Measurable Health Effects Associated with the Daylight Saving Time Shift

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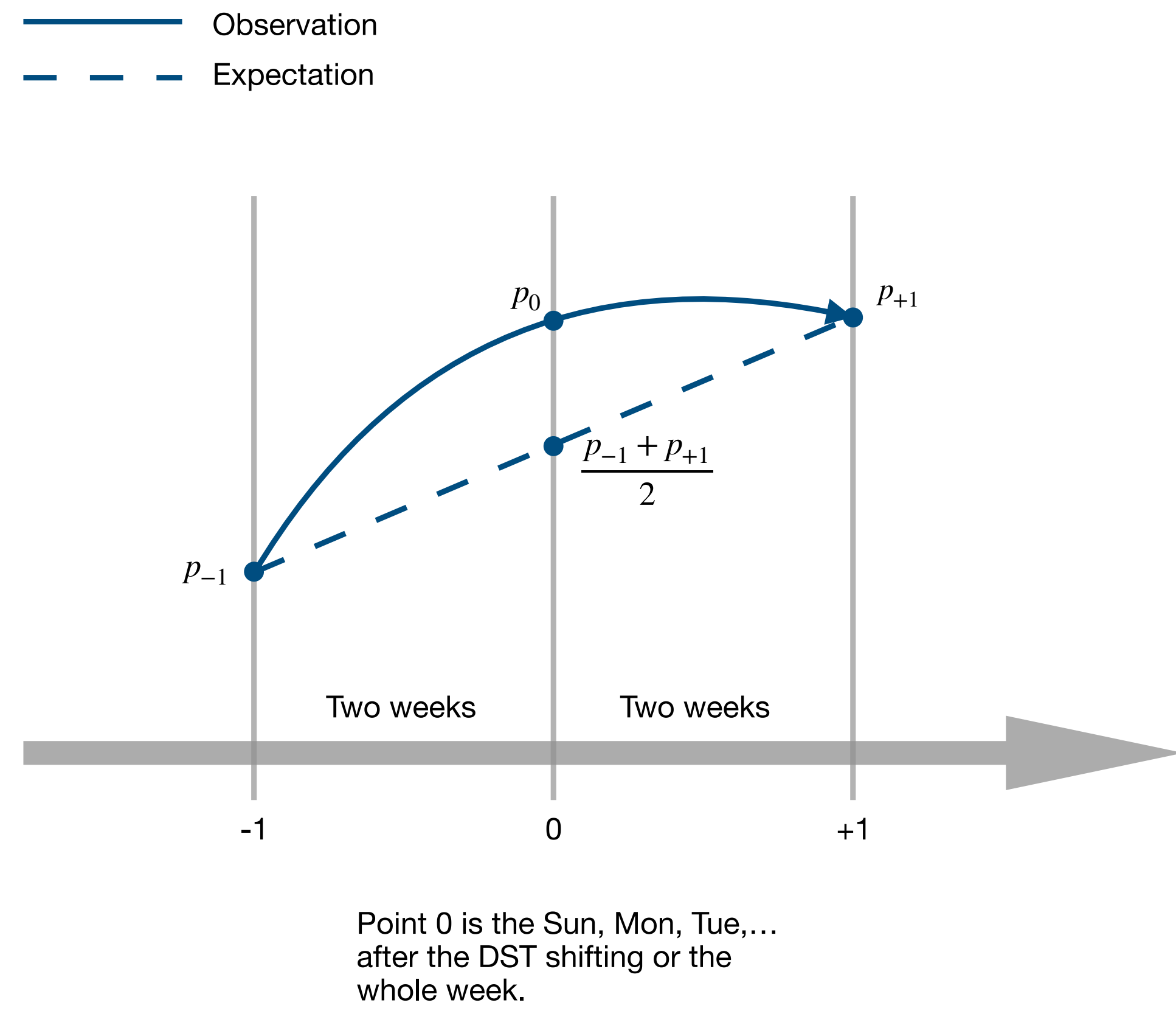The University of Chicago and Karolinska Institutet

