Supplemental Material

Hospitalizations from Hypertensive Diseases, Diabetes, and Arrhythmia in Relation to Low and High Temperatures: Population-Based Study

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Table S1. Descriptive statistics of weather data in Ontario, Canada during 1996-2013

Region	The number of weather monitoring stations	Mean humidity (%)	Temperature									
			Mean	Min	1st	10th	25th	Med	75th	90th	99th	Max
Ontario	125	74.0	7.6	-22.9	-16.0	-6.9	-0.6	8.0	17.0	20.9	25.2	29.3
Health regions												
1. Erie St. Clair	9	74.9	9.7	-19.3	-11.7	-3.8	1.4	10	18.7	22.5	26.4	30.2
2. South West	6	76.1	8.1	-19.6	-13.5	-5.7	0.0	8.4	17.0	20.7	24.8	28.6
3. Waterloo Wellington	2	76.1	7.8	-22.3	-15.1	-6.4	-0.4	8.2	16.9	20.9	25.7	29.8
4. Hamilton Niagara Haldimand Brant	9	75.0	9.1	-18.2	-12.3	-4.3	1.2	9.3	18.2	22	26.2	30.1
5. Central West	4	71.9	8.5	-20.9	-14.2	-5.6	0.4	8.8	17.8	21.8	26.5	31.0
6. Mississauga Halton	1	69.6	9.4	-17.9	-11.4	-3.5	1.8	9.3	18.2	22.2	26.8	31.2
7. Toronto Central	3	73.1	9.2	-19.3	-12.1	-3.6	1.9	9.1	17.9	21.7	25.7	30.5
8. Central	1	70.8	8.4	-21.9	-14.8	-5.8	0.2	8.6	17.7	21.7	26.8	32.2
9. Central East	6	74.7	7.5	-23.7	-16.3	-6.2	0.1	7.8	16.4	20.1	24.0	29.3
10. South East	7	75.4	7.7	-24.9	-16.9	-6.9	-0.2	8.2	17.1	21.0	24.8	28.6
11. Champlain	3	71.8	6.9	-26.8	-19.6	-9.5	-1.9	7.7	17.2	21.2	25.8	29.8
12. North Simcoe Muskoka	9	77.2	7.0	-24.7	-17.7	-7.5	-1.0	7.4	16.4	20.2	24.7	27.4
13. North East	31	74.4	4.6	-28.4	-22.0	-11.7	-4.3	5.4	14.9	18.8	22.7	26.2
14. North West	34	75.0	2.2	-33.1	-25.8	-16.1	-7.4	3.4	13.4	17.6	21.8	24.8

Table S2. Cumulative relative risks (RRs) and 95% confidence interval (CIs) for the cold and heat effects on daily hospitalizations for hypertension, diabetes and arrhythmia over 21 lag days, using different degrees of freedom (*df*) for temperature and lag

***Df* for temperature**	**Cold effects[a]**		**Heat effects[b]**	
	1 internal knot for lag	2 internal knots for lag	1 internal knot for lag	2 internal knots for lag
Hypertension				
4 *df*	1.16 (0.94, 1.43)	1.15 (0.93, 1.42)	1.14 (0.92, 1.43)	1.16 (0.93, 1.45)
5 *df*	1.17 (0.94, 1.47)	—	1.11 (0.88, 1.39)	—
6 *df*	1.19 (0.95, 1.49)	—	1.11 (0.87, 1.40)	—
Diabetes				
4 *df*	1.08 (0.97, 1.19)	1.08 (0.97, 1.20)	1.11 (0.98, 1.25)	1.12 (0.99, 1.26)
5 *df*	1.10 (1.00, 1.22)	—	1.07 (0.94, 1.21)	—
6 *df*	1.10 (0.99, 1.22)	—	1.07 (0.94, 1.22)	—
Arrhythmia				
4 *df*	1.01 (0.92, 1.12)	1.01 (0.92, 1.12)	0.98 (0.91, 1.07)	0.98 (0.90, 1.07)
5 *df*	1.03 (0.93, 1.14)	—	0.95 (0.88, 1.04)	—
6 *df*	1.04 (0.94, 1.15)	—	0.97 (0.89, 1.05)	—

[a] Cold effects were examined by calculating relative risks associated with the 1st percentile of temperature relative to the 25th percentile of temperature. [b]Heat effects were examined by calculating relative risks associated with the 99th percentile of temperature relative to the 75th percentile of temperature.

Table S3. Cumulative relative risks (RRs) and 95% confidence interval (CIs) for the cold and heat effects on daily hospitalizations for hypertension, diabetes and arrhythmia over 21 lag days, with and without adjusting for ambient fine particles ($PM_{2.5}$)[*].

	Cold effects[a]		**Heat effects[b]**	
	Adjusting for $PM_{2.5}$	Not adjusting for $PM_{2.5}$	Adjusting for $PM_{2.5}$	Not adjusting for $PM_{2.5}$
Hypertension	1.11 (0.84, 1.48)	1.12 (0.84, 148)	1.10 (0.79, 1.52)	1.09 (0.78, 1.51)
Diabetes	1.00 (0.87, 1.15)	1.00 (0.87, 1.15)	1.11 (0.92, 1.33)	1.11 (0.92, 1.33)
Arrhythmia	0.99 (0.88, 1.13)	0.99 (0.87, 1.12)	0.96 (0.86, 1.08)	0.97 (0.86, 1.08)

[*]This analysis was restricted to the period from 2003 to 2010 when the data of $PM_{2.5}$ was available. [a]Cold effects were examined by calculating relative risks associated with the 1st percentile of temperature relative to the 25th percentile of temperature. [b]Heat effects were examined by calculating relative risks associated with the 99th percentile of temperature relative to the 75th percentile of temperature.

Table S4. International Classification of Diseases (ICD) codes of four comorbidities.

