Adverse Weather Events and Mental Health: Evidence from Health Insurance Records

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Abstract

We examine direct mental health costs of climate change using high frequency electronic healthcare records data from 2005 to 2019 for around 1,000,000 Austrians. Adopting a fixed-effects estimator we find that a 1° C increase in mean quarterly temperature increases a) prescription drug expenditures for treatment of mental, behavioral and neurological disorders by €0.62 b) expenditures for outpatient treatment by €0.372 for psychologists, psychotherapists and psychiatrists, and c) expenditures for inpatient treatment of nervous system and mental and behavioral disorders by €2.29 on average. Using the projected mean temperature increase from SSP5-8.5 scenario for Austria until 2060, the estimated additional cumulative costs of healthcare expenditures are 82.834 billion Euro.

JEL Classification: I10, I12, I18, Q50, Q51, Q54.
Keywords: Weather, climate, mental health.

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Climate change and mental health are two critical global challenges , both expected to escalate further, leading to more damages and costs unless sufficient action is taken (Ingle and Mikulewicz, 2020). A recent policy brief by the World Health Organization acknowledges direct and indirect impacts of climate on mental health and well-being and calls for integration of climate change considerations into policies and programmes for public mental health (WHO, 2022).

Climate change and its negative impacts on physical health (e.g., increased mortality, frequency and gravity of respiratory and cardiovascular disease, food- and water-borne and infectious diseases) have been already well documented and their economic costs quantified (Carleton et al., 2020; Watts et al., 2018; Gage et al., 2008; Bosello et al., 2006). Yet mental health and well-being have been largely neglected and overlooked in their interrelation with climate change with only a few quantitative empirical studies (Mullins and White, 2019; Burke et al., 2018) available.

In this paper, we analyse the impacts of climate change reflected as variation in temperature, precipitation, and wind speed measured at fine spatial and temporal scale on mental health using electronic healthcare records from Upper Austrian Health Insurance Fund. Unlike Mullins and White (2019) or Burke et al. (2018) who use emergency department visits or suicide rates as a measure of mental health outcomes, we focus on non-acute and recurring costs of mental health reflected in claims from prescription drugs (such as antidepressants, anti-anxiety medications, anti-psychotics, stimulants and mood-stabilizers) as our main variables of interest. We also control for healthcare expenditures on outpatient treatment including treatments by psychologists and psychiatrists and inpatient treatment in hospitals.

Filling this gap in existing studies identifying impacts of temperature on specific severe mental health outcomes, we provide a comprehensive analysis of climate-change trigger direct medical costs corresponding to the use of the mental health care system's resources (Oliva-Moreno et al., 2009). Due to the richness of data used in our analysis we are able to examine: inpatient care (in general hospitals, psychiatric and day hospitals, and emergency room care), outpatient care (consultations with psychologists, psychotherapists, or psychiatrists), and claims on prescription based drugs. In this analysis we are also able to differentiate between mental and behavioral disorders and nervous system related claims.

Overlooking such recurring costs of mental health related to adverse weather conditions leads to potential underestimation of climate damages reflected in "social cost of carbon", reflecting the marginal cost of damages caused by emitting one extra ton of greenhouse gas into the atmosphere, and thus the benefits of reducing emissions. Since the social cost of carbon is used to inform billions of euros of policy and investment decisions in EU and all over the world, the underlying economic estimations have to be as comprehensive as possible. In this regard, for instance, a recent paper by Cromar et al. (2021) includes health impacts of climate change in the social cost of carbon and finds that health related

costs represent 8.7% of the social cost of carbon estimates, given such an effect of adding only physical eight diseases in the estimations suggests that improving the health-based portion of social cost of carbon estimates could have substantial impacts on the total magnitude of the economic costs of climate change and thereby on climate policy and investments.

For our measures of mental health we use data from Upper Austrian Health Insurance Fund, which covers basically all the employees of Upper Austria in the private sectors as well as co-insured members of their household. These data include all services that the health insurance funds have billed for their insured individuals in the corresponding period for inpatient, outpatient treatment, as well as prescription based drugs. We limit our sample to individuals older than 14 y.o. at the beginning of the observation period (January 2005). Weather data are sourced from the European Climate Assessment dataset consisting of daily station series obtained from climatological divisions of National Meteorological and Hydrological Services and station series maintained by observatories and research centres throughout Europe and the Mediterranean. The data include automatic daily measurements of temperature, precipitation, wind speed, sunshine duration, humidity and cloud coverage from more than 250 weather stations in Austria. We match each individual to the nearest weather station by the center of the zip-code area of their residence and assign the closest weather station. The average distance between the assigned weather stations and the centroid of zip-code area of individuals' residence is 6.7 kilometers.

In order to identify the causal impacts of adverse weather conditions on our measures of mental health, we adopt a panel fixed-effects methodology that is a standard in the climate economics literature (Mullins and White, 2019; Burke et al., 2018; Hsiang et al., 2017). We also include location-by-quarter fixed effects specifications enabling that the estimates are identified off of random year-to-year variation in weather within a given location and quarter. We find that on average a 1° C increase in mean quarterly temperature increases a) prescription drug expenditures for treatment of mental, behavioral and neurological disorders by €0.62 b) expenditures for outpatient treatment by €0.372 for psychologists, psychotherapists and psychiatrists, and c) expenditures for inpatient treatment by €2.29 of nervous system and mental and behavioral disorders, which if largely driven by increase in the inpatient treatment of the later (€1.47). Similar, although smaller in economic terms effects, are discovered for storm conditions (wind speed above 26 m/s). Further on, using projections from the IPCC report's scenario SSP5-8.5 for expected increase in mean temperatures in Austria, we estimate cumulative climate change triggered costs for public mental health care until 2060 of 82.834 billion Euro.

