Bunch, 2019). In Denmark, all citizens have access to the publicly funded healthcare system, and long-term absence from work due to illness is compensated by the government. Denmark is therefore an ideal setting for investigating associations between flourishing and public healthcare expenditure.

In this study, using a large random sample of the adult Danish population, we set out to investigate to which extent flourishing is associated with lower government expenditure—specifically, healthcare costs and sickness benefit transfers. Based on the aforementioned evidence, we hypothesized that flourishing (as compared to the below threshold level of flourishing) would be associated with lower healthcare costs and sickness benefit transfers in the following year. A secondary objective of the study was to compare flourishing prevalence proportions in Denmark in 2016 with two previous time points (2006 and 2012). The rationale for this objective was to monitor the degree of change in the prevalence of psychological flourishing in Denmark over the period spanning the years 2006 to 2016. If flourishing is shown to be associated with lower expenditure, it is relevant to investigate prevalence rates of flourishing in previous years.

2. Methods

2.1. Sampling

Our data came from The Danish Mental Health and Well-Being Survey 2016 (DMHWBS2016) (Nielsen et al., 2017), which is a random population-based sample of Danes aged 16 years and above. The Danish government agency Statistics Denmark sent an electronic letter to 10,250 sampled individuals in October 2016 with information about the study and an invitation to participate. A total of 3508 people responded to the web-based survey (between October 18, 2016 and November 13, 2016), resulting in a response rate of 34%. Additionally, the survey was linked to the Danish Civil Registration System (Pedersen, 2011) via Statistics Denmark, which allows for the merging of data on employment status, household income, healthcare utilization, and social service use, among other data. Each citizen in Denmark has a personal registration number, enabling linkage between registers (Thygesen et al., 2011). All data are pseudonymized, so they cannot be traced back to specific participants. There is no formal agency for ethical approval of questionnaire-based survey studies in Denmark. The study complies with the Helsinki 2 Declaration on Ethics and is registered with the Danish Data Protection Authority; all confidentiality and privacy requirements were met. The participants' voluntary completion and return of the survey questionnaires constituted implied consent. To compare flourishing prevalence rates for Denmark between 2016, 2012, and 2006 (i.e, our secondary objective), we also used data from the European Social Survey (ESS) rounds 3 (2006) and 6 (2012). More information about these two ESS modules is reported in Appendix 1 (Table A1.1) and elsewhere (Santini et al., 2018). Descriptives of the current sample and those reported previously for the ESS samples (Santini et al., 2018) indicate that the sample characteristics across these surveys were broadly matched .

2.2. Outcome: healthcare costs and sickness benefit transfers

All costs were extracted from Statistics Denmark for years 2016 and 2017. This cost analysis utilized data from Danish national registers using each respondent's anonymized civil registration number linked to DMHWBS2016. Costs comprised (1) healthcare costs (general practitioners/specialists, hospitalizations, outpatient services, prescription medicines), and (2) sickness benefit transfers (compensations made by the Danish government for long-term absence from work due to illness). Unit costs for general practitioners and specialists are based on the current national health insurance rate (Kronborg et al., 2009). Charges based on Diagnostic Related Groups (DRG) were used as unit costs for both costs of hospitalizations and outpatient services. Costs were omitted for healthcare services that did not involve treatment for illnesses, such as health services for contraceptive management (ICD-10 codes Z30) and other circumstances (ICD-10 codes Z76). For the costs of prescription medicines, public expenditure was calculated by subtracting user payments from the retail price of the medicine.

All healthcare costs were aggregated for: (1) the full calendar year 2016 and (2) the full calendar year 2017. Sickness benefit transfers (long-term absence, 31+ days) were estimated based on the weekly number of hours absent from work and respective salaries (Anker et al., 2009). Sickness benefit transfers were also aggregated for: (1) the full year 2016 and (2) the full year 2017.

For a detailed description of cost components, see Appendix 2 (Table A2). All costs used for analysis are in 2016/2017 prices (DKK) and results were subsequently converted to international dollars (United States Dollars - USD, Purchase Power Parity - PPP) using an online conversion tool (2017 rates for price and target year, PPP values from the International Monetary Fund, 1DKK=USD$0.13 PPP) (EPPI-Centre Cost Converter, 2021).

2.3. Predictor: flourishing

We used a psychological flourishing scale proposed by Huppert and So (2013) as the predictor in this study. According to their conceptualization, flourishing involves features pertaining to three domains: (1) positive characteristics (5 items comprising emotional stability, vitality, optimism, resilience, and self-esteem), (2) positive functioning (4 items comprising engagement, competence, meaning, and positive relationships), and (3) positive emotion (1 item comprising happiness). Table 1 presents the items in the flourishing scale. The flourishing scale has previously been validated across different European regions (including Scandinavia) with acceptable model fit (Huppert & So, 2013), and research performing cross-tabulation analysis has reported moderate agreement with other well-known operational definitions of flourishing (Hone et al., 2014).

Flourishing in this study was considered a state (as a binary variable) (Hone et al., 2014), where a person is flourishing when he or she meets the criteria of having the combination of (1) at least four out of five features pertaining to positive characteristics, (2) at least three out of four features pertaining to positive functioning, and (3) positive emotion. It was coded as follows: For the items pertaining to positive characteristics, we categorized a feature as present when the participant responded 'agree' or 'strongly agree' on a 5-point Likert scale with "strongly disagree" at the opposite end (for optimism, self-esteem, and resilience), or responded "most of the time" or "all or almost all of the time" on a 4-point Likert scale, with "none or almost none of the time" at the opposite end (for vitality and emotional stability). Note that the resilience item (under the positive characteristics domain) was negatively worded, and was therefore scored inversely. For the items pertaining to positive functioning, a feature was coded as present when a participant responded "agree" or "strongly agree" on a 5-point Likert scale, with "strongly disagree" at the opposite end (for competence, meaning, positive relationships, and engagement). For the items pertaining to positive emotion, we categorized the feature as present when a participant rated his or her happiness 8, 9, or 10 on a 10-point Likert scale, with 1 being "extremely unhappy" and 10 being "extremely happy." As a result of coding the scale according to the aforementioned criteria, we ended up with a binary variable—that is, either flourishing or below the threshold level of flourishing. Cronbach's alpha for the items included in the flourishing scale was 0.87. For the ESS data, the criteria for flourishing was the same, more information can be found in Appendix 1 and elsewhere (Santini et al., 2018).

Table 1
Flourishing items.

Factor	Feature	Sample item
Positive characteristics	Optimism[a]	Always optimistic about my future
	Self-esteem[a]	In general feel very positive about myself
	Vitality[b]	Had lot of energy, how often past week
	Emotional stability[b]	Felt calm and peaceful, how often past week
	Resilience[a]	When things go wrong in my life it, takes a long time to get back to normal (reverse scored)
Positive functioning	Competence[a]	Feel accomplishment from what I do
	Meaning[a]	Feel what I do in life is valuable and worthwhile
	Positive relationships[a]	There are people in my life who care about me
	Engagement[a]	Love learning new things
Positive emotion	Happiness[c]	How happy are you

[a] Response options were as follows: strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree.
[b] Response options were as follows: all or almost all of the time, most of the time, some of the time, and none or almost none of the time.
[c] Response options were as follows: 0 (extremely unhappy), 1, 2, 3, 4, 5, 6; 7, 8, 9, and 10 (extremely happy).
The criteria used for flourishing was having the combination of:
(1) At least four out of five features pertaining to positive characteristics (present: 'agree/strongly agree' or 'most of the time/all or almost all of the time')
(2) At least three out of four features pertaining to positive functioning (present: 'agree/strongly agree')
(3) Positive emotion (present: 8, 9, or 10).

2.4. Covariates

All sociodemographic variables were extracted from Statistics Denmark for the year 2016. The sociodemographic variables were as follows: age; sex (female, male); migration background (not immigrant; immigrant or descendent of an immigrant); marital status (married or registered partnership; divorced, terminated partnership or widowed; single); education (primary or unknown; high school; tertiary education); employment status (employed; unemployed; student; retired; social pension/early retirement; other - employment status not defined); and income (lowest quartile; second-lowest quartile; second-highest quartile; highest quartile). Because 6.8% of data on income were missing, a "missing" category was created for this variable.