	ICD-9	**ICD-10**
Congestive heart failure	428	I50
Disorders of fluid, electrolyte, and acid-base balance	276	E86-E87
Renal failure	584–588	N17-N19
Cancer	140-239	C00-D48

Table S5. Comparison of Akaike Information Criteria for quasi-Poisson (Q-AIC) values for the relationship between temperature and hospitalization in Ontario, using distributed lag non-linear models[*].

	Natural cubic spline for temperature with three different knot locations		
	10^{th}, 50^{th} and 90^{th}	10^{th}, 75^{th} and 90^{th}	10^{th}, 35^{th}, 65^{th} and 90^{th}
Hypertension	146840.94	146843.13	146882.79
Diabetes	327352.31	327364.90	327354.51
Arrhythmia	311383.65	311390.97	311418.64

[*]Models were fitted using natural cubic for lags (3 degrees of freedom) with three internal knots placed at equally-spaced values in the log scale of lags and adjusting for seasonality and long-term trend using natural cubic spline for time (7 degrees of freedom per year), relative humidity, nitrogen dioxide, ozone, statutory holidays, a day-of-week indicator, and daily influenza activity.

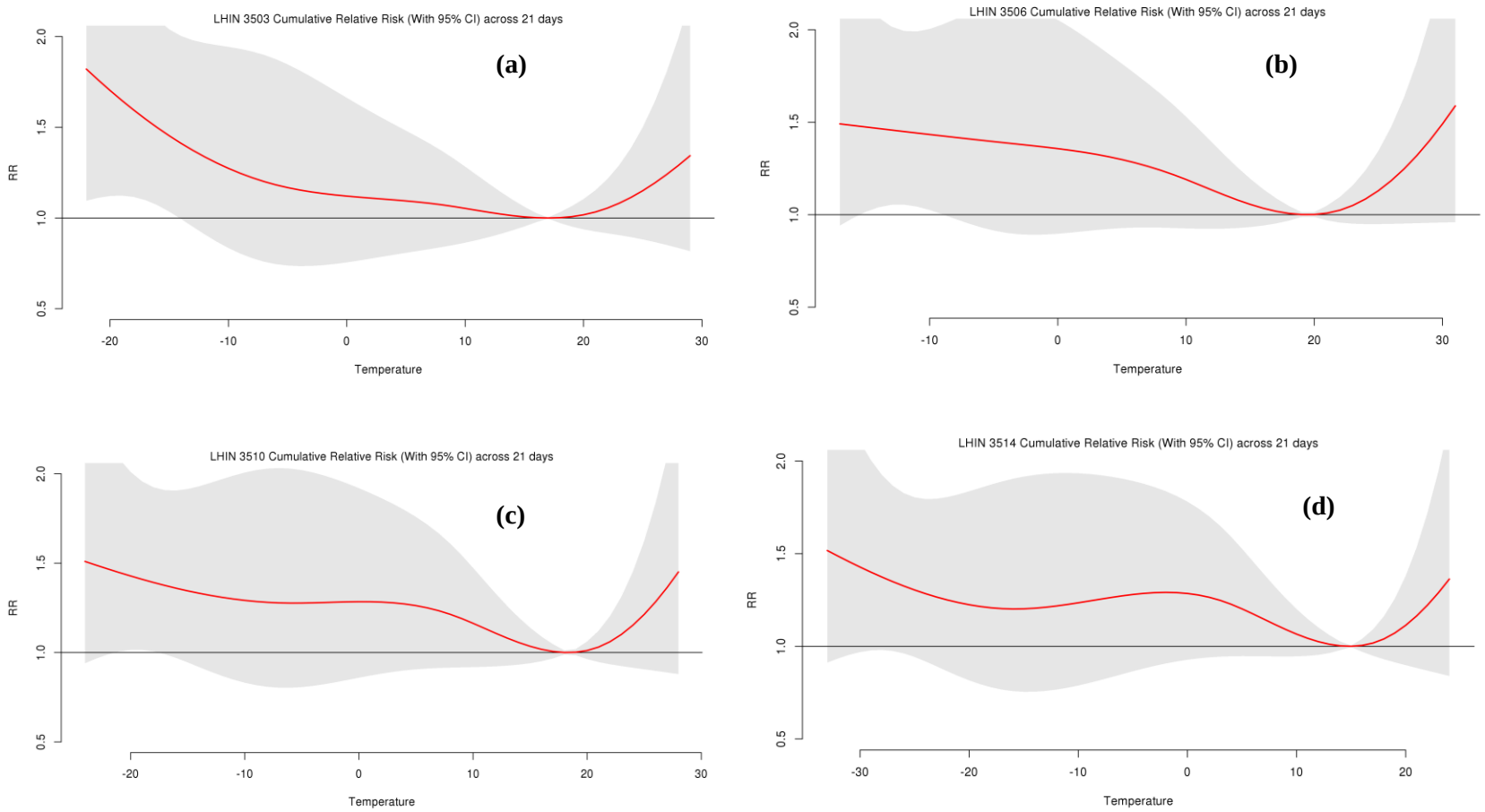

Figure S1. Cumulative exposure–response associations of daily mean temperatures and daily hospital admissions for hypertension over a lag of 21 days in (a) Waterloo Wellington, (b) Mississauga Halton, (c) South East and (d) North West, 1996-2013.