1 Estimation results

1.1 Mean air temperature

Table 1: Regression results mean temperature: prescription drugs' claims

	(1) Drug costs	(2) Drug costs	(3) Drug costs
Mean T ($°C$)	0.627***	0.651***	0.0357***
	(0.0685)	(0.0698)	(0.00244)
Precipitation (0.1 m)	-0.0535***	-0.0553***	-0.0241***
	(0.0123)	(0.0130)	(0.00154)
2.quarter	-6.673***		
	(0.975)		
3.quarter	-8.622***		
	(1.237)		
4.quarter	-0.493**		
	(0.193)		
Year FE	No		
Station FE	Yes		
Individual FE	Yes	Yes	Yes
Station-by-quarter FE		Yes	
Station-by-year FE			Yes
Constant	13.74***	9.594***	15.11***
	(0.363)	(0.978)	(0.0539)
N	37926601	37926601	37926601
adj. R^2	0.524	0.524	0.525

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Category atcN includes all prescription drugs for treatment of mental and behavioral and neurological disorders.

Table 2: Regression results mean temperature: outpatient treatment

	(1) Neurology, psychiatry	(2) Neurology, psychiatry	(3) Psychotherapy, psychology	(4) Psychotherapy, psychology	(5) Psychotherapy, psychology
Mean T ($°C$)	0.00299	0.192***	0.0250***	0.180***	0.262***
	(0.00541)	(0.0203)	(0.00593)	(0.0221)	(0.0313)
Precipitation (0.1 m)	-0.000160	-0.0125***	0.000487	-0.00850***	-0.0141***
	(0.000982)	(0.00229)	(0.00110)	(0.00204)	(0.00382)
2.quarter	-0.0621	-2.329***	-0.299***	-2.165***	-2.167***
	(0.0773)	(0.272)	(0.0873)	(0.292)	(0.241)
3.quarter	-0.180	-3.126***	-0.573***	-2.994***	-3.312***
	(0.107)	(0.347)	(0.116)	(0.379)	(0.345)
4.quarter	0.111***	-0.592***	-0.0891***	-0.657***	-1.089***
	(0.0228)	(0.0581)	(0.0238)	(0.0734)	(0.146)
Wind speed (0.1 m/s)					-0.000297
					(0.000824)
Sunshine (0.1 Hours)					-0.0237***
					(0.00579)
Year FE	Yes	No	Yes	No	No
Station FE	No	Yes	No	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes
Constant	2.268***	2.121***	1.355***	1.209***	1.945***
	(0.0272)	(0.0587)	(0.0321)	(0.0490)	(0.221)
N	37926601	37926601	37926601	37926601	32356846
adj. R^2	0.220	0.218	0.217	0.216	0.228

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Regression results mean temperature: inpatient treatment

	(1) Days,MH&BD	(2) Days,MH&BD	(3) Days,NS	(4) Days,NS	(5) Costs,MH&BD	(6) Costs,MH&BD	(7) Costs,NS	(8) Costs,NS
Mean T ($^{\circ}C$)	0.000514**	0.00248***	-0.00000322	0.000758***	0.186**	1.428***	0.0108	0.793***
	(0.000195)	(0.000316)	(0.0000705)	(0.000114)	(0.0670)	(0.194)	(0.0391)	(0.0938)
Precipitation (0.1 m)	-0.00000747	-0.000121*	-0.0000279**	-0.0000829***	-0.00190	-0.0732**	-0.0167*	-0.0600***
	(0.0000438)	(0.0000663)	(0.0000130)	(0.0000130)	(0.0123)	(0.0263)	(0.00867)	(0.0110)
2.quarter	-0.00530**	-0.0291***	0.000677	-0.00842***	-2.129**	-17.16***	0.0685	-9.407***
	(0.00255)	(0.00397)	(0.000979)	(0.00142)	(0.884)	(2.410)	(0.553)	(1.207)
3.quarter	-0.00570	-0.0366***	0.000641	-0.0112***	-2.177*	-21.69***	0.00173	-12.30***
	(0.00354)	(0.00480)	(0.00117)	(0.00171)	(1.120)	(2.864)	(0.653)	(1.449)
4.quarter	-0.00000130	-0.00735***	0.000375	-0.00248***	-0.162	-4.805***	0.104	-2.783***
	(0.000924)	(0.000840)	(0.000331)	(0.000424)	(0.264)	(0.480)	(0.185)	(0.301)
Constant	0.0679***	0.0661***	0.0211***	0.0207***	24.00***	22.85***	11.23***	10.46***
	(0.000992)	(0.00137)	(0.000401)	(0.000391)	(0.313)	(0.598)	(0.225)	(0.319)
Year FE	Yes	No	Yes	No	Yes	No	Yes	No
Station FE	No	Yes	No	Yes	No	Yes	No	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	37926601	37926601	37926601	37926601	37926601	37926601	37926601	37926601
adj. R^2	0.087	0.087	0.070	0.070	0.095	0.095	0.046	0.046

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

MH - mental health and behavioral disorders inpatient treatment in days and related costs; NS - nervous system inpatient treatment and related costs.

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