Three variables pertaining to health status and health behaviours were included. The first two – chronic and psychiatric conditions – came from the national registers. To classify the presence of chronic

conditions, we used the Charlson Comorbidity Index (CCI). This is based on 19 different medical conditions, each weighted and assigned 1–6 points according to its potential impact on mortality, derived from relative risk estimates (Thygesen et al., 2011). The CCI score is then categorized into three comorbidity levels: low (CCI=0), medium (CCI=1-2), high (CCI≥3). To assess the presence of psychiatric conditions, a variable was created for any psychiatric or self-harm diagnosis based on the ICD-10 codes F00-F99 (mental and behavioural disorders, including disorders relating to psychoactive substance use) and X60-X84 (intentional self-harm), i.e. a binary variable was constructed (any psychiatric condition, no psychiatric condition). Finally, level of physical activity was assessed with a binary variable (weekly or more, less than weekly), obtained from the survey. The sociodemographic and health status/behaviour variables were included because they are associated with mental well-being and healthcare service utilization (Sears et al., 2013; Harrison et al., 2012; Riley et al., 2018; Stewart-Brown et al., 2015; Diehr et al., 1999).

2.5. Statistical analysis

STATA version 14 was used to perform all analyses. Following recommendations regarding the use of healthcare cost data, we applied a two-part model (Mihaylova et al., 2011; Manning & Mullahy, 2001) with 2017 costs as the outcome. The two-part model made adjustment for the covariates described below and also for costs in 2016. In the first part of the model, the probability of incurring any expenditure was estimated by a probit model using the full sample. Then, a generalized linear model (GLM) with log link and a gamma distribution was fitted to the subset of people that had any expenditure in 2017. More formally, the model can be written as the product of expectations from the first and second parts of the model, as follows:

$$E(y|X) = Pr(y > 0|X) \times E(y|y > 0, \mathbf{x})$$

Thus, the two-part model allows for a separate investigation of the effects of a predictor on the extensive margin (probit model, if any expenditures) and on the intensive margin (GLM, amount of expenditures, if any). Subsequently, the incremental effects of the predictor on the outcome for the combined probit and GLM were calculated (Deb & Norton, 2018).

The statistical analyses conducted were as follows. First, flourishing prevalence estimates were calculated for Denmark in 2016, and compared to prevalence estimates in 2012 and 2006 using two-sample tests of proportions. Subsequently, means (unadjusted) were computed to compare costs in 2017 between flourishing categories. Finally, we estimated the costs (2017 costs controlling for 2016 costs and other covariates) associated with flourishing as compared to the below threshold level of flourishing. Using 1-year time periods for the assessment of healthcare costs (total expenditures 12-months post baseline assessment as well as 12-month expenditure as a baseline covariate) is a common approach in economic modelling of longitudinal healthcare utilization and cost data (Sears et al., 2013; Harrison et al., 2012; Ruhl et al., 2017; Curcio et al., 2019; Wooldridge, 2009), along with the use of two-step models in such analyses (Harrison et al., 2012; Ruhl et al., 2017).

For each analysis estimating costs, Model 1 adjusted for age, sex, migration background, marital status, education, income, and employment status (except not adjusting for employment status in models estimating sickness benefit transfers) and costs in 2016, while Model 2 adjusted for all the aforementioned variables as well as chronic conditions, the number of psychiatric conditions, and physical activity. Both of these two-part models were performed using the categorical flourishing variable as the predictor (reference category=below threshold level of flourishing). We performed the Model 2 analyses in order to avoid inflated results due to differing levels of physical or mental health problems. However, since we already adjusted for prior healthcare costs, this also ran the risk of overadjustment. Hence, we performed both models as a means to be able to compare the results and make sure that they were not markedly different from each other.

All variables were entered into the models as categorical, except for age, which was continuous. In all analyses, a survey non-response statistical weight (Nielsen et al., 2017) based on age, education, region, marital status, employment status, and migration background was taken into account to attenuate selection bias. Both models were based on the sample ($N = 3508$) with no missing data, and missing data [N(%)] were as follows: flourishing/non-flourishing 28 (0.08%); sex 0 (0%); age 10 (0.3%); migration background 0 (0.0%); marital status 10 (0.3%); education 0 (0%); income (see section on covariates); employment status 7 (0.2%); chronic conditions 0 (0%); number of psychiatric conditions 0 (0%); physical activity 5 (0.1%); healthcare costs in 2016 0 (0.0%); and healthcare costs in 2017 0 (0.0%). In order to assess the influence of multicollinearity, we calculated the variance inflation factor (VIF) value for each independent variable. All VIFs were <5, which is much lower than the commonly used-cut off of 10 (O'brien, 2007), indicating that multicollinearity was unlikely to be a problem in our analyses.

Finally, based on population data from Statistics Denmark (2021), statistically significant results were extrapolated to the entire Danish population (aged 16+ years) and expressed in international dollars (USD PPP). All extrapolated estimates were based on model 2 results. Based on 95% confidence intervals, we also generated extrapolations based on a lower bound estimate (based on the 95% CI lower bound limit), and an upper bound estimate (based on the 95% CI upper bound limit).

3. Results

All results that include costs were converted (from DKK) and are presented in USD PPP in the main tables; the original results expressed in the Danish currency DKK are shown in Appendix 4 (Table A4.1, A4.2, A4.3, A4.4). Information regarding the sociodemographic distributions of the study sample is shown in Table 2. The mean age of the study population was 52.1 years, with 54.2% of the participants being female.

In 2016, 34.7% (95% CI = 33.1%, 36.3%) of the Danish population was estimated to be flourishing (See Table 2). The estimated prevalence was significantly lower than a prevalence of 55.8% (95% CI = 53.4%, 58.2%) in 2012 ($p < 0.001$), and a prevalence of 52.7% (95% CI = 50.2%, 55.3%) in 2006 ($p < 0.001$) (not shown in tables). The prevalence estimates for 2012 and 2006 were not significantly different from each other ($p = 0.090$). Unadjusted mean costs in 2017 by flourishing categories are shown in Table 3. As can be seen, healthcare costs and sickness benefit transfers were consistently lower as compared to the below threshold level of flourishing.

For the analytical statistics, only model 2 results are reported here in text (both model 1 and model 2 results are shown in Table 4). Table 4 shows the adjusted value of costs associated with the flourishing category in comparison to the below threshold level of flourishing. Flourishing was associated with significantly lower healthcare costs ($-687.7, 95% CI = $-1295.0, $-80.4) and sickness benefit transfers ($-297.8, 95% CI = $-551.1, $-44.0) per person in 2017, as compared to the below threshold level of flourishing.

Table 2
Characteristics of the 3,508 participants in the Danish mental health and well-being survey 2016.

Characteristic	Category	N	%
Sex	Female	1852	54.2
Age	16–25 years	319	15.8
	26–44 years	735	28.8
	45–64 years	1437	32.1
	65+ years	1017	23.4
Migration background	Immigrant or descendent of immigrant	236	12.6
Education	Primary or unknown	831	33.9
	High school	1457	39.2
	Tertiary education	1220	26.9
Marital status	Married/Registered partnership	1992	45.7
	Divorced, separated partners, widowed	589	17.3
	Unmarried	917	37.1
Income	Highest quartile	817	19.5
	Second-highest quartile	818	23.1
	Second-lowest quartile	818	26.5
	Lowest quartile	817	30.9
	Missing	238	6.8
Employment status	Employed	1906	51.0
	Unemployed	147	5.1
	Student	312	15.1
	Retired	948	21.8
	Social pension/Early retirement	120	3.6
	Other	68	3.4
Chronic comorbidity index (CCI)	Low (CCI = 0)	3309	95.2
	Moderate (CCI = 1-2)	173	4.1
	High (CCI ≥ 3)	26	0.7
Any psychiatric condition	Present	237	8.5
Physical activity	Less than weekly	352	11.7
Flourishing	Present	1207	34.7
Healthcare costs 2016 [median][a]		519.6	
Sickness benefit transfers 2016 [median][a]		1968.6	
Healthcare costs 2017 [median][a]		575.5	
Sickness benefit transfers 2017 [median][a]		2947.2	

Note. Data are unweighted n (weighted %) unless otherwise specified.
[a] All costs are in $PPP. Zero-costs were omitted

Table 5 shows the extrapolation of results to the Danish population in 2017. Extrapolated to the Danish population (population size of 4.1M people aged 16+ years) (see Appendix 3, Table A3), flourishing was associated with lower healthcare costs and sickness benefit transfers amounting to $-1.2bn (95% CI = $-2.3bn, $-149.0M) as compared to the below threshold level of flourishing.