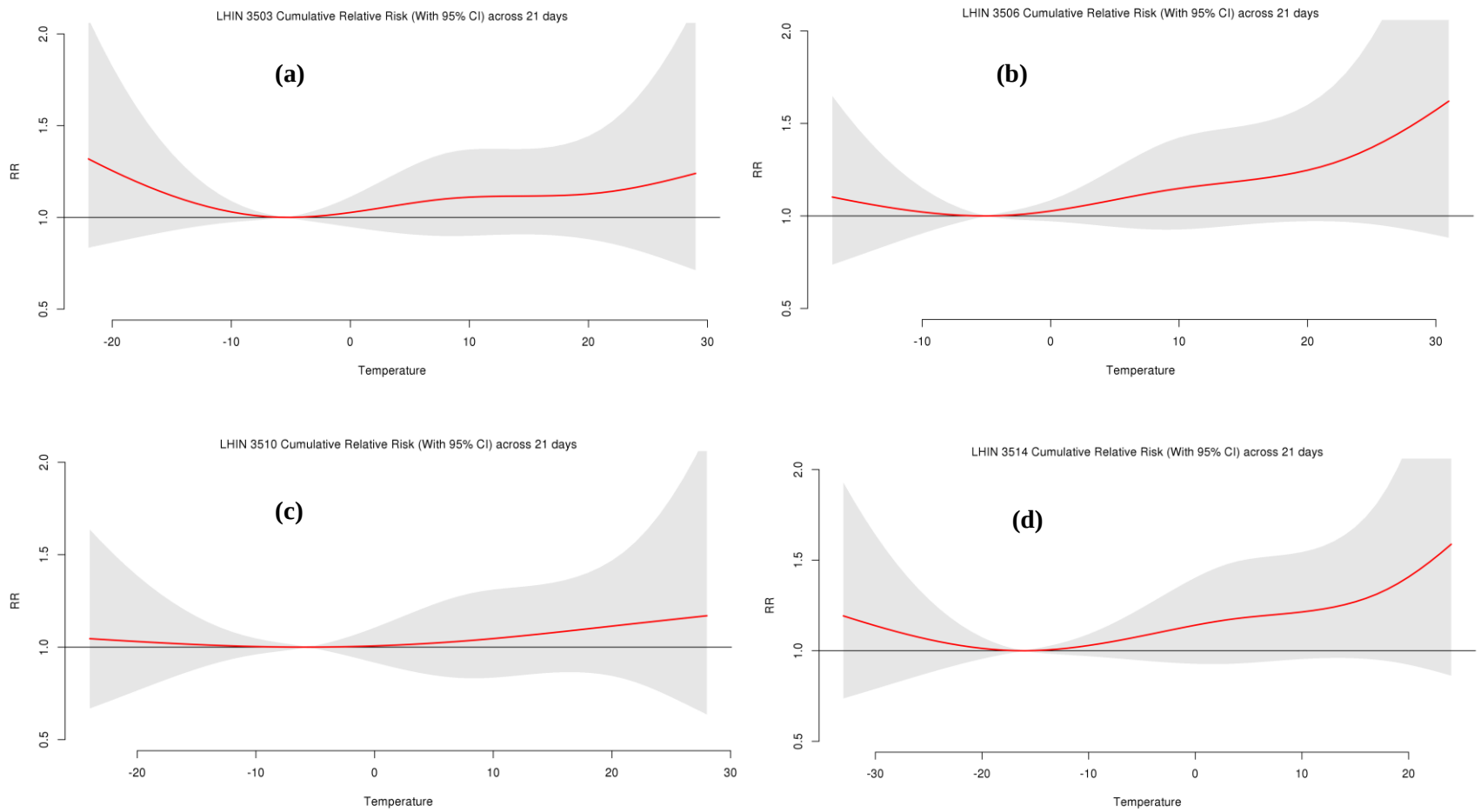

Figure S2. Cumulative exposure–response associations of daily mean temperatures and daily hospital admissions for diabetes over a lag of 21 days in (a) Waterloo Wellington, (b) Mississauga Halton, (c) South East and (d) North West, 1996-2013.

