Using the 'nasapower' package to merge open source meteorological data to individual-level health data from the CESCAS I cohort study in Argentina, Chile, and Uruguay.

Introduction: scientific evidence suggests that blood pressure (BP) could be related to weather patterns.[1] Increased BP in wintertime has been demonstrated in many studies; however, this hypothesis has not yet been explored in a general population sample from the Southern Cone of America.

Objective: to examine the effect of mean outdoor temperature on levels of systolic and diastolic blood pressure in a general population sample from 4 cities in Argentina, Chile, and Uruguay.

Methods: the CESCAS I study (https://estudiocescas.iecs.org.ar/en/) recruited 7524 men and women, aged 35 to 74 years from randomly selected samples in Marcos Paz and Bariloche (Argentina), Temuco (Chile), and Canelones (Uruguay) between February 2010 and December 2011. BP together with other individual-level demographic and health data was measured using validated instruments.[2]

The NASA Langley Research Center (LaRC) POWER Project funded through the 'NASA' Earth Science Applied Sciences Program (https://power.larc.nasa.gov/) features freely available global meteorology datasets. For the present analysis, daily temperature data for the study cities were obtained and the mean outdoor temperature for the day of the participants' BP measurement was used. The analysis consisted of two steps:

1-Merging datasets: meteorological data was fetched using the "*NASA POWER API Client"* (https://cran.r-project.org/package=nasapower) [3] of the R computing environment (Version 3.4.1, R Development Core Team, 2017). Coordinates from a single point within each city were used to obtain the mean outdoor temperature for each day of the study period, and this value was merged to the CESCAS I dataset, based on the date of BP measurement for each participant.

2-Fitting linear regression models: multivariate linear regression models were used to assess the association of mean outdoor temperature and season on levels of systolic and diastolic blood pressure. First, temperature was used as the independent variable to report changes in BP per 5°C unit increase in outdoor temperature, adjusting for age (in years) and sex (binary). Second, the mean difference between blood pressure in winter vs. summer was assessed according to study location, sex, age group, cardiovascular risk, history of hypertension and history of diabetes. To weight results accounting for the complex survey design of the CESCAS I study, the package "survey" was used.[4] Graphs were constructed using the "ggplot2" package.[5] Finally, "dplyr" was used for data processing.[6]

Ethical information: the study complies with the Declaration of Helsinki. Ethics approval was obtained from the Ethics Review Committees of Argentina, Chile, Uruguay, and the US. Written informed consent was provided by all study participants. There was no racial or gender bias in the selection of participants.

Results: Figure 1 depicts the relationship between outdoor temperature and BP measurements. Per 5°C increases in mean outdoor temperature, an average reduction of 0.64 mmHg (95%CI: −0.94; −0.35) was observed for systolic blood pressure (SBP) and −1.03 mmHg (95%CI: −1.22; −0.84) for diastolic blood pressure (DBP).

In winter, SBP was on average 3.66 mmHg higher than in summer and DBP increased by 1.55 mmHg. However, wide variability was observed among study cities. In Marcos Paz and Bariloche winter rises in SBP were above 6 mmHg while Bariloche showed no difference between seasons for both systolic and diastolic BP. Additionally, the effect of wintertime on BP was more marked for SBD than DBP and accentuated with older age, high cardiovascular risk and history hypertension or diabetes.

Conclusion: blood pressure levels are associated with outdoor temperature in 3 of the studied cities (Temuco, Marcos Paz, and Canelones). BP levels of the adult population in these cities are higher during wintertime, which should be considered for clinical practice and policymaking. Interestingly, this association was not observed in Bariloche. Probably because despite the existence of seasons, year-long temperatures for Bariloche are consistently lower compared to all other cities.

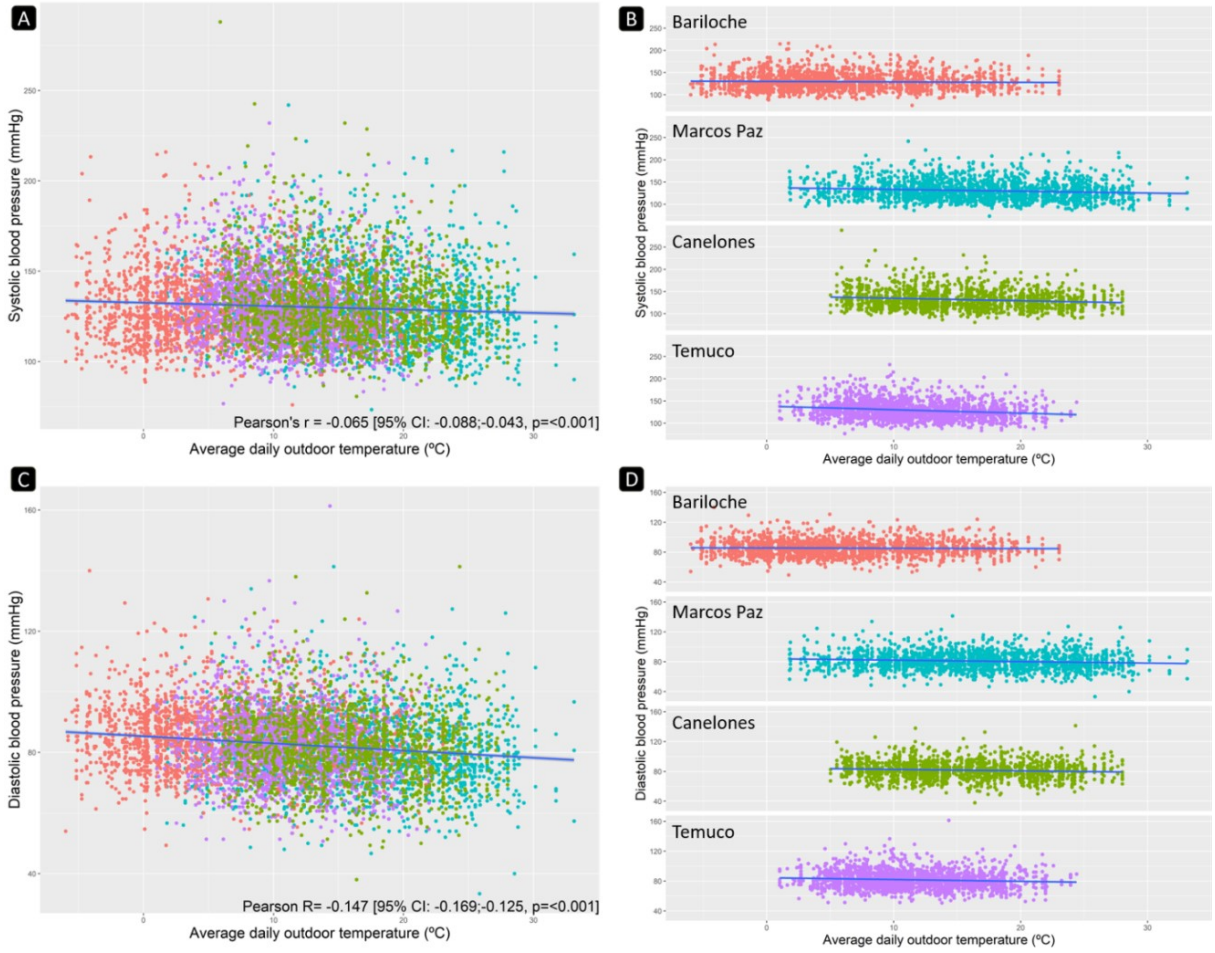

Figure 1. *Relationship between average daily outdoor temperature (°C) and systolic (A & B) and diastolic (C & D) blood pressure in four cities from the Southern Cone of Latin America between November 2010 and December 2012. Least square linear method for the line of best fit.*

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