

# Ambulatory blood pressure in older adults at low versus high altitude: the Colorado High Altitude Monitoring blood Pressure Study (CHAMPS)

Greta Kreider Carlson, Andrew C Burns, Ilaria Ferrari, Cameron Niswander and Linda E Keyes  
University of Colorado, Section of Wilderness Medicine

## Background

- How blood pressure (BP) changes after acute high altitude exposure varies between individuals<sup>1</sup>.
- What contributes to individual variations is unclear.
- 24-hour ambulatory BP (ABP) monitoring is the most accurate way to assess BP<sup>2</sup>.
- Understanding impacts of altitude on BP is essential in the creation of evidence-based travel guidelines.

## Objective

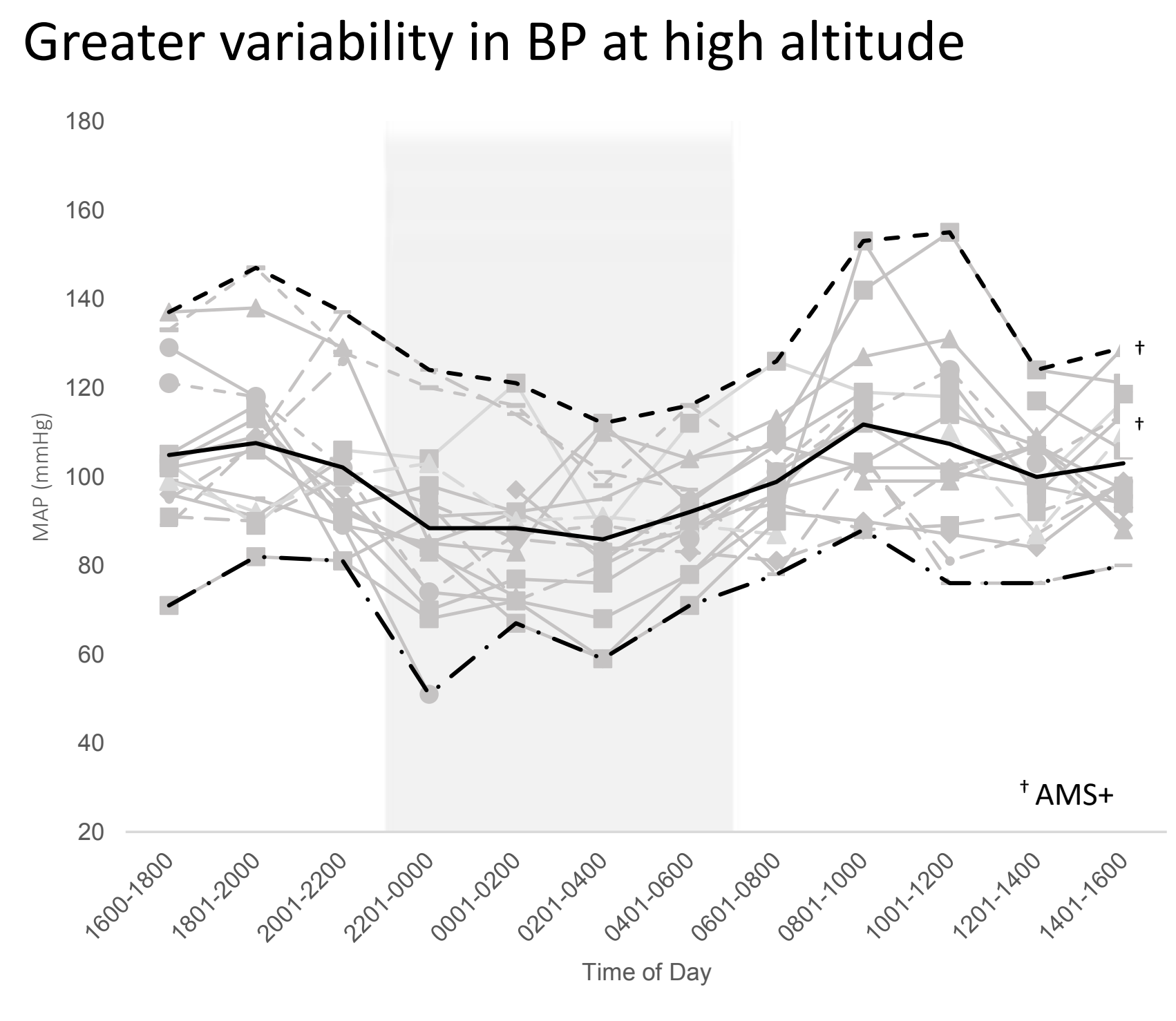
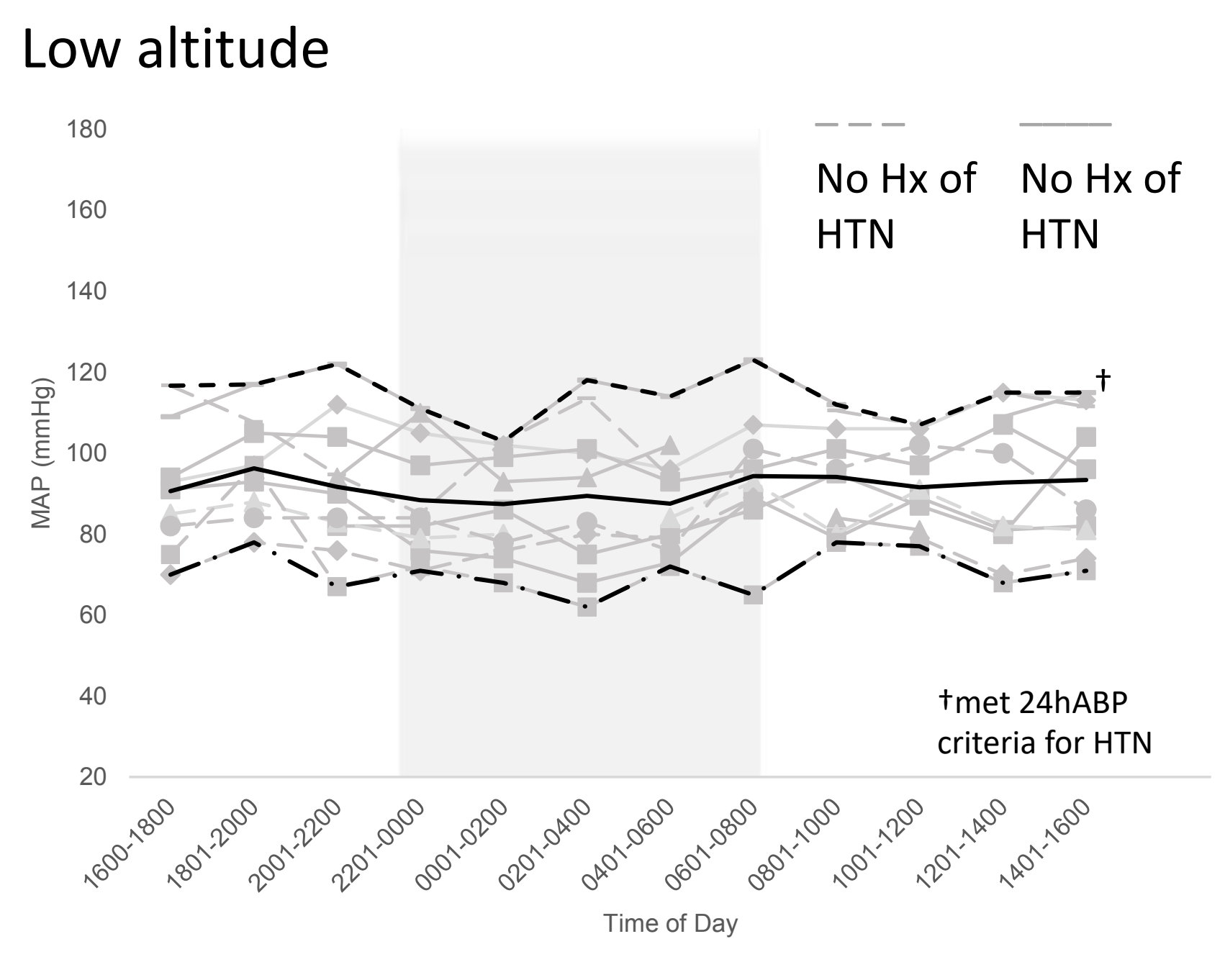
To determine how 24h ambulatory BP changes on acute exposure to high altitude.