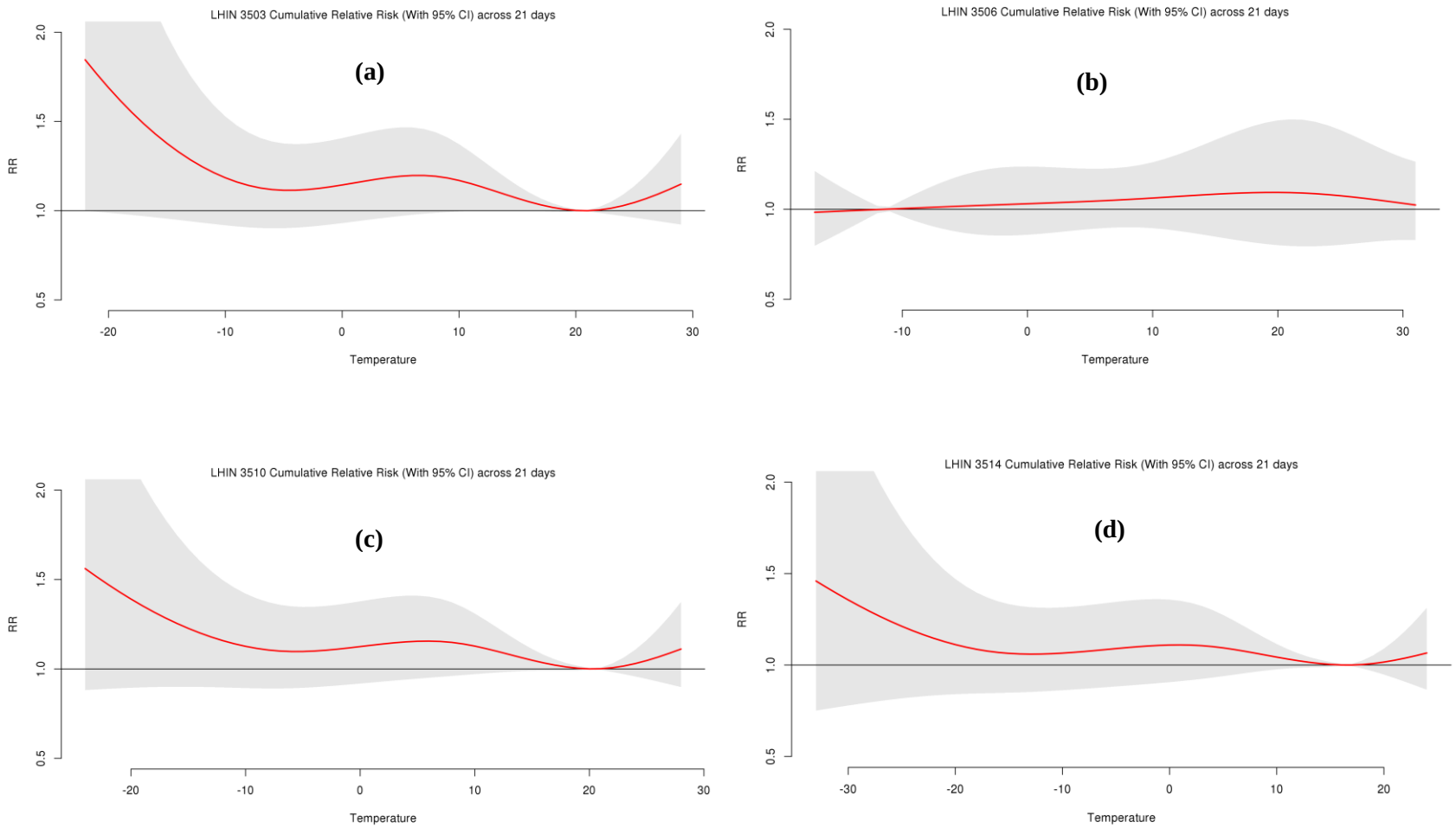

Figure S3. Cumulative exposure–response associations of daily mean temperatures and daily hospital admissions for arrhythmia over a lag of 21 days in (a) Waterloo Wellington, (b) Mississauga Halton, (c) South East and (d) North West, 1996-2013

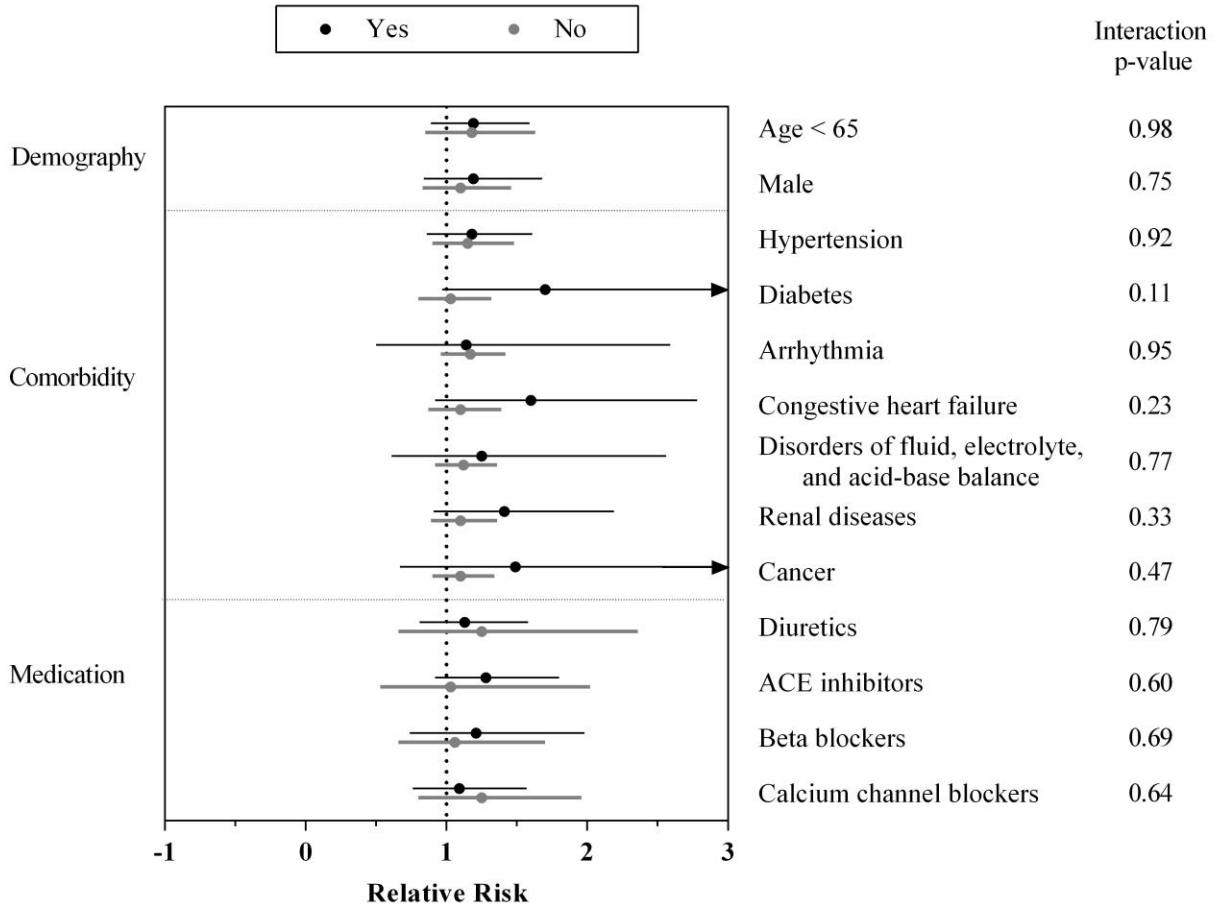

Figure S4. Cumulative relative risks (RRs) and 95% confidence intervals (CIs) for the cold effects on daily hospitalizations for hypertension by individual characteristics, comorbid medical conditions and the intake of medication over 21 lag days in Ontario, Canada during 1996-2013. Cold effects were examined by calculating relative risks associated with the 1st percentile of temperature relative to the 25th percentile of temperature. The subgroup analyses of medication intake were restricted to subjects aged 65 and over.