NIH
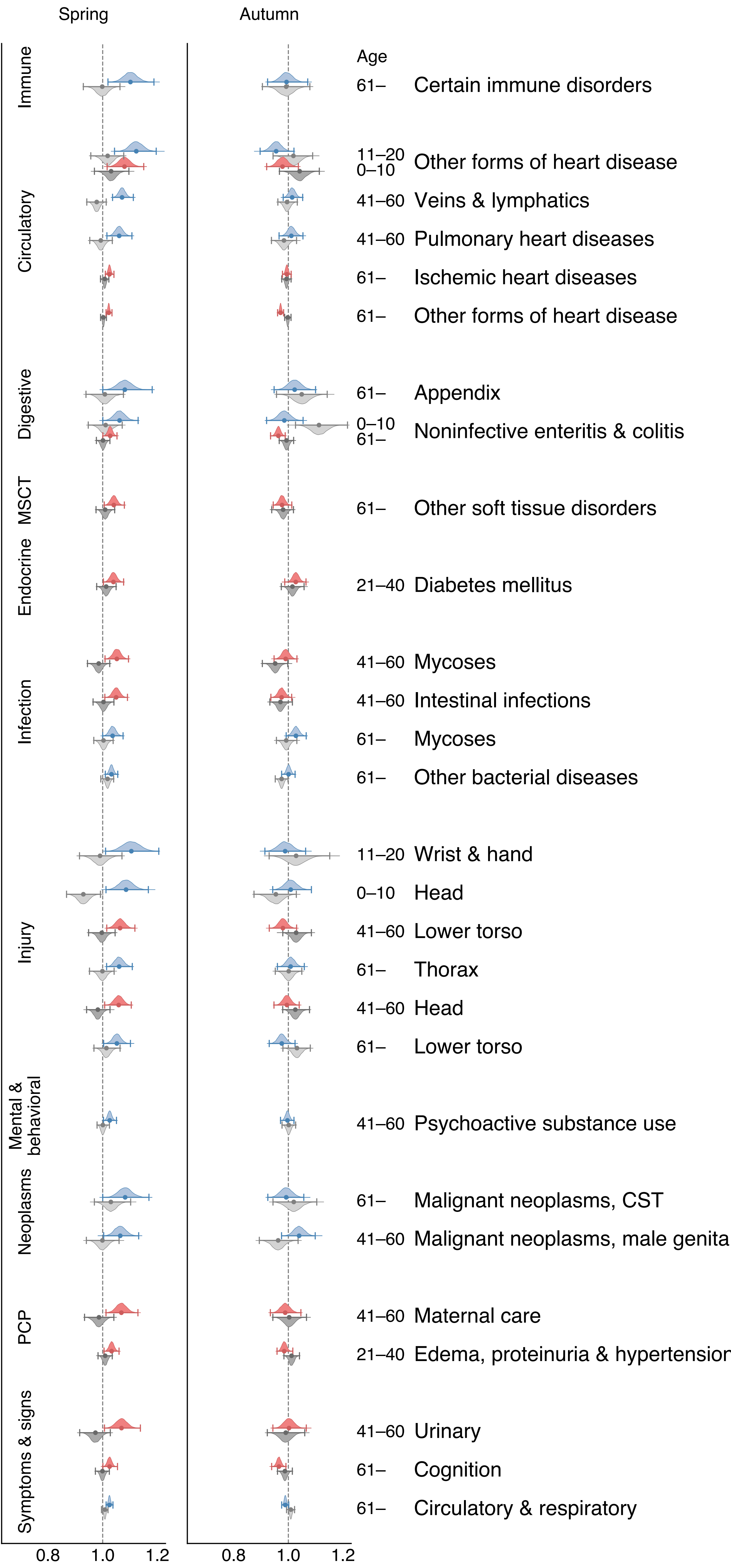National Institutes
of Health

Abstract

In a comprehensive, phenome-wide screening of the putative effects of the daylight-saving time (DST) shift in the United States and Sweden, we identified a few dozen diseases and clinical findings that register a significant relative risk (RR) increase immediately after the springtime shift. Our study identified the majority of these health effects for the first time and corroborated earlier published findings. Among these diseases, we identified five prominent, elevated risk clusters, including cardiovascular diseases (such as heart attacks), injuries, mental and behavioral disorders in children and teenagers, complications in childbirth-related procedures associated with advanced-age mothers, and immune-related diseases such as noninfective enteritis and colitis.
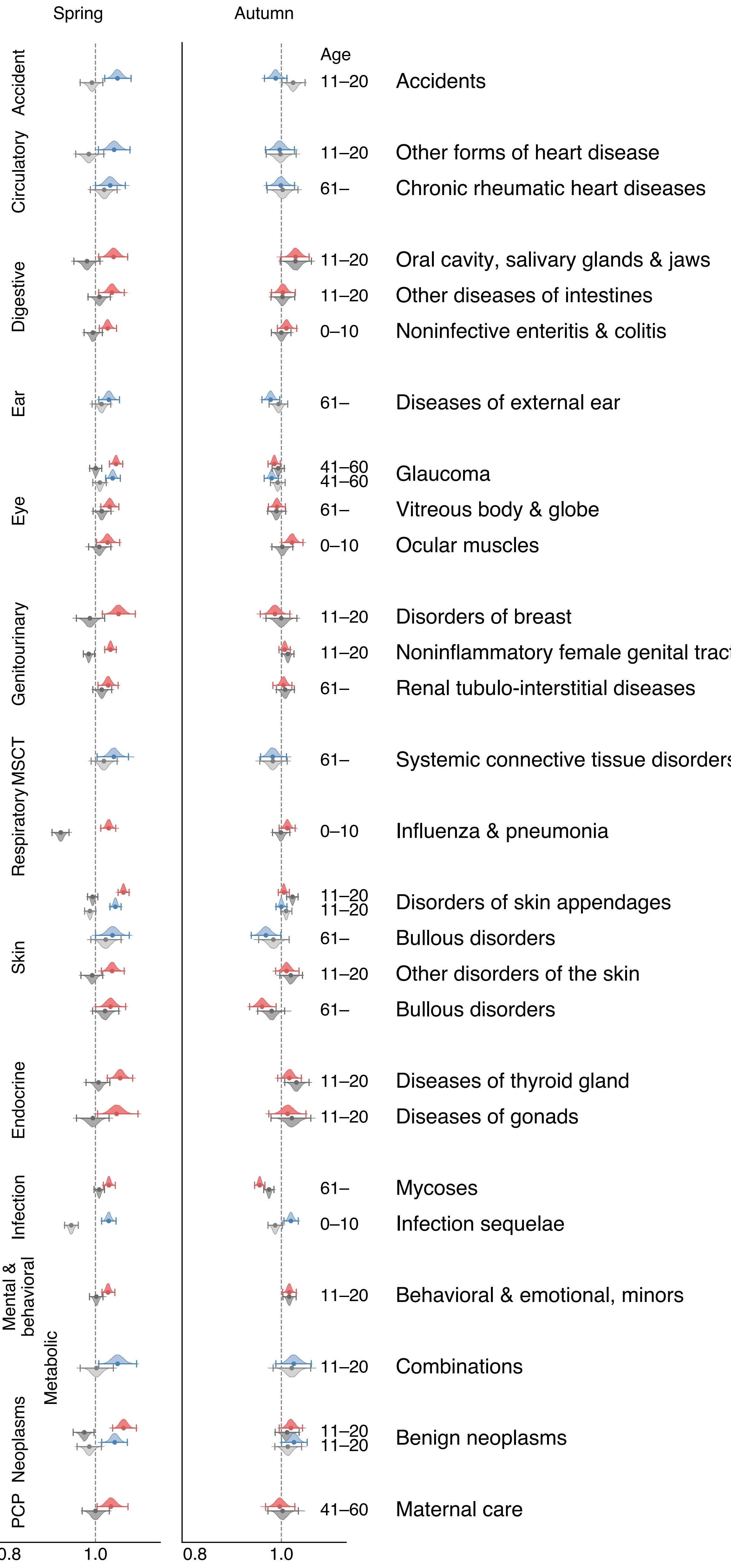
Materials and Methods

Our study accessed EHRs from two countries: In the US, through the IBM Watson Health MarketScan® dataset (150M patients), and in Sweden, through the Swedish national inpatient register (10M patients). We quantified the relative risk (RR) involved with shifting to and from DST by comparing the diagnosis rate for each day during the week following a DST shift to the linear expectation, which is the average diagnosis rate of the same week day, two weeks before and two weeks after the day of interest.

Observation

Expectation

p_{+1}

p_0

$\frac{p_{-1} + p_{+1}}{2}$

p_{-1}

Two weeks   Two weeks

-1   0   +1

Point 0 is the Sun, Mon, Tue,… after the DST shifting or the whole week.

In the US *inpatient* cohort, we detected a significant risk elevation in a number of disease and condition groups. We are the first to observe spring-DST-shift-associated complications in maternal care for women aged 41–60.