## Methods

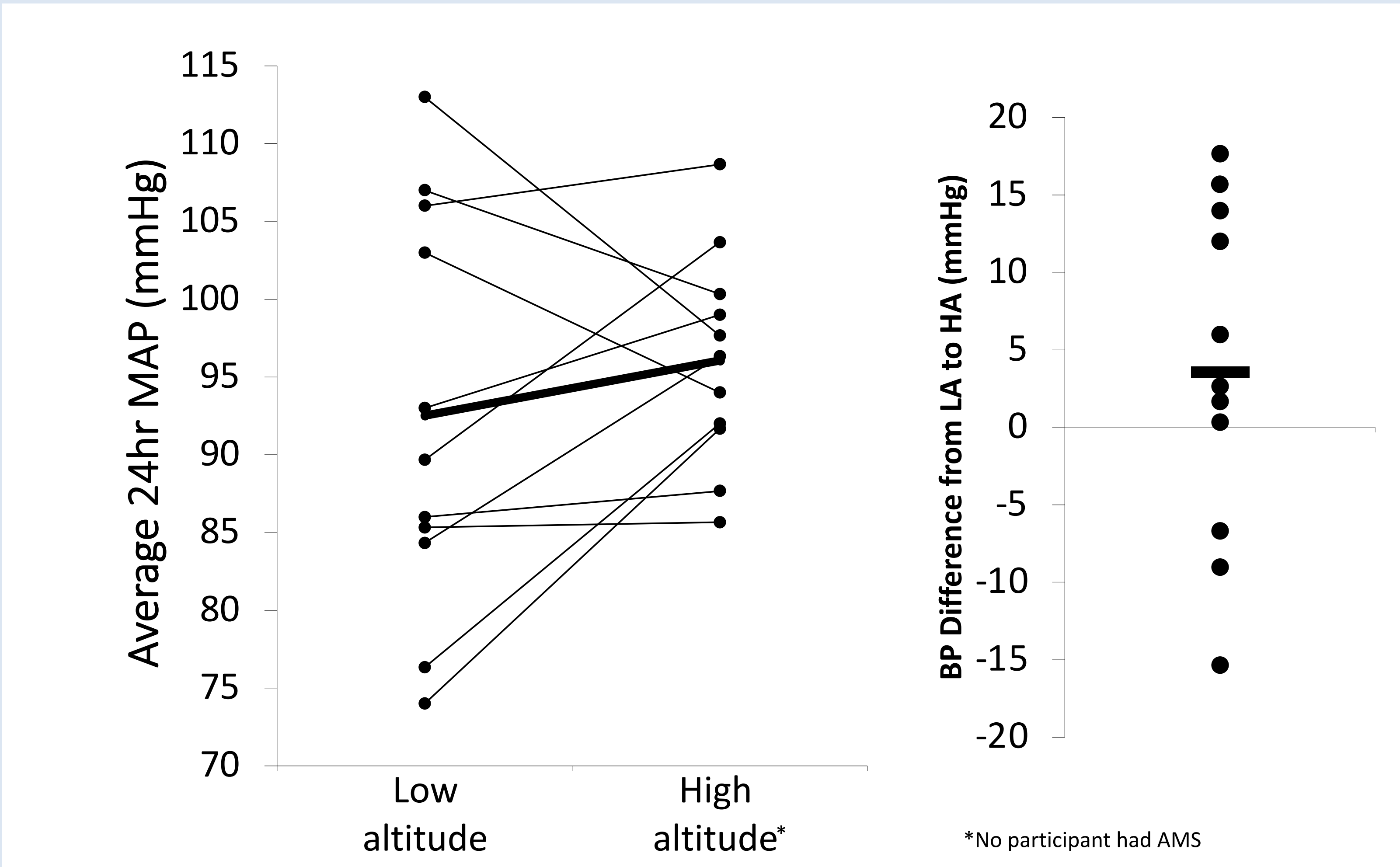
- Prospective observational cohort study of adult lowlanders compared 24h ABP at low vs the first 24h at high altitude (2470-2700m).
- Ascent profile was similar in all participants. Lowlanders flew to Denver and immediately ascended by motor vehicle to 2470-2800 m. 24h ABP Monitoring began within 4-6 of hours of arrival at high altitude.
- ABP was measured q1h 7am-10pm and q30 min 10pm-7am with Welch-Allyn 6100 ABP monitors.