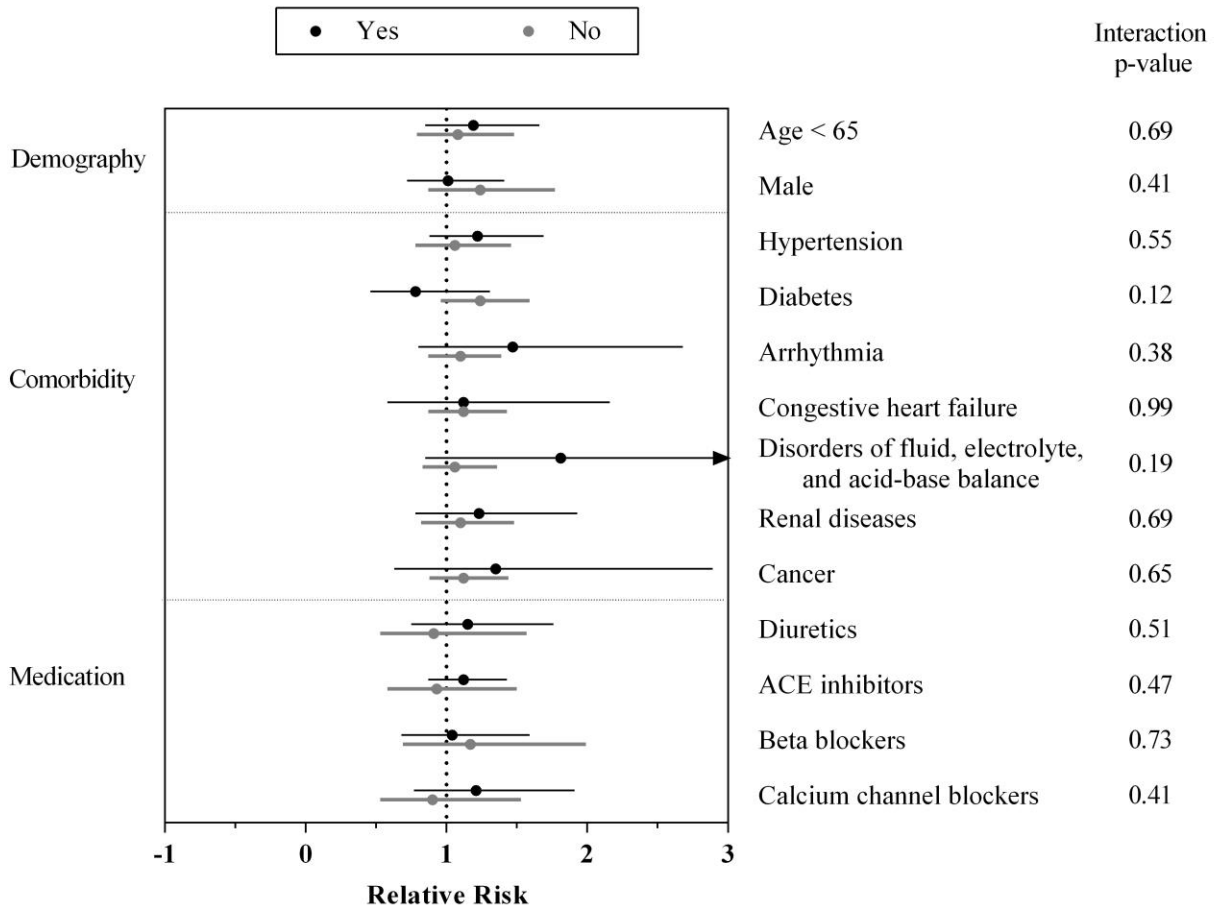

Figure S5. Cumulative relative risks (RRs) and 95% confidence intervals (CIs) for the heat effects on daily hospitalizations for hypertension by individual characteristics, comorbid medical conditions and the intake of medication over 21 lag days in Ontario, Canada during 1996-2013. Heat effects were examined by calculating relative risks associated with the 99th percentile of temperature relative to the 75th percentile of temperature. The subgroup analyses of medication intake were restricted to subjects aged 65 and over.