Table 3
Unadjusted mean annual healthcare costs and sickness benefit transfers in 2017 (reported as USD PPP) per person by flourishing categories (measured in 2016) among Danish adults aged 16+ years.

	Below threshold level of flourishing		**Flourishing**	
	Mean	95% CI	Mean	95% CI
Healthcare costs	2648.9	2293.5, 3004.3	1616.4	1339.7, 1893.1
Sickness benefit transfers	731.5	518.2, 944.7	221.3	92.9, 349.7

Note. USD PPP = International U. S. Dollars adjusted by Purchasing Power Parity. All prices are converted from DKK (Danish Krone).

Table 4
Per person healthcare costs and sickness benefit transfers in 2017 (reported as USD PPP) associated with flourishing as compared to the below threshold level of flourishing (measured in 2016) among Danish adults aged 16+ years.

	Model 1		Model 2	
	Healthcare costs			
	Marginal effect	95% CI	Marginal effect	95% CI
Below threshold level of flourishing	Ref.		Ref.	
Flourishing	-622.7	-1175.6, -69.7	-687.7	-1295.0, -80.4
	Sickness benefit transfers			
	Marginal effect	95% CI	Marginal effect	95% CI
Below threshold level of flourishing	Ref.		Ref.	
Flourishing	-369.4	-602.0, -136.8	-297.8	-551.5, -44.0

Note. USD PPP = International U. S. Dollars adjusted by Purchasing Power Parity. All prices are converted from DKK (Danish Krone).
Model 1 is adjusted for age, sex, migration background, education, marital status, employment status (expect not adjusted for employment status in models estimating sickness benefit transfers), income, and 2016 costs.
Model 2 is adjusted for all the aforementioned covariates, as well as chronic conditions, any psychiatric condition, and physical activity.

Table 5
Healthcare costs and sickness benefit transfers in 2017 (reported as USD PPP) associated with flourishing (as compared to the below level threshold of flourishing) for the Danish population aged 16+ years.

	Point estimate	
	Costs per person (USD PPP)	Extrapolated population costs (USD PPP)
Healthcare costs	-687.7	-980,080,617.6
Sickness benefit transfers[a]	-297.8	-231,960,731.9
Total	**-985.5**	**-1,212,041,349.4**
	Lower bound estimate (95%CI lower bound limit)	
	Costs per person (USD PPP)	Extrapolated population costs (USD PPP)
Healthcare costs	-1295.0	-1,845,461,627.8
Sickness benefit transfers[a]	-551.5	-429,650,632.4
Total	**-1846.5**	**-2,275,112,260.1**
	Upper bound estimate (95%CI upper bound limit)	
	Costs per person (USD PPP)	Extrapolated population costs (USD PPP)
Healthcare costs	-80.5	-114,699,607.3
Sickness benefit transfers[a]	-44.0	-34,281,244.9
Total	**-124.5**	**-148,980,852.2**

Note. USD PPP = International U. S. Dollars adjusted by Purchasing Power Parity. All prices are converted from DKK (Danish Krone).
All extrapolations (see Appendix 3) are based on model 2 results that were statistically significant ($p < 0.05$).
[a] The result was extrapolated to the Danish population of employed individuals aged 16-64 years old.

4. Discussion

Our results suggest that 34.7% of the Danish population was flourishing in 2016, a prevalence that appears to have declined significantly when compared to ESS prevalence estimates in 2016 and 2012. The objective of this study was to estimate the costs associated with flourishing as compared to the below-threshold level of flourishing. In line

with previous findings, our results confirmed our expectations that flourishing would be significantly associated with lower costs in the year following the baseline survey. Four prior studies are worth considering in the context of our findings. Keyes & Grzywacz (2005) conducted a cross-sectional study on American data to assess the association between complete health (including flourishing based on Keyes' flourishing scale) and healthcare utilization. They found that those not having complete health were significantly more likely (OR = 2–4) to utilize healthcare services (work injury, overnight hospitalization, medical visits due to physical or mental health problems) as compared to those fulfilling criteria for complete health. This study was the only one of the four to use a measure of flourishing. Both Harrison et al. (2012) and Sears et al. (2013) used American insurance data to assess the association between baseline well-being scores (a continuous measure ranging from 0 to 100) and healthcare expenditure 12-months post baseline well-being assessment. They found that each increase in well-being was associated with significantly lower future healthcare costs (prescription and medical costs). More recently, Santini et al. (2021) conducted a similar study on Danish data, assessing the association between baseline well-being (a continuous measure ranging from 14 to 70) and healthcare costs/sickness benefit transfers in the following year. The results showed that each point increase was significantly associated with lower healthcare costs (US$ 42.5) and lower sickness benefit transfers (US$ 23.1). In the Present study, after adjusting for a wide range of covariates (including 2016 costs, psychiatric conditions, chronic illnesses and health behaviour), we found that flourishing was significantly associated with lower healthcare costs ($-687.7, 95% CI = $-1,295.0, $-80.4) and lower sickness benefit transfers ($-297.8, 95% CI = $-551.1, $-44.0) per person in 2017, as compared to the below threshold level of flourishing. These are particularly strong findings, given that all models adjusted for costs in the previous year, since these are known to be highly correlated with future costs (Sears et al., 2013; Harrison et al., 2012). Extrapolated to the Danish population (population size of 4.1M people aged 16+ years), flourishing was estimated at $-1.2bn (95% CI = $-2.3bn, $-149.0M) in healthcare costs and sickness benefit transfers.

Additionally, we follow recommendations to assess the implications of each limit within our confidence intervals (Amrhein et al., 2019). According to these estimates, the lower costs associated with flourishing may range from $149.0M to $2.3bn. Both of these values and all values inside this interval are reasonably compatible with our data. Notably, even the lowest value within this interval is substantial and warrants attention. In 2017, the Danish government spent a total of $24.5bn on the healthcare sector (Dam, 2019). If the estimated $1.2bn in reduced costs could have been achieved by moving a large segment of the population to a flourishing state (this scenario being strictly hypothetical), the Danish government would have had the freedom to potentially allocate these financial resources to other priorities within or beyond the healthcare system. Similarly, funds that would otherwise have been transferred to workers due to sickness absence could also have been used for different welfare budgets or other purposes.

Considering the large differences in expenditure between those who flourish and those below the threshold level of flourishing, the potential return on investment for programs and policies that promote mental health and well-being would be sizable and financially well worth the effort. Policy and research priorities formed by the European Commission and the World Health Organization support the view that a focus on promoting mental health and well-being is crucial for long-term growth and sustainable development (Forsman et al., 2015; EU, 2019; WHO, 2005). Our results add to a growing evidence base (Knapp et al., 2011; Nurse et al., 2014) suggesting that increasing the population prevalence of flourishing individuals could have the potential added benefit of curbing care costs for physical as well as mental health problems. That said, it should be noted that the results of the present study show that flourishing predicts future healthcare expenditure, but we cannot make firm inferences regarding directions of causality. For example, we cannot exclude the possibility that in the years prior to the survey, healthier lifestyles could have predicted both flourishing and a reduced need for future healthcare services. Although there is evidence from the U.S. that change in well-being (as a result of intervention) is related to reductions in healthcare expenditure (Sears et al., 2013), future intervention research, especially within a European setting, is strongly warranted to provide causal evidence.

The prevalence of flourishing in 2016 was 34.7%, which is substantially lower than 55.8% in 2012 and 52.7% 2006. It is possible that the decline in flourishing prevalence over this period could have contributed to escalating healthcare expenditure over the same period. It may also be noted that the prevalence does not appear to have declined due to the global financial crisis in 2007–2008; in fact, our data revealed a slight, albeit non-significant, increase in the prevalence of flourishing from 2006 to 2012. This trend is in line with previous research suggesting that while low levels of well-being and mental health problems are strongly associated with socioeconomic factors, the same pattern is not observed for high levels of well-being (Stewart-Brown et al., 2015; Kahneman & Deaton, 2010; Santini et al., 2020; Van Lente et al., 2012; Nielsen et al., 2016; Solin et al., 2019).