## Results

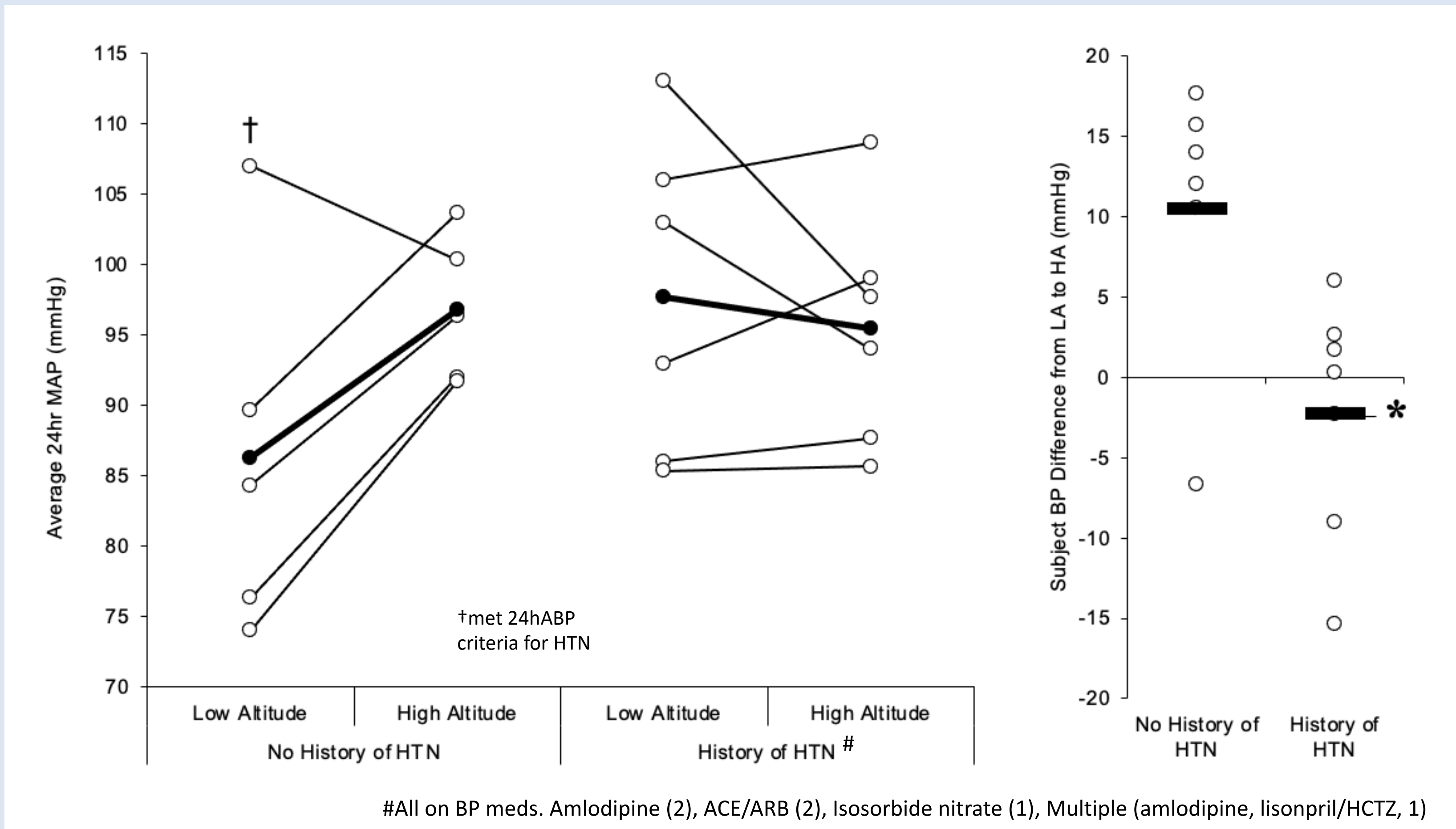
| Participant Demographics      |            |
|-------------------------------|------------|
| Age Mean (CI)                 | 64 (60-69) |
| Male N (%)                    | 15 (78.9%) |
| Mean BMI All (HTN Group)      | Footnote 1 |
| Medical conditions            | N (%)      |
| Hypertension                  | 11 (57.9%) |
| High Cholesterol              | 9 (47.3%)  |
| Coronary Arterty Disease      | 2 (10.5%)  |
| Diabetes Mellitus             | 1 (5.3%)   |
| Asthma                        | 1 (5.3%)   |
| Sleep Apnea                   | 1 (5.3%)   |
| History of AMS                | 4 (21%)    |
| Smoke                         | 0 (0%)     |
| Alcohol Use                   | 19 (100%)  |
| Other                         | Footnote 2 |
| Activity                      | N (%)      |
| Very athletic                 | 2 (10.5%)  |
| Athletic                      | 9 (47.3%)  |
| Average                       | 7 (36.8%)  |
| Sedentary                     | 1 (5.3%)   |
| Blood Pressure Meds           | N (%)      |
| Total Taking BP Meds          | 10 (52.6%) |
| Total Taking Multiple BP Meds | 3 (15.8%)  |
| Beta Blockers                 | 3 (15.8%)  |
| CCBs                          | 5 (26.3%)  |
| Thiazides                     | 1 (5.3%)   |
| ACE Inhibitors                | 1 (5.3%)   |
| ARBs                          | 2 (10.5%)  |
| Other                         | Footnote 3 |
| Combo BP Meds                 | Footnote 4 |
| Other Medications             | N (%)      |