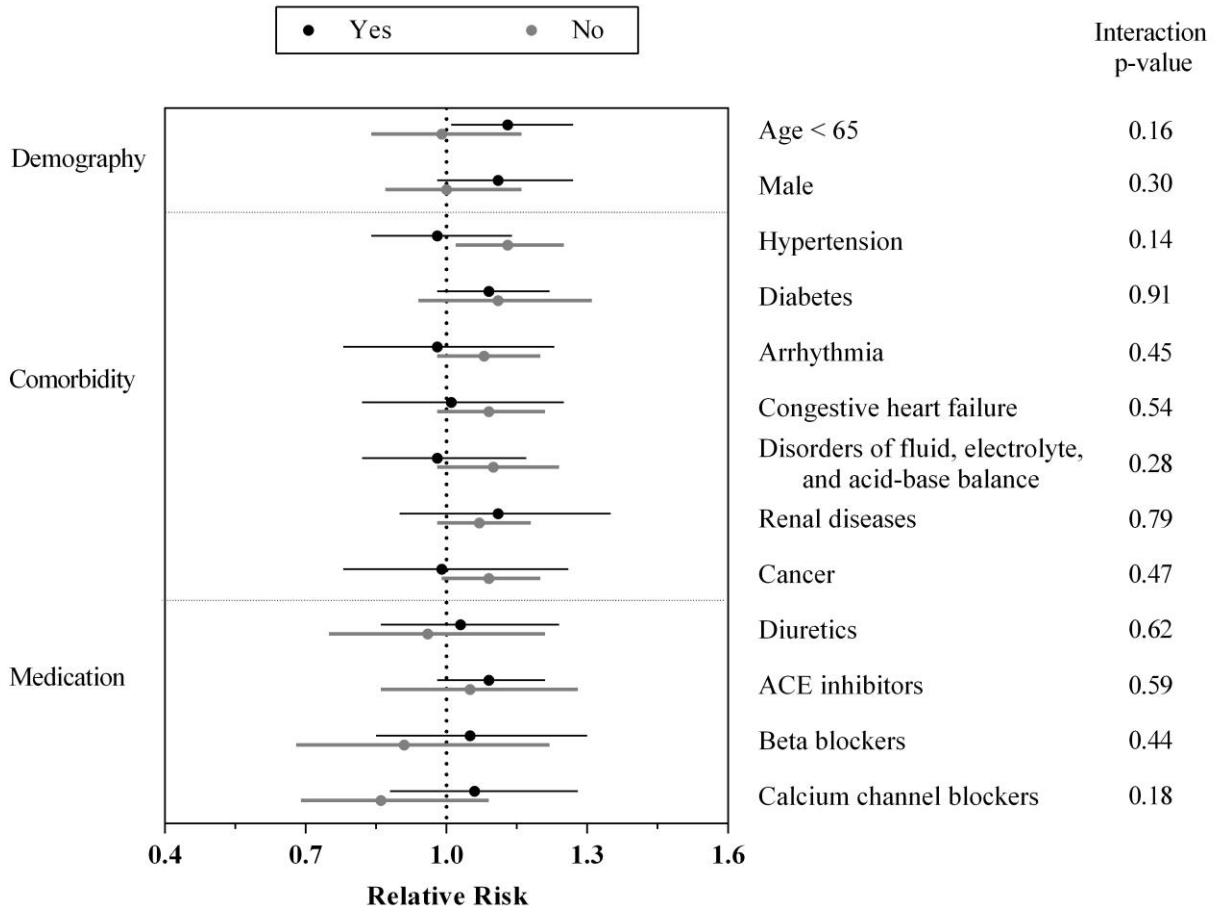

Figure S6. Cumulative relative risks (RRs) and 95% confidence intervals (CIs) for the cold effects on daily hospitalizations for diabetes by individual characteristics, comorbid medical conditions and the intake of medication over 21 lag days in Ontario, Canada during 1996-2013. Cold effects were examined by calculating relative risks associated with the 1st percentile of temperature relative to the 25th percentile of temperature. The subgroup analyses of medication intake were restricted to subjects aged 65 and over.

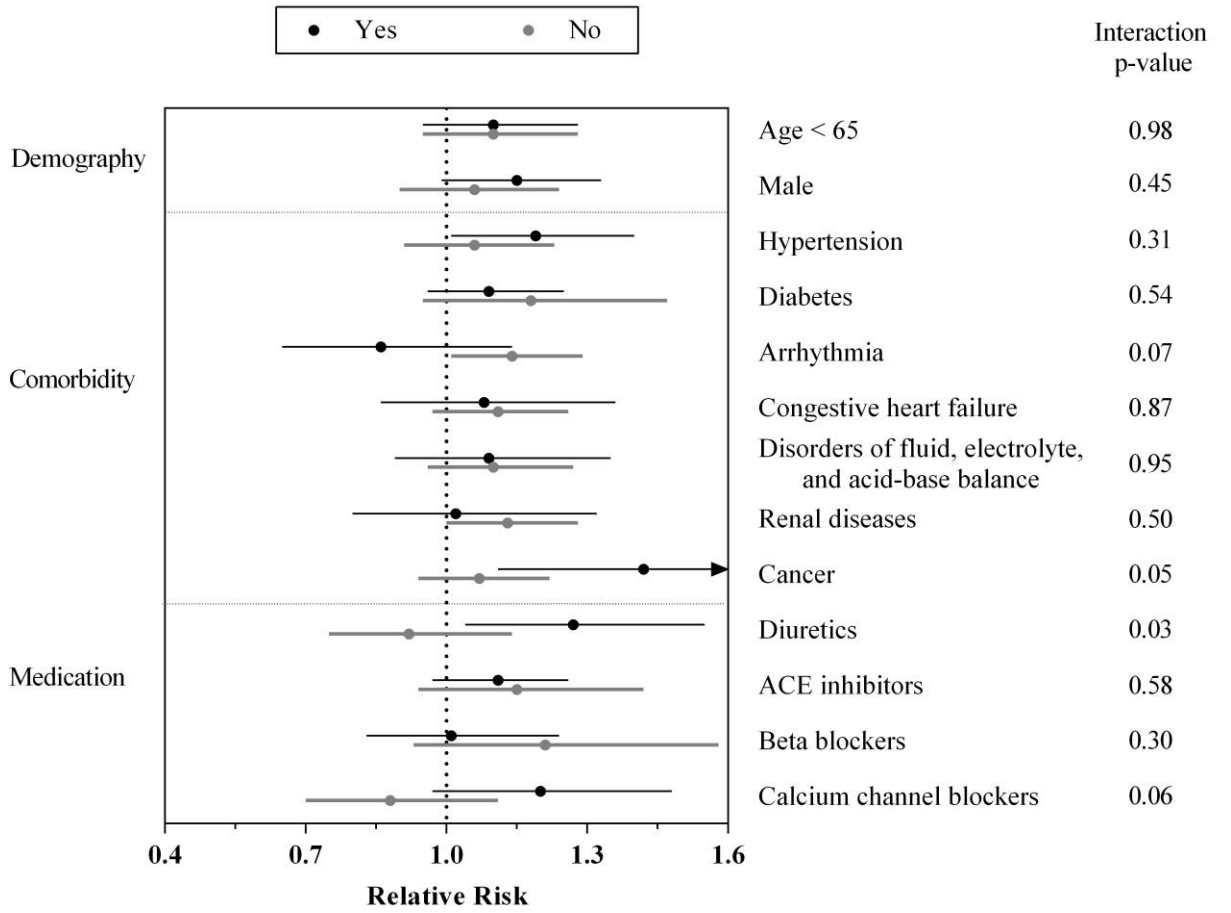

Figure S7. Cumulative relative risks (RRs) and 95% confidence intervals (CIs) for the heat effects on daily hospitalizations for diabetes by individual characteristics, comorbid medical conditions and the intake of medication over 21 lag days in Ontario, Canada during 1996-2013. Heat effects were examined by calculating relative risks associated with the 99th percentile of temperature relative to the 75th percentile of temperature. The subgroup analyses of medication intake were restricted to subjects aged 65 and over.