Promoting mental health and well-being is not the same as preventing poor mental health or mental illness (although the two are related and overlap). Whereas the prevention of poor mental health and illness generally focuses on reducing risk factors for these conditions (e.g., combating poverty or bullying), promoting mental health and well-being focuses on strengthening protective factors and resources for thriving and flourishing (e.g., boosting self-efficacy or encouraging gratitude, meaning, and purpose in life). To exemplify the difference: Being poor or bullied increases the risk of mental health problems or mental illness, and hence ensuring social safety and implementing anti-bullying initiatives are important preventative measures. But *not* being poor or bullied will not in itself result in good mental health and well-being, let alone flourishing. Therefore, initiatives with a specific focus on promoting mental health and well-being are also needed. In light of our results, such initiatives may not only promote mental health and well-being, but may also be beneficial from a financial perspective (Santini et al., 2021). Protective factors and resources for mental health and well-being should be promoted at several levels—namely, individual, community, and societal—as there will always be an interplay between these levels. Various research studies have explored social, recreational and lifestyle factors that are predictive of high levels of well-being and flourishing (Lyubomirsky et al., 2005; Santini et al., 2020; Santini et al., 2018; VanderWeele, 2020, 2017; Barry, 2009; Kalra et al., 2012; Regan et al., 2016; Lyubomirsky & Layous, 2013; Sin & Lyubomirsky, 2009; Bolier et al., 2013). Societal and policy efforts are important in promoting flourishing, such as strengthening social capital and community coherence. Individual activities can also make important contributions, such as keeping active in various ways, connecting with others, and engaging in meaningful causes or challenges (Santini et al., 2018; VanderWeele, 2020; Lyubomirsky & Layous, 2013; Sin & Lyubomirsky, 2009; Bolier et al., 2013). From a health economic perspective, taking the step further would imply considering the cost-benefit of any action that could promote flourishing (presumably alongside other relevant outcomes) (Knapp et al., 2011; Nurse et al., 2014).

Some strengths and limitations should be kept in mind when interpreting the results. Major strengths include the prospective design, the use of a validated scale for measuring flourishing, and the use of a population-based survey linked with national registers. This approach made it possible to make direct links between flourishing in one year and cost outcomes expressed in monetary terms in the subsequent year, as well as a range of register-based covariates. Some limitations to consider include: first, the relatively low (34%) response rate to the survey; although this is not unusual for web-based surveys, selection bias cannot be ruled out. Second, response rates were higher for women, individuals aged 45 years old and above, individuals with higher (tertiary) education, individuals who were married or in a registered partnership,

employed individuals, individuals with a non-immigrant background, and individuals with higher incomes (Nielsen et al., 2017). We applied weights in all analyses, which to some extent reduced the statistical uncertainty related to selection bias. Third, in terms of the criteria used for flourishing, it may be considered that the distinction between hedonic and eudaimonic well-being is not universally agreed upon (Kashdan et al., 2008), and some scholars have argued that eudaimonic well-being tends to predict hedonic well-being, rather than the two simply reflecting different facets of well-being (Sheldon, 2018). Fourth, we were not able to restrict healthcare cost outcomes to those pertaining to mental health care only, both due to data restrictions and due to the fact that some mental health care in Denmark is provided through primary care or other care services outside the psychiatry. Hence, we were not able to tease out the differences between associations with general health care and mental health care specifically, and future research is needed to explore this. Last, it is worth noting that the results are not necessarily generalisable to other countries, especially those outside Scandinavia. Denmark is different from most countries in the world with regard to its healthcare system, economy, and social structure, which may affect how flourishing is associated with healthcare expenditure as compared to other country settings. As mentioned earlier, only one American study reported an inverse association between flourishing (as a component of complete health) and healthcare utilization (Keyes & Grzywacz, 2005), which is in line with our findings. However, healthcare utilization in the U.S. is heavily dependent on private or company health insurance, which may affect the relationship between flourishing/non-flourishing and healthcare utilization or expenditure (e.g. individuals may *not* be flourishing but may also *not* utilize healthcare services due to lack of insurance).

Because some relevant variables, such as alcohol consumption, smoking, and nutrition, were not available in our dataset, we could not adjust for these factors, although they may also be mediators. Furthermore, the flourishing assessment was made based on one particular conceptualization of flourishing, and conceptualizations that include other components, such as a greater emphasis on character (e.g., ability to delay gratification) and virtue (e.g., doing good for others) (VanderWeele, 2017) may have produced different results. Importantly, flourishing here was specifically *psychological* flourishing. Some flourishing assessments include physical health (VanderWeele, 2017), which would have been problematic in this study given its focus on assessing the effects of flourishing on healthcare costs; thus, we restricted the assessment to psychological flourishing and adjusted for physical health in the analyses. Finally, there was some overlap between the time of the survey (October 2016) and the data on costs (2016 and 2017). In this study, our final results are based on analytical models that adjusted for health status and health behaviour (apart from demographics and socioeconomic factors). We did this to minimize the confounding of health factors; however, overadjustment is a possibility, as we already adjusted for past healthcare utilization, hence, we conducted two models with and without the adjustment for health factors. Finally, our results pertain to the included outcomes, but flourishing may also be related to numerous other costs (for more information, see Santini et al., 2021), for example, our results do not capture loss to productivity (both in regard to paid and unpaid work) due to long-term sick leave. Also, our results capture reductions in costs associated with flourishing over the short-term (one year from assessment), but not flourishing over the longer term (e.g. continuously flourishing over repeated assessments/-years). Taking these things into account, our results may be considered conservative from a public health and economic standpoint.

5. Conclusion

The results of the present study lend support to and expand prior findings that flourishing predicts lower costs in terms of future healthcare expenditure and sickness benefit transfers. Flourishing was associated with lower healthcare costs ($-687.7, 95% CI = $-1295.0, $-80.4) and lower sickness benefit transfers ($-297.8, 95% CI = $-551.1, $-44.0) per person in 2017, as compared to the below threshold level of flourishing. Extrapolated to the Danish population (population size of 4.1M people aged 16+ years), flourishing was estimated at $-1.2bn (95% CI = $-2.3bn, $-149.0 M) in healthcare costs and sickness benefit transfers. Because these estimates cover the cost outcomes included in this study and refer to the potential reductions in short-term costs associated with flourishing, they must be considered conservative from a societal perspective. Even so, the lower costs associated with flourishing are substantial and warrant attention. Increasing the number of individuals who flourish in the population could potentially free up resources and reduce costs in the short term, as well as generate cost savings for society in the longer term.

Contributor statement

All authors have contributed to the work submitted.

Declaration of Competing Interest

No conflicts of interest declared.

Acknowledgments

None declared.

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.

Funding

Nordea-fonden.

No support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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.

Appendix 1. The European social survey (ESS)

The European Social Survey (ESS) is a biennially repeated cross-sectional investigation conducted in a wide range of European countries. We used data specifically from the well-being modules (Rasmussen & Kristensen, 2019; Dam, 2019), which were only included in the third and sixth round of the survey conducted in 2006 and 2012, respectively. The ESS selected participants using strict probability samples of the resident national population aged 15 or older living in private households. Data were gathered via face-to-face interviews with standardized questionnaires. Statistical data and comprehensive methodological documentation are freely available on the website of the ESS (www.europeansocialsurvey.org). The ESS subscribes to the Declaration on Professional Ethics of the International Statistics Institute (Knapp et al., 2011). According to this declaration, participants must be protected against potentially harmful effects of taking part in the survey. Hence, participation was based on participants' voluntarily given informed consent. For this analysis, we included only one of the available ESS countries at both rounds - namely, Denmark. The sample size for Denmark was 1,505 in 2006 (response rate 50.8%) and 1650 in 2012 (response rate 49.4). In the 2006 data, 4.8% of the flourishing data were missing, leaving a final sample size of 1433, while 3.9% of the flourishing data were missing in the 2012 data, leaving a final sample size of 1585. Because some items in the flourishing scale were changed from round three to round six of the ESS, items on positive relationships and engagement were not identical in both rounds. However, it is possible to arrive at almost identical flourishing scales for both rounds (Dam, 2019; Nurse et al., 2014). The flourishing scale has been validated using the ESS data, including measurement invariance testing across European regions (including Scandinavia) (Kim et al., 2021).