Spring   Autumn

Age

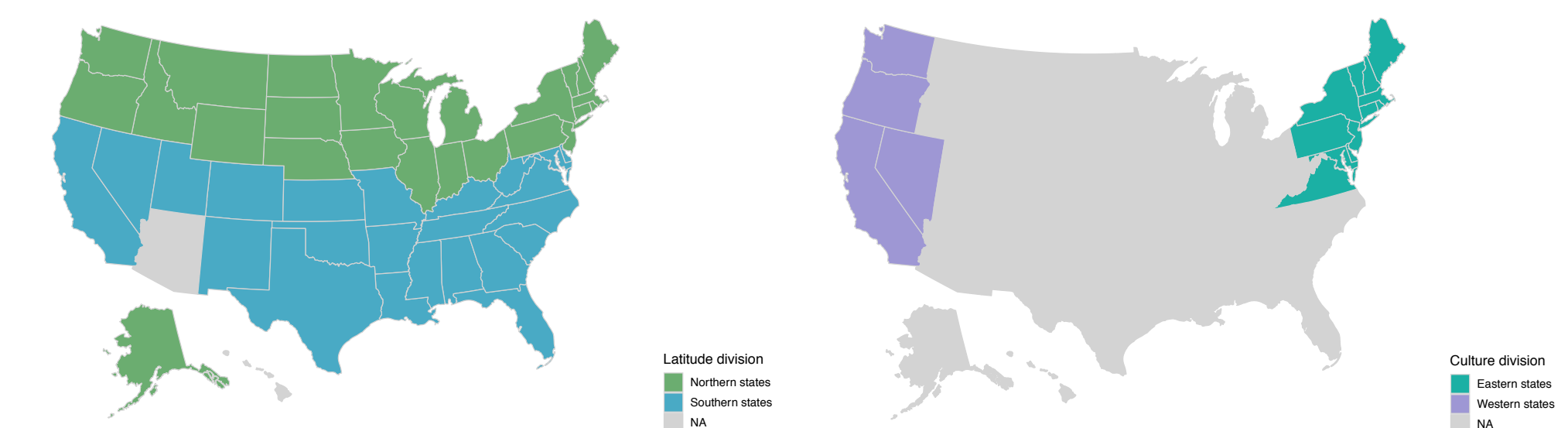| Category	Age	Condition
Immune	61–	Certain immune disorders
Circulatory	11–20, 0–10	Other forms of heart disease
	41–60	Veins & lymphatics
	41–60	Pulmonary heart diseases
	61–	Ischemic heart diseases
	61–	Other forms of heart disease
Digestive	61–	Appendix
	0–10, 61–	Noninfective enteritis & colitis
MSCT	61–	Other soft tissue disorders
Endocrine	21–40	Diabetes mellitus
Infection	41–60	Mycoses
	41–60	Intestinal infections
	61–	Mycoses
	61–	Other bacterial diseases
Injury	11–20	Wrist & hand
	0–10	Head
	41–60	Lower torso
	61–	Thorax
	41–60	Head
	61–	Lower torso
Mental & behavioral	41–60	Psychoactive substance use
Neoplasms	61–	Malignant neoplasms, CST
	41–60	Malignant neoplasms, male genital
PCP	41–60	Maternal care
	21–40	Edema, proteinuria & hypertension
Symptoms & signs	41–60	Urinary
	61–	Cognition
	61–	Circulatory & respiratory

0.8 1.0 1.2   0.8 1.0 1.2

For *all patients*, we also discovered novel significant signals, such as a spring-DST-shift-associated increase in mental and behavioral disorders. We validate previous findings in injuries and accidents and acute heart conditions.

Spring   Autumn

Age

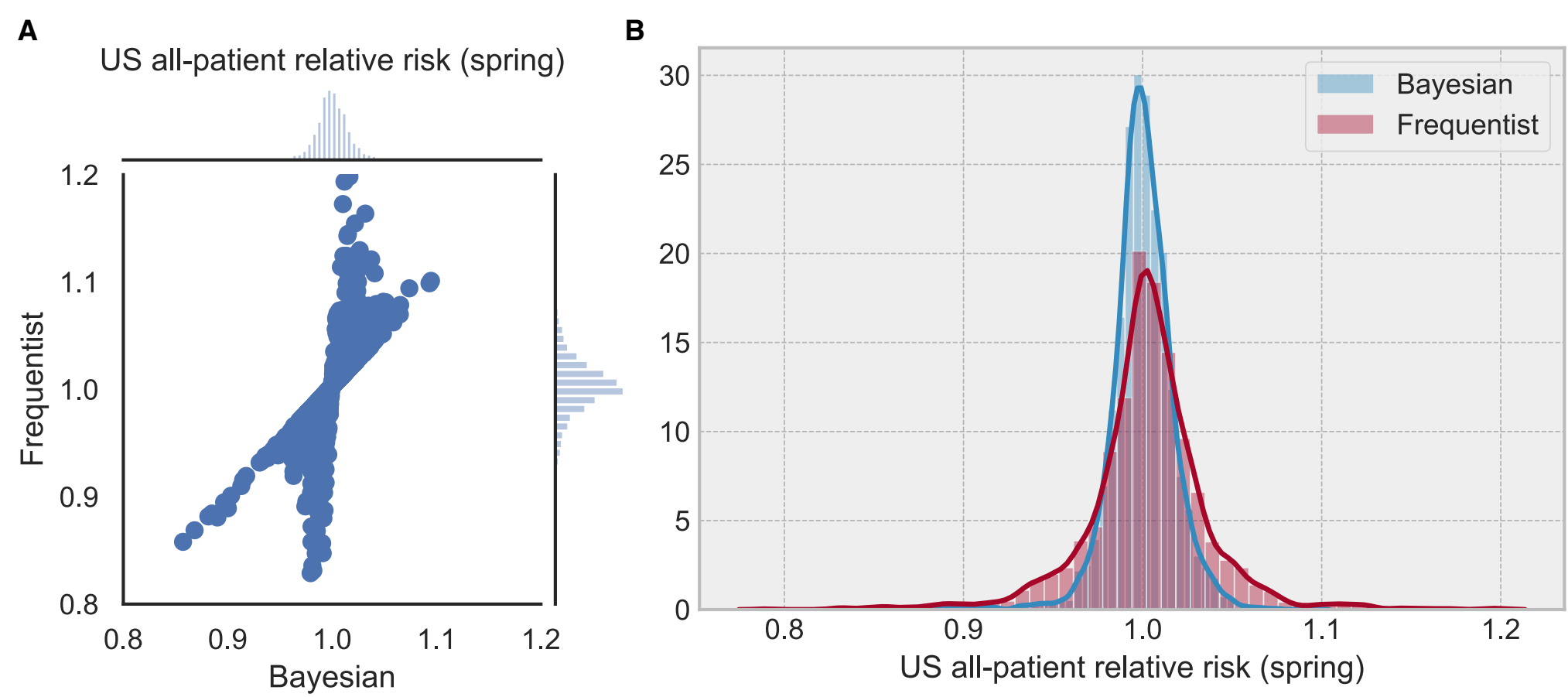| Category	Age	Condition
Accident	11–20	Accidents
Circulatory	11–20	Other forms of heart disease
	61–	Chronic rheumatic heart diseases
Digestive	11–20	Oral cavity, salivary glands & jaws
	11–20	Other diseases of intestines
	0–10	Noninfective enteritis & colitis
Ear	61–	Diseases of external ear
Eye	41–60, 41–60	Glaucoma
	61–	Vitreous body & globe
	0–10	Ocular muscles
Genitourinary	11–20	Disorders of breast
	11–20	Noninflammatory female genital tract
	61–	Renal tubulo-interstitial diseases
MSCT	61–	Systemic connective tissue disorders
Respiratory	0–10	Influenza & pneumonia
Skin	11–20, 11–20	Disorders of skin appendages
	61–	Bullous disorders
	11–20	Other disorders of the skin
	61–	Bullous disorders
Endocrine	11–20	Diseases of thyroid gland
	11–20	Diseases of gonads
Infection	61–	Mycoses
	0–10	Infection sequelae
Mental & behavioral	11–20	Behavioral & emotional, minors
Metabolic	11–20	Combinations
Neoplasms	11–20, 11–20	Benign neoplasms
PCP	41–60	Maternal care

0.8 1.0   0.8 1.0

Various Controls

We implemented controls in various ways. We compared geographical differences, Bayesian vs. frequentist methods, and negative controls on non-DST states and non-DST dates.

Latitude division: Northern states, Southern states, NA

Culture division: Eastern states, Western states, Middle states

Shrinkage and Multiple Comparisons

The multiplicity involved in constructing thousands of credible or confidence intervals simultaneously in the present study may have given rise to erroneous inferences. We controlled this problem in different–but appropriate–ways for the Bayesian and frequentist estimates. For the Bayesian method, we controlled multiplicity by an across-the-board prior. We adjusted the simultaneous confidence intervals constructed by the frequentist analyses by controlling the false coverage rate

A   US all-patient relative risk (spring)

Frequentist

Bayesian

B

Bayesian
Frequentist

US all-patient relative risk (spring)

Acknowledgements