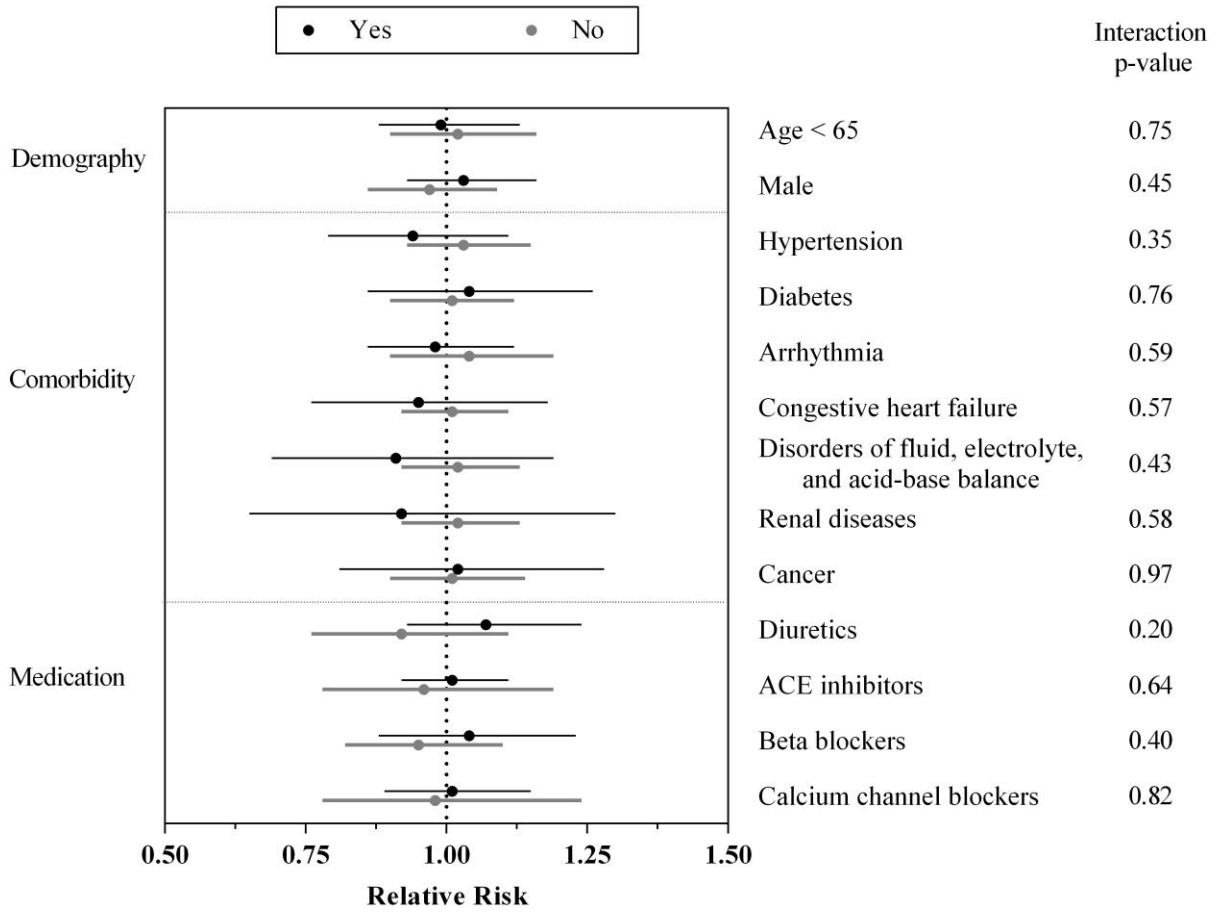

Figure S8. Cumulative relative risks (RRs) and 95% confidence intervals (CIs) for the cold effects on daily hospitalizations for arrhythmia by individual characteristics, comorbid medical conditions and the intake of medication over 21 lag days in Ontario, Canada during 1996-2013. Cold effects were examined by calculating relative risks associated with the 1st percentile of temperature relative to the 25th percentile of temperature. The subgroup analyses of medication intake were restricted to subjects aged 65 and over.