References

1. Huppert F, Marks N, Clark A, Siegrist J, Stutzer A, Vittersø J, et al. Measuring Well-being Across Europe: Description of the ESS Well-being Module and Preliminary Findings. Social Indicators Research. 2009;91(3):301-15.

2. Harrison E, Quick A, Abdallah S, editors. Looking through the wellbeing kaleidoscope2016.

3. ISI. Declaration on Professional Ethics. Reykjavik, IS: ISI; 2010.

4. Santini ZI, Meilstrup C, Hinrichsen C, Nielsen L, Koyanagi A, Koushede L. Associations between formal volunteer activity and psychological flourishing in Scandinavia: Findings from two cross-sectional rounds of the European Social Survey. 2018;6:255-69.

5. Huppert F, So TTC. Flourishing across Europe: Application of a new conceptual framework for defining well-being. Social Indicators Research. 2013;110(3):837-61.

Table A1.1
Flourishing items in the ESS rounds 3 and 6.

Factor	Feature	Rounds	Sample item
Positive characteristics	Optimism[a]	Both	Always optimistic about my future
	Self-esteem[a]	Both	In general feel very positive about myself
	Vitality[b]	Both	Had lot of energy, how often past week
	Emotional stability[b]	Both	Felt calm and peaceful, how often past week
	Resilience[a]	Both	When things go wrong in my life, it takes a long time to get back to normal (reverse scored)
Positive functioning	Competence[a]	Both	Feel accomplishment from what I do
	Meaning[a]	Both	Feel what I do in life is valuable and worthwhile
	Positive relationships[a]	Round 3	There are people in my life who care about me
	Positive relationships[a]	Round 6	Receive help and support from people you are close to
	Engagement[a]	Round 3	Love learning new things
	Engagement[a]	Round 6	Absorbed in what you are doing, how much of the time
Positive emotion	Happiness[c]	Both	How happy are you

[a] Response options were as follows: strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree.
[b] Response options were as follows: all or almost all of the time, most of the time, some of the time, and none or almost none of the time.
[c] Response options were as follows: 0 (extremely unhappy), 1, 2, 3, 4, 5, 6; 7, 8, 9, and 10 (extremely happy).

Appendix 2.

Sources

[1] K. Furu, B. Wettermark, M. Andersen, J. E. Martikainen, A. B. Almarsdottir, and H. T. Sørensen, "The Nordic Countries as a Cohort for Pharmacoepidemiological Research," *Basic Clin. Pharmacol. Toxicol.*, vol. 106, no. 2, pp. 86–94, Feb. 2010.

[2] M. Kruse and T. Christiansen, "Register-based studies of healthcare costs," *Scand. J. Public Health*, vol. 39, no. 7, pp. 206–209, 2011.

[3] J. Sahl Andersen, N. De Fine Olivarius, and A. Krasnik, "The Danish national health service register," *Scand. J. Public Health*, vol. 39, no. 7, pp. 34–37, 2011.

Table A2
Information on healthcare costs components.

Register-based cost studies	The tracking of individual contacts within the healthcare system over time and across institutions is made feasible by an anonymized unique personal identification number (CPR-number). A resident's CPR number is granted at birth or upon immigration and is included in all national registers. Statistics Denmark encrypts the CPR number before releasing data for research [1,2].
General Practitioners (GPs) and specialists	Unit costs for contacts with the primary care sector were estimated based on the fee paid by the government to the healthcare professionals (General Practitioners and specialists). The data on contacts with the primary care sector was stratified from the Danish National Health Service Register (NHSR)). The NHSR contains information on doctor and patient centered data. Data on services for GPs and specialists comprises more than 200 individually priced services. The prices are agreed upon between the Organization of General Practitioners and the Danish regions. Data on contacts with patients and type of service delivered are reported to the NHSR as all GPs are linked to a uniform computer system [1,3].
Hospitalizations and outpatient services	The National Patient Register (Danish: Landspatientregisteret (LPR)) was used to obtain the costs for hospitalization and outpatient treatment [4]. The LPR includes both administrative and clinical data. The administrative data are patient centered. As soon as a person has been examined or hospitalized, the hospital records a series of information about the patient: The person's CPR number, background information on causes leading to hospital contact, etc. Clinical data relates to diagnosis and treatment procedures. Here, the LPR adapts the International Classification on Diseases, version (ICD-10). The National Patient Register includes all full-time admissions, emergency room contacts, and outpatient contacts for each CPR number respectively. Each treatment for a similar condition is linked to a rate that represents the average

(*continued on next page*)

Table A2 (*continued*)

	cost of a treatment course. We used these Diagnosis Related Groups charges (DRG) for admissions and Danish outpatient charges (DAGS) for outpatient contacts as unit cost estimates [5]. Admissions related to normal births, sterilization or healthy companions (the system registers when a patient needs a companion during appointments) were not included.
Prescription medicines	The Danish National Prescription Registry (DNPR) was used to estimate the unit costs of prescription medicines. The DNPR holds information on prescription drugs acquired at Danish pharmacies. We applied the market price as a unit cost estimate [9]. Out-of-pocket payments were deducted from the total cost, thereby generating a cost outcome that pertains strictly to government healthcare expenditure.
Sickness benefit transfers (long-term)	The LPR was used to extract relevant information on sickness benefit transfers. The Danish register includes information on sickness benefit transfers (long-term) when individuals are absent from work due to sickness for at least 31 days, i.e. absence is not registered for periods less than 31 days (short-term). Sickness benefit transfers (long-term) are estimated based on the weekly number of hours absent from work and respective salary [6–8]. Analyses on sickness benefit transfers were only applied to the subgroup of the study sample who fall in the working age population (range of 16 to 64 years).

Table A3
Extrapolating results to the Danish population.

	Healthcare costs	
	% in DMHWBS 2016	Persons in the Danish population[a]
Persons 16+ years old		4,106,988
Flourishing	34.7	1,425,125
	Sickness benefit transfers	
	% in DMHWBS 2016	Persons in the Danish population[a]
Employed persons 16-64 years old		2,245,056
Flourishing	34.7	779,034

[a] From Statistics Denmark:
Note. Persons in the Danish population 16+ years old per Jan 1, 2017: 4,106,988
Persons in the Danish population 16-64 years old per Jan 1, 2017: 3,067,016
Total average annual employment rate for 2017: 73.2
Employed persons in the Danish population 16-64 years old per Jan 1, 2017: 2,245,056

Table A4.1
Unadjusted mean annual healthcare costs and sickness benefit transfers in 2017 (reported as DKK) per person by flourishing categories (measured in 2016) among Danish adults aged 16+ years.

	Below threshold level of flourishing		Flourishing	
	Mean	95% CI	Mean	95% CI
Healthcare costs	19,816.3	17,157.4, 22,475.2	12,092.4	10,022.5, 14,162.3
Sickness benefit transfers	5472.0	3876.8, 7067.1	1655.2	694.6, 2615.8

Note. DKK = Danish Krone (official currency of Denmark), 1DKK = USD$0.13 PPP.

Table A4.2
Per person healthcare costs and sickness benefit transfers in 2017 (reported as DKK) associated with flourishing as compared to the below threshold level of flourishing (measured in 2016) among Danish adults aged 16+ years.

	Model 1		Model 2	
	Healthcare costs			
	Marginal effect	95% CI	Marginal effect	95% CI
Below threshold level of flourishing	Ref.		Ref.	
Flourishing	-4658.1	-8794.7, -521.5	-5144.8	-9687.5, -602.1
	Sickness benefit transfers			
	Marginal effect	95% CI	Marginal effect	95% CI
Below threshold level of flourishing	Ref.		Ref.	
Flourishing	-2763.5	-4503.2, -1023.2	-2227.5	-4125.9, -329.2

Note. DKK = Danish Krone (official currency of Denmark), 1DKK = USD$0.13 PPP.
Model 1 adjusted for age, sex, migration background, education, marital status, employment status (expect not adjusted for employment status in models estimating sickness benefit transfers), income, and 2016 costs. Model 2 adjusted for all the aforementioned covariates as well as chronic conditions, any psychiatric condition, and physical activity.

[4] E. Lynge, J. L. Sandegaard, and M. Rebolj, "The Danish National Patient Register," *Scand. J. Public Health*, vol. 39, no. 7, pp. 30–33, 2011.

[5] C. Kronborg, G. Handberg, and F. Axelsen, "Health care costs, work productivity and activity impairment in non-malignant chronic pain patients," *Eur. J. Heal. Econ.*, vol. 10, no. 1, pp. 5–13, 2009.

[6] J. Anker, J. Lindén, M. H. Wegner, and J. A. Holch, "Overview and analysis minimum income schemes in Denmark A Study of National Policies," no. April, 2009.

[7] M. Baadsgaard and J. Quitzau, "Danish registers on personal income and transfer payments," *Scand. J. Public Health*, vol. 39, no. 7, pp. 103–105, 2011.

[8] Statistics Denmark, "The Public Health Insurance Register," *2017*. [Online] Available: https://econ.au.dk/the-national-centre-for-register-based-research/danish-registers/the-public-health-insurance-register/.

[9] H. Wallach Kildemoes, H. Toft Sørensen, and J. Hallas, "The Danish national prescription registry," *Scand. J. Public Health*, vol. 39, no. 7, pp. 38–41, 2011.

Appendix 3. Population data for Denmark

Table A4.3
Per person healthcare costs and sickness benefit transfers in 2017 (reported as DKK) associated with all covariates (in 2016) among Danish adults aged 16+ years.

	Healthcare costs		Sickness benefit transfers	
	Probit			
	Coef	95% CI	Coef	95% CI
Below threshold level of flourishing	Ref.		Ref.	
Flourishing	-0.01	-0.3, 0.1	-0.3	-0.5, -0.1
Male	Ref.		Ref.	
Female	0.3	0.1, 0.5	0.3	0.1, 0.5
Age	0.01	0.002, 0.02	0.0006	-0.01, 0.01
Non immigrant	Ref.		Ref.	
Immigrant or descendent of immigrant	-0.2	-0.5, 0.2	-0.44	-0.9, 0.006
Education primary or unknown	Ref.		Ref.	
High school	0.1	-0.2, 0.3	-0.06	-0.3, 0.2
Tertiary education	-0.1	-0.3, 0.2	-0.2	-0.5, 0.06
Married/registered partnership	Ref.		Ref.	
Divorced, separated partners, widowed	-0.3	-0.6, 0.02	0.03	-0.26, 0.32
Unmarried	0.002	-0.3, 0.3	-0.09	-0.33, 0.16
Income highest quartile	Ref.		Ref.	
Income second-highest quartile	-0.1	-0.4, 0.2	0.02	-0.2, 0.3
Income second-lowest quartile	-0.3	-0.6, 0.004	0.3	0.01, 0.5
Income lowest quartile	-0.4	-0.7, -0.1	0.3	-0.05, 0.6
Missing	-0.9	-0.5, 0.3	0.1	-0.3, 0.5
Employed	Ref.		NA	NA
Unemployed	-0.2	-0.6, 0.3	NA	NA
Student	0.2	-0.2, 0.7	NA	NA
Retired	0.002	-0.4, 0.4	NA	NA
Social pension/early retirement	-0.4	-0.9, 0.2	NA	NA
Other	-0.3	-0.8, 0.3	NA	NA
CCI Low	Ref.		Ref.	
CCI Moderate	-0.7	-1.4, 0.1	0.9	0.5, 1.3
CCI High	-1.7	-2.7, -0.6	1.2	0.09, 2.4
No psychiatric condition	Ref.		Ref.	
Any psychiatric condition	0.2	-0.3, 0.6	0.5	0.1, 0.8
Physically active less than weekly	Ref.		Ref.	
Physical active at least weekly	0.2	-0.1, 0.4	0.2	-0.1, 0.6
Costs 2016	0.02	0.02, 0.03	0.01	0.008, 0.02
	GLM			
	Coef	95% CI	Coef	95% CI
Below threshold level of flourishing	Ref.		Ref.	
Flourishing	-0.3	-0.6, -0.02	-0.2	-0.8, 0.3
Male	Ref.		Ref.	
Female	-0.08	-0.3, 0.18	0.06	-0.4, 0.5
Age	0.009	-0.005, 0.02	-0.006	-0.03, 0.02
Non immigrant	Ref.		Ref.	
Immigrant or descendent of immigrant	-0.06	-0.6, 0.5	-1.1	-2.0, -1.0
Education primary or unknown	Ref.		Ref.	
High school	-0.08	-0.4, 0.3	-0.2	-0.8, 0.3
Tertiary education	-0.08	-0.4, 0.3	-0.6	-1.1, 0.01
Married/registered partnership	Ref.		Ref.	
Divorced, separated partners, widowed	0.07	-0.3, 0.4	0.3	-0.3, 0.8
Unmarried	0.1	-0.3, 0.5	-0.08	-0.6, 0.5
Income highest quartile	Ref.		Ref.	
Income second-highest quartile	-0.3	-0.7, 0.04	-0.4	-0.9, 0.2
Income second-lowest quartile	-0.2	-0.6, 0.15	-0.3	-0.9, 0.4
Income lowest quartile	-0.1	-0.6, 0.3	-0.3	-1.04, 0.5
Missing	-0.4	-1.0, 0.2	-0.2	-0.8, 0.4
Employed	Ref.		Ref.	
Unemployed	-0.1	-0.8, 0.6	NA	NA
Student	-0.6	-1.2, -0.02	NA	NA
Retired	0.1	-0.3, 0.6	NA	NA
Social pension/early retirement	0.1	-0.6, 0.8	NA	NA

(*continued on next page*)

Table A4.3 (*continued*)

Other	0.8	-0.3, 1.9	NA	NA
CCI Low	Ref.		NA	NA
CCI Moderate	0.6	-0.04, 1.2	0.3	-0.2, 0.8
CCI High	1.6	0.15, 3.1	1.1	0.4, 1.7
No psychiatric condition	Ref.		Ref.	
Any psychiatric condition	-0.05	-0.6, 0.5	0.4	-0.3, 0.1
Physically active less than weekly	Ref.		Ref.	
Physical active at least weekly	0.07	-0.4, 0.5	-0.4	-1.3, 0.4
Costs 2016	0.02	0.02, 0.03	0.01	0.002, 0.01
	Marginal effect			
	Coef.	95% CI	Coef.	95% CI
Below threshold level of flourishing	Ref.		Ref.	
Flourishing	-5144.8	-9687.5, -602.1	-2227.5	-4125.9, -329.2
Male	Ref.		Ref.	
Female	-1342.3	-6295.4, 3610.8	1801.8	-166.9, 3771.5
Age	178.9	-93.7, 451.5	-21.3	-141.6, 99.0
Non immigrant	Ref.		Ref.	
Immigrant or descendent of immigrant	-1168.0	-11,706.7, 9370.7	-3497.6	-4907.4, -2087.7
Education primary or unknown	Ref.		Ref.	
High school	-1480.7	-8185.8, 5224.4	-1690.3	-5642.6, 2262.1
Tertiary education	-1545.7	-8845.7, 5754.4	-3726.2	-7451.6, -0.8
Married/registered partnership	Ref.		Ref.	
Divorced, separated partners, widowed	1213.1	-6005.8, 8431.9	1408.6	-1767.2, 4584.4
Unmarried	1917.5	-5466.6, 9301.7	-671.1	-2909.5, 1567.2
Income highest quartile	Ref.		Ref.	
Income second-highest quartile	-6591.8	-14,212.2, 1028.5	-1326.2	-3856.0, 1203.5
Income second-lowest quartile	-5105.7	-13,340.8, 3129.3	274.8	-3088.9, 3638.5
Income lowest quartile	-3143.8	-12,088.8, 5801.2	418.7	-3789.1, 4626.6
Missing	-7944.8	-18,276.9, 2387.3	-88.3	-3592.7, 3416.2
Employed	Ref.		NA	NA
Unemployed	-1963.9	-12,861.3, 8933.6	NA	NA
Student	-8177.0	-14,329.3, -2024.8	NA	NA
Retired	2353.7	-6103.9, 10,811.4	NA	NA
Social pension/early retirement	1782.8	-12,376.8, 15,942.5	NA	NA
Other	21,315.3	-20,788.3, 63,418.8	NA	NA
CCI Low	Ref.		Ref.	
CCI Moderate	11,675.4	-4682.4, 28,033.2	9960.6	2043.2, 17,878.1
CCI High	56,042.4	-51,306.6, 163,391.3	37,439.7	-9243.4, 84,122.9
No psychiatric condition	Ref.		Ref.	
Any psychiatric condition	-822.2	-10,431.6, 8787.2	5661.9	-1040.1, 12,363.9
Physically active less than weekly	Ref.		Ref.	
Physical active at least weekly	1332.7	-6448.4, 9113.8	-785.1	-5404.8, 3834.6
Costs 2016	447.0	307.6, 586.4	94.5	58.8, 130.3

Note. DKK = Danish Krone (official currency of Denmark), 1DKK = USD$0.13 PPP.
All results are model 2 results.

Appendix 4. Results in DKK

Table A4.4
Healthcare costs and sickness benefit transfers in 2017 (reported as DKK) associated with flourishing (as compared to the below threshold level of flourishing) for the Danish population aged 16+ years.

	Point estimate	
	Costs per person (DKK)	Extrapolated population costs (DKK)
Healthcare costs	-5144.8	-7,331,983,100.0
Sickness benefit transfers[a]	-2227.5	-1,735,298,235.0
Total	**-7372.3**	**-9,067,281,335.0**
	Lower bound estimate (based on the 95%CI lower bound limit)	
	Costs per person (DKK)	Extrapolated population costs (DKK)
Healthcare costs	-9687.5	-13,805,898,437.5
Sickness benefit transfers[a]	-4125.9	-3,214,216,380.6
Total	**-13,813.4**	**-17,020,114,818.1**
	Upper bound estimate (based on the 95%CI upper bound limit)	
	Costs per person (DKK)	Extrapolated population costs (DKK)
Healthcare costs	-602.1	-858,067,762.5
Sickness benefit transfers[a]	-329.2	-256,457,992.8
Total	**-931.3**	**-1,114,525,755.3**

Note. DKK = Danish Krone (official currency of Denmark), 1DKK = USD$0.13 PPP.
All extrapolations (see Appendix 3) are based on model 2 results that were statistically significant ($p < 0.05$).
[a] The result was extrapolated to the Danish population of employed individuals aged 16–64 years old.

References

Amrhein, V., Greenland, S., & McShane, B. (2019). *Scientists rise up against statistical significance*. Nature Publishing Group.

Anker J., Lindén J., Wegner M.H., Holch J. Overview and analysis of minimum income schemes in Denmark. A study of national policies. European Commission. DG Employment, Social Affairs and Equal Opportunities … 2009.

Barry, MM. (2009). Addressing the determinants of positive mental health: Concepts, evidence and practice. *International Journal of Mental Health Promotion, 11*(3), 4–17.

Bolier, L., Haverman, M., Westerhof, G. J., Riper, H., Smit, F., & Bohlmeijer, E. (2013). Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health, 13*(1), 119.

Curcio, N., Philpot, L., Bennett, M., Felius, J., Powers, M. B., Edgerton, J., et al. (2019). Anxiety, depression, and healthcare utilization 1 year after cardiac surgery. *The American Journal of Surgery, 218*(2), 335–341.

Dam P.S. Så meget koster det danske sundhedsvæsen. Berlingske. 2019.

De Neve, J., Diener, E., Tay, L., & Xuereb, C. (2013). *The objective benefits of subjective well-being*. New York, NY: UN Sustainable Development Solutions Network.

Deb, P., & Norton, E. C. (2018). Modeling health care expenditures and use. In *Annual Review of Public Health, 39* pp. 489–505).

Diehr P., Yanez D., Ash A., Hornbrook M., Lin D.Y. Methods for analyzing health care utilization and costs. Annu Rev Public Health. 1999;20:125-44. doi:10.1146/annurev.publhealth.20.1.125.

Diener, E., & Chan, MY. (2011). Happy people live longer: Subjective well-being contributes to health and longevity. *Applied Psychology: Health and Well-Being, 3*(1), 1–43.

Diener E., Pressman S.D., Hunter J., Delgadillo-Chase D. If, why, and when subjective well-being influences health, and future needed research. Applied Psychology: Health and Well-Being, 2017;9(2):133-167.

Diener, E., Suh, E.M., Lucas, R.E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. Psychological bulletin, 125(2), 276.

EPPI-Centre. CCEMG - EPPI-Centre Cost Converter: 2021 The campbell and cochrane economics methods group (CCEMG) & the evidence for policy and practice information and coordinating centre (EPPI-Centre); [Available from: https://eppi.ioe.ac.uk/costconversion/.

EU. (2019). *The economy of wellbeing - Draft council conclusions*. Council of the European Union. Brussels, BE[Available from https://data.consilium.europa.eu/doc/document/ST-13171-2019-INIT/en/pdf.

Forsman, A. K., Wahlbeck, K., Aaro, L. E., Alonso, J., Barry, M. M., Brunn, M., et al. (2015). Research priorities for public mental health in Europe: Recommendations of the ROAMER project. *European Journal of Public Health, 25*(2), 249–254.

Gandy W.M., Coberley C.R., Pope J.E., Rula EY. Well-being and employee health—How employees' well-being scores interact with demographic factors to influence risk of hospitalization or an emergency room visit. Population health management, 2014;17(1):13-20.

Harrison, P. L., Pope, J. E., Coberley, C. R., & Rula, EY. (2012). Evaluation of the relationship between individual well-being and future health care utilization and cost. *Population Health Management, 15*(6), 325–330.

Hone, L. C., Jarden, A., Schofield, G. M., & Duncan, S. (2014). Measuring flourishing: The impact of operational definitions on the prevalence of high levels of wellbeing. *International Journal of Wellbeing, 4*(1).

Huppert, F., & So, TTC. (2013). Flourishing across Europe: Application of a new conceptual framework for defining well-being. *Social Indicators Research, 110*(3), 837–861.

Huppert, F. (2009). A new approach to reducing disorder and improving well-being. *Perspectives on Psychological Science, 4*(1), 108–111.

Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. *Proceedings of the National Academy of Sciences, 107*(38), 16489–16493.

Kalra, G., Christodoulou, G., Jenkins, R., Tsipas, V., Christodoulou, N., Lecic-Tosevski, D., et al. (2012). Mental health promotion: Guidance and strategies. *European Psychiatry: The Journal of the Association of European Psychiatrists, 27*(2), 81–86.

Kashdan, T. B., Biswas-Diener, R., & King, LA. (2008). Reconsidering happiness: The costs of distinguishing between hedonics and eudaimonia. *The Journal of Positive Psychology, 3*(4), 219–233.

Keisler-Starkley, K., & Bunch, LN. (2019). *Health Insurance Coverage in the United States* (p. 2020). Washington, DC: United States Census Bureau.

Keyes, C. L. M., & Annas, J. (2009). Feeling good and functioning well: Distinctive concepts in ancient philosophy and contemporary science. *The Journal of Positive Psychology, 4*(3), 197–201.

Keyes, C. L., & Grzywacz, JG. (2005). Health as a complete state: The added value in work performance and healthcare costs. *Journal of Occupational and Environmental Medicine, 47*(5), 523–532.

Keyes, C. L., & Simoes, EJ. (2012). To flourish or not: Positive mental health and all-cause mortality. *American Journal of Public Health, 102*(11), 2164–2172.

Keyes, CLM. (2002). The mental health continuum: From languishing to flourishing in life. *Journal of health and social behavior, 43*(2), 207–222.

Keyes, C. L. M. (2015). Human flourishing and salutogenetics. In *Genetics of psychological well-being: The role of heritability and genetics in positive psychology* (pp. 3–19). Oxford Scholarship Online.

Kim, E. S., Delaney, S. W., Tay, L., Chen, Y., Diener, E. D., & Vanderweele, TJ. (2021). Life satisfaction and subsequent physical, behavioral, and psychosocial health in older adults. *The Milbank Quarterly, 99*(1), 209–239.

Knapp, M., McDaid, D., & Parsonage, M. (2011). *Mental health promotion and mental illness prevention: The economic case*. London School of Economics and Political Science. London, UK.

Kronborg, C., Handberg, G., & Axelsen, F. (2009). Health care costs, work productivity and activity impairment in non-malignant chronic pain patients. *The European Journal of Health Economics, 10*(1), 5–13.