| Statin                        | 11 (57.9%) |
| Aspirin                       | 7 (36.8%)  |
| Acetaminophen                 | 1 (5.3%)   |
| Ibuprofen                     | 4 (21%)    |
| Acetazolamide                 | 1 (5.3%)   |
| Steroids                      | 1 (5.3%)   |



Mean 24h MAP was similar at low and high altitude among older adults, but there was large individual variability in degree of change.



Mean 24h MAP increased in those without underlying hypertension and did not change in those with prior history of hypertension.



## Conclusions

In these older adults, mean BP was similar at low and high altitude. BP was more likely to increase at high altitude in those without underlying hypertension, and to stay the same or decrease in those with hypertension. The reasons for these differing responses require further study and confirmation with larger cohort.

### References

1. Keyes LE, Sallade TD, Duke C, et al. Blood Pressure and Altitude: An Observational Cohort Study of Hypertensive and Nonhypertensive Himalayan Trekkers in Nepal. High altitude medicine & biology. 2017;18(3):267-277.
2. Huang QF, Yang WY, Asayama K, et al. Ambulatory Blood Pressure Monitoring to Diagnose and Manage Hypertension. Hypertension. 2021;77(2):254-264.

<sup>1</sup>Missing two subjects' BMI in the no previous HTN group. <sup>a</sup> stent, ulcerative colitis and thyroid disease: n=1. No hx of coronary bypass, kidney disease, or stroke. <sup>3</sup>Isosorbide Nitrate for Heart Disease n=1. 4Lisinopril/HCTZ (ACE + Thiazide) n=1.