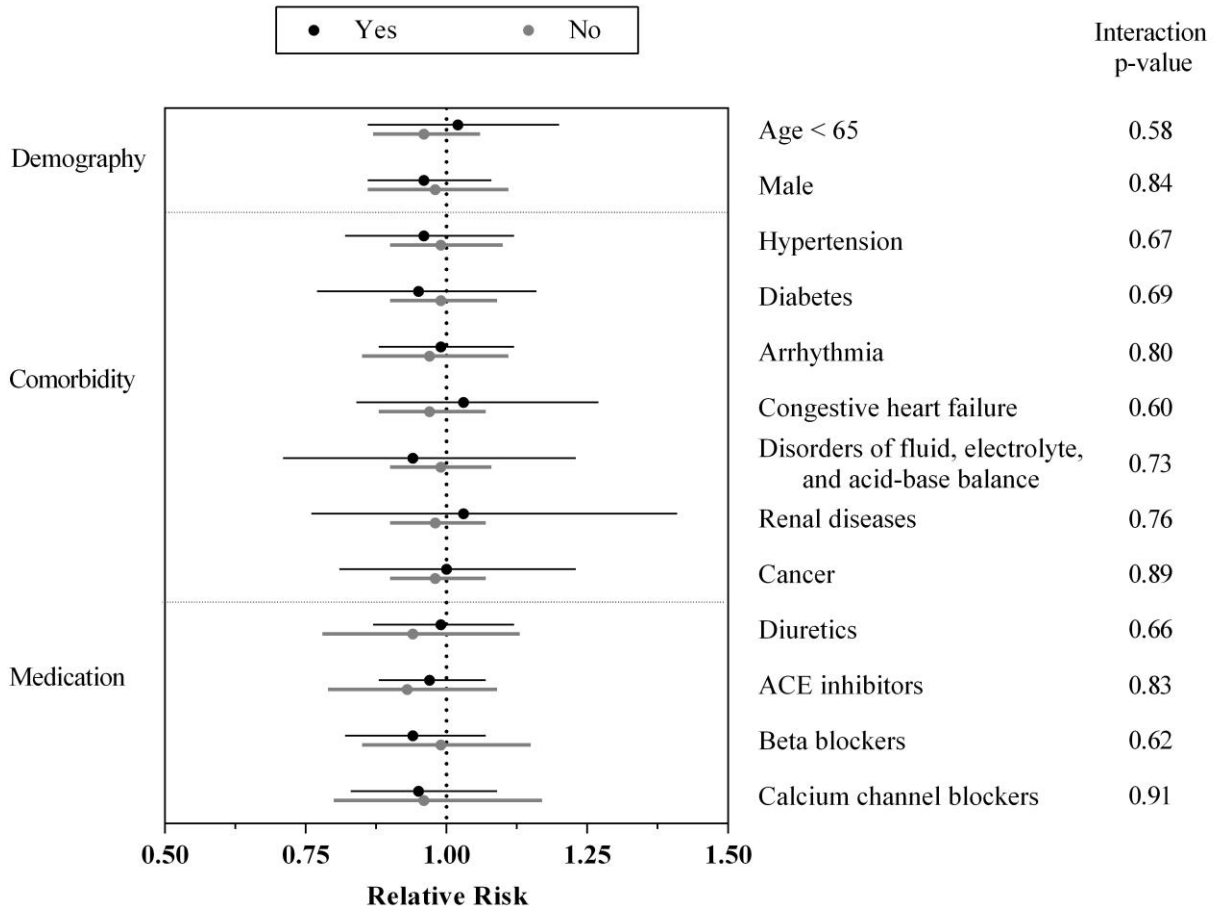

Figure S9. Cumulative relative risks (RRs) and 95% confidence intervals (CIs) for the heat effects on daily hospitalizations for arrhythmia by individual characteristics, comorbid medical conditions and the intake of medication over 21 lag days in Ontario, Canada during 1996-2013. Heat effects were examined by calculating relative risks associated with the 99th percentile of temperature relative to the 75th percentile of temperature. The subgroup analyses of medication intake were restricted to subjects aged 65 and over.

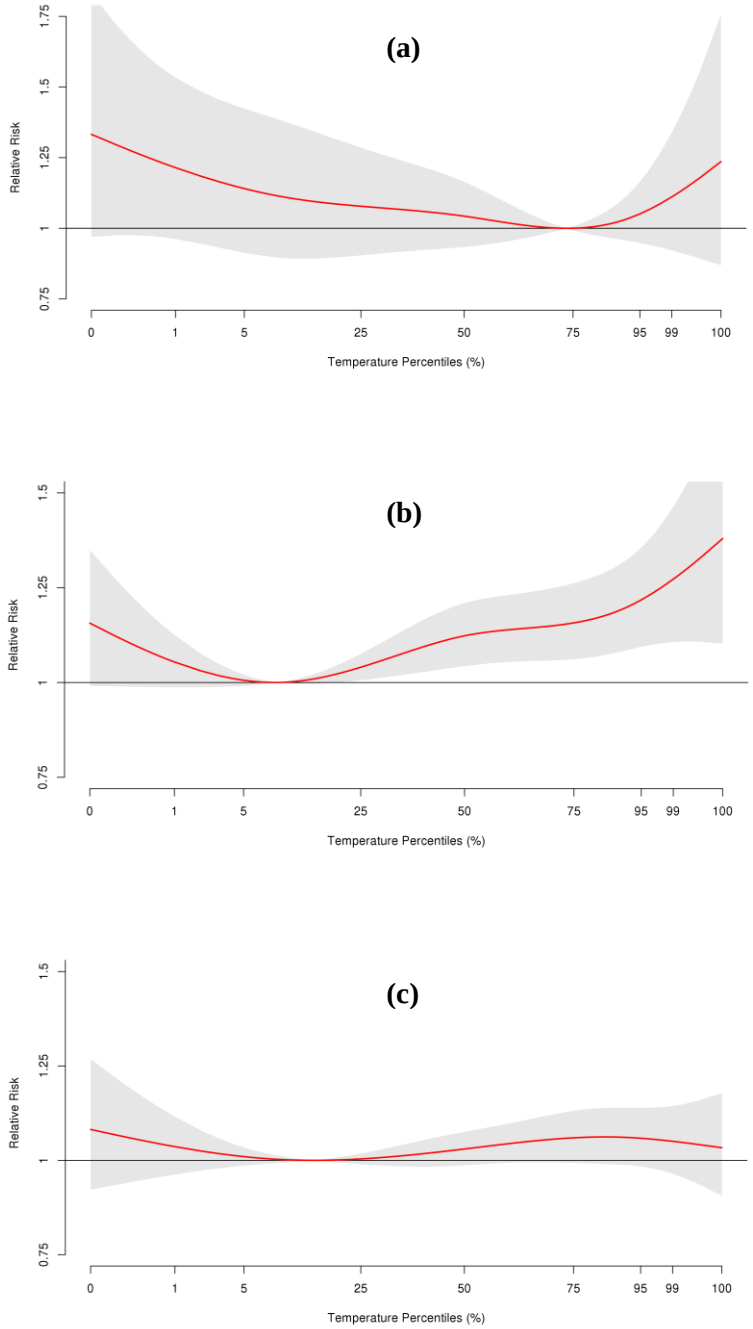

Figure S10. Cumulative exposure–response associations of daily mean temperatures and daily hospital admissions for (a) hypertension, (b) diabetes, and (c) arrhythmia over a lag of 14 days in Ontario, Canada, 1996-2013