Hemodynamics During Submaximal Exercise in Premenopausal and Postmenopausal Women

the Heritage Family Study

by

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Menopause Effects on Resting Cardiovascular Hemodynamics

Recent studies suggest that estrogen loss during menopause may contribute to:

- ↓ peak aortic flow velocity
- ↑ pulsatility index (resistance to flow)
- ↓ diastolic filling performance

Pines et al, 1992
Pines et al, 1992
Gangar et al, 1991
Bourne et al, 1990

Menopause Effects on Cardiovascular Hemodynamics During Maximum Exercise

Results of work done by Spina and colleagues indicate:

- Peak cardiac output does not change with exercise training
- Training induced increases in peak VO2 result solely from an increase in AVO2difference

Spina et al, 1993

Purpose of Study

The purpose of this study was to determine if estrogen replacement affects cardiovascular hemodynamics in postmenopausal women during submaximal exercise. Specifically, we tested for differences between exercising postmenopausal women taking estrogen and exercising postmenopausal women not taking estrogen with respect to flow / pressure hemodynamics.

Variables in This Analysis and Corresponding Data Collection Methods

Cardiac Output (Q): CO2 rebreathing - Collier technique

Mean Arterial Pressure (MAP): DBP+(SBP-DBP)/3

Total Peripheral Resistance (TPR): MAP / Q

Oxygen Consumption (VO_2): Sensor Medics 2900 Met Cart

Heart Rate (HR): electrocardiography

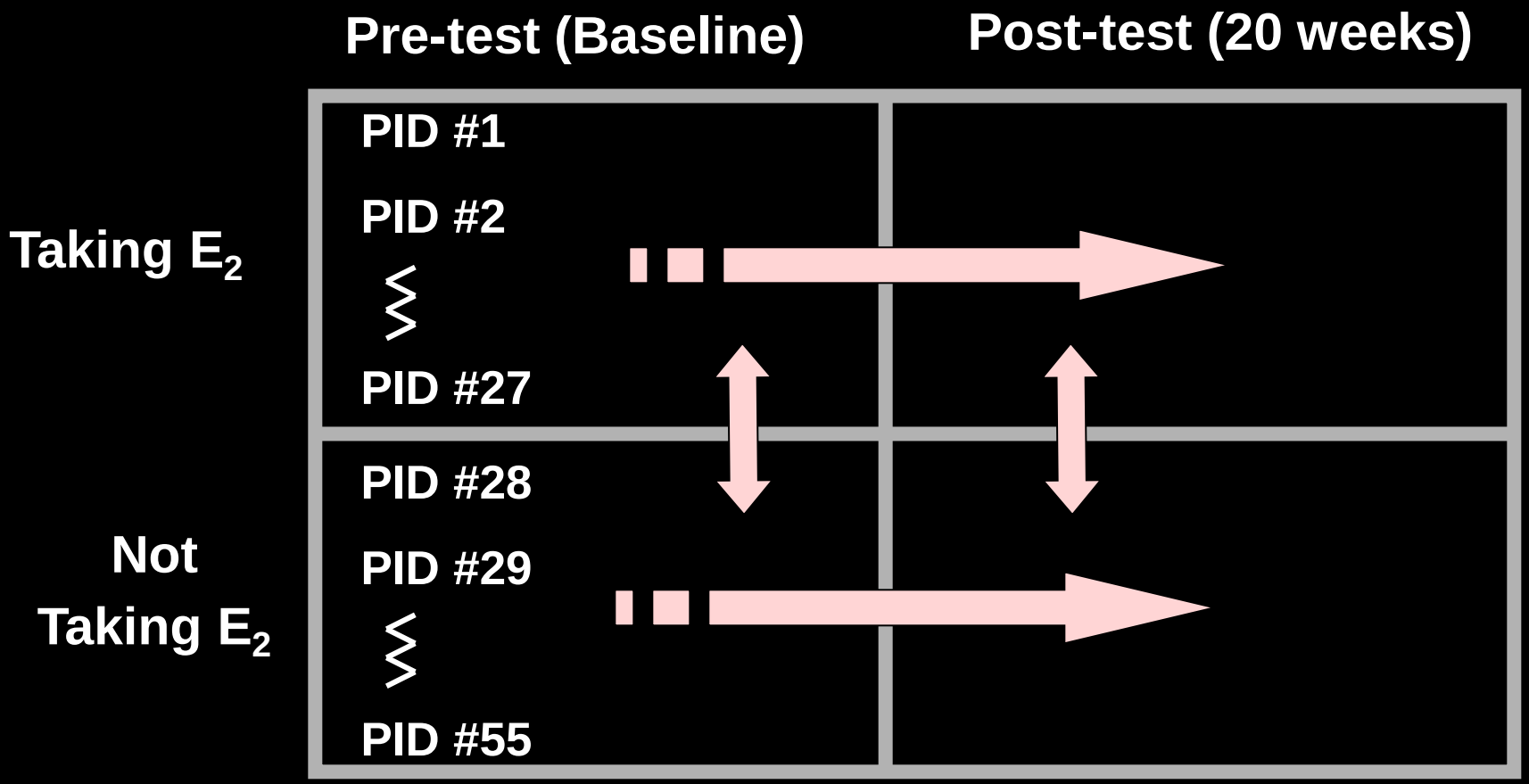
Stroke Volume (SV): Q / HR

Arteriovenous Oxygen Difference (AVO_2D): VO_2 / Q

Design & Analysis of Data: Postmenopausal Women Taking vs. Not Taking E_2

Split Plot Analysis of Variance with Repeated Measures

(Subjects nested within Estrogen Replacement Status)