Lyubomirski, S., Sheldon, K. M., & Schkade, D. (2005). Pursuing happiness: The architecture of sustainable change. *Review of General Psychology, 9*(2), 111–131.

Lyubomirsky, S., & Layous, K. (2013). How do simple positive activities increase well-being? *Current Directions in Psychological Science, 22*(1), 57–62.

Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin, 131*(6), 803.

Manning, W. G., & Mullahy, J. (2001). Estimating log models: To transform or not to transform? *Journal of Health Economics, 20*(4), 461–494.

Mihaylova, B., Briggs, A., O'Hagan, A., & Thompson, S. (2011). Review of statistical methods for analysing healthcare resources and costs. *Health Economics, 20*(8), 897–916.

Nielsen, L., Stewart-Brown, S., Vinther-Larsen, M., Meilstrup, C., Holstein, B. E., & Koushede, V. (2016). High and low levels of positive mental health: Are there socioeconomic differences among adolescents? *Journal of Public Mental Health, 15*(1), 37–49.

Nielsen L., Hinrichsen C., Santini Z.I., Koushede V. Måling af mental sundhed. En baggrundsrapport for spørgeskemaundersøgelsen Danskernes Trivsel 2016: Statens Institut for Folkesundhed, SDU; 2017.

Nurse J., Dorey S., Yao L., Sigfrid L., Yfantopolous P., McDaid D., et al. The case for investing in public health: a public health summary report for EPHO 8. 2014.

O'brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity, 41*(5), 673–690.

Pedersen, CB. (2011). The Danish civil registration system. *Scandinavian Journal of Public Health, 39*(7), 22–25. Suppl.

Rasmussen, M., & Kristensen, L. (2019). De offentlige sundhedsudgifter er steget markant mere end de øvrige offentlige udgifter siden 2000. *DST Analyse*, 1–9. https://www.dst.dk/da/Statistik/Analyser/visanalyse?cid=31651.

Regan, M., Elliott, I., & Goldie, I. (2016). *Better Mental Health for All: A Public Health Approach to Mental Health Improvement*. London: Faculty of Public Health and Mental Health Foundation.

Riley, C., Roy, B., Herrin, J., Spatz, E. S., Arora, A., Kell, K. P., et al. (2018). Association of the overall well-being of a population with health care spending for people 65 years of age or older. *JAMA Network Open, 1*(5), Article e182136. e.

Roy, B., Riley, C., Herrin, J., Spatz, E., Hamar, B., Kell, K. P., et al. (2019). Associations between community well-being and hospitalisation rates: Results from a cross-sectional study within six US states. *BMJ Open, 9*(11), Article e030017.

Ruhl, A. P., Huang, M., Colantuoni, E., Karmarkar, T., Dinglas, V. D., Hopkins, R. O., et al. (2017). Healthcare utilization and costs in ARDS survivors: A 1-year longitudinal national US multicenter study. *Intensive Care Medicine, 43*(7), 980–991.

Ryff, C. D., & Singer, B. (1998). The contours of positive human health. *Psychological Inquiry, 9*(1), 1–28.

Santini Z.I., Meilstrup C., Hinrichsen C., et al. Formal Volunteer Activity and Psychological Flourishing in Scandinavia: Findings from Two Cross-sectional Rounds of the European Social Survey. Social Currents. 2019;6(3):255-269. doi:10.1177/2329496518815868.

Santini Z.I., Donovan R., Koushede V. Here's a mental health workout that's as simple as ABC: The conversation; 2018 [Available from: https://theconversation.com/heres-a-mental-health-workout-thats-as-simple-as-abc-98124.

Santini, Z. I., Stougaard, S., Koyanagi, A., Ersbøll, A. K., Nielsen, L., Hinrichsen, C., et al. (2020). Predictors of high and low mental well-being and common mental disorders: Findings from a Danish population-based study. *European Journal of Public Health, 30*(3), 503–509. https://doi.org/10.1093/eurpub/ckaa021

Santini, Z. I., Becher, H., Jørgensen, M. B., Davidsen, M., Nielsen, L., Hinrichsen, C., et al. (2021). Economics of mental well-being: A prospective study estimating associated health care costs and sickness benefit transfers in Denmark. *Eur J Health Econ, 22*, 1053–1065. https://doi.org/10.1007/s10198-021-01305-0

Schotanus-Dijkstra, M., Pieterse, M. E., Drossaert, C. H. C., Westerhof, G. J., de Graaf, R., ten Have, M., et al. (2016). What factors are associated with flourishing? Results from a large representative national sample. *Journal of Happiness Studies, 17*(4), 1351–1370.

Schotanus-Dijkstra, M., ten Have, M., Lamers, S. M. A., de Graaf, R., & Bohlmeijer, E. T. (2016). The longitudinal relationship between flourishing mental health and incident mood, anxiety and substance use disorders. *The European Journal of Public Health, 27*(3), 563–568.

Sears, L. E., Shi, Y., Coberley, C. R., & Pope, JE. (2013). Overall well-being as a predictor of health care, productivity, and retention outcomes in a large employer. *Population Health Management, 16*(6), 397–405.

Sheldon, K. M. (2018). Understanding the good life: Eudaimonic living involves well-doing, not well-being. *The Social Psychology of Living Well*, 116–136.

Shi Y., Sears L.E., Coberley C.R., Pope J. Classification of individual well-being scores for the determination of adverse health and productivity outcomes in employee populations. Population health management, 2013;16(2):90-98.

Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: a practice-friendly meta-analysis. *J Clin Psychol., 65*(5), 467–487. https://doi.org/10.1002/jclp.20593

Solin, P. C. M., Reinikainen, J., Martelin, T., & Tamminen, N. (2019). Predicting high and low levels of positive mental health among people living alone in the Lapland region of Finland. *Journal of Public Mental Health, 18*(4), 214–223. https://doi.org/10.1108/JPMH-02-2019-0026

Statistics Denmark. BEF5: Population 1. January by sex, 2021 Age and country of birth [Internet]. Statistics Denmark. Available from: https://www.statbank.dk/BEF5.

Stewart-Brown, S., Samaraweera, P. C., Taggart, F., Kandala, N., & Stranges, S. (2015). Socioeconomic gradients and mental health: Implications for public health. *The British Journal of Psychiatry, 206*(6), 461–465.

Thygesen, L. C., Daasnes, C., Thaulow, I., & Brønnum-Hansen, H. (2011). Introduction to Danish (nationwide) registers on health and social issues: Structure, access, legislation, and archiving. *Scandinavian Journal of Public Health, 39*(7), 12–16. suppl.

Thygesen, S. K., Christiansen, C. F., Christensen, S., Lash, T. L., & Sørensen, HT. (2011). The predictive value of ICD-10 diagnostic coding used to assess Charlson comorbidity index conditions in the population-based Danish national registry of patients. *BMC Medical Research Methodology, 11*(1), 83.

Trudel-Fitzgerald, C., Millstein, R. A., von Hippel, C., Howe, C. J., Tomasso, L. P., Wagner, G. R., et al. (2019). Psychological well-being as part of the public health debate? Insight into dimensions, interventions, and policy. *BMC Public Health, 19*(1), 1712.

Van Lente, E., Barry, M. M., Molcho, M., Morgan, K., Watson, D., Harrington, J., et al. (2012). Measuring population mental health and social well-being. *International Journal of Public Health, 57*(2), 421–430.

VanderWeele, TJ. (2017). On the promotion of human flourishing. *Proceedings of the National Academy of Sciences, 114*(31), 8148.

VanderWeele, TJ. (2020). Activities for flourishing: An evidence-based guide. *Journal of Positive School Psychology, 4*(1), 79–91.

Walsh, L. C., Boehm, J. K., & Lyubomirsky, S. (2018). Does happiness promote career success? Revisiting the evidence. *Journal of Career Assessment, 26*(2), 199–219.

WHO. (2005). *Mental health action plan for Europe: Facing the challenges, building solutions.* World Health Organization. Copenhagen, DK.

Wooldridge, JM. (2009). Econometrics: Panel data methods. In RA Meyers (Ed.), *Encyclopedia of complexity and systems science* (pp. 2769–2792). New York, NY: Springer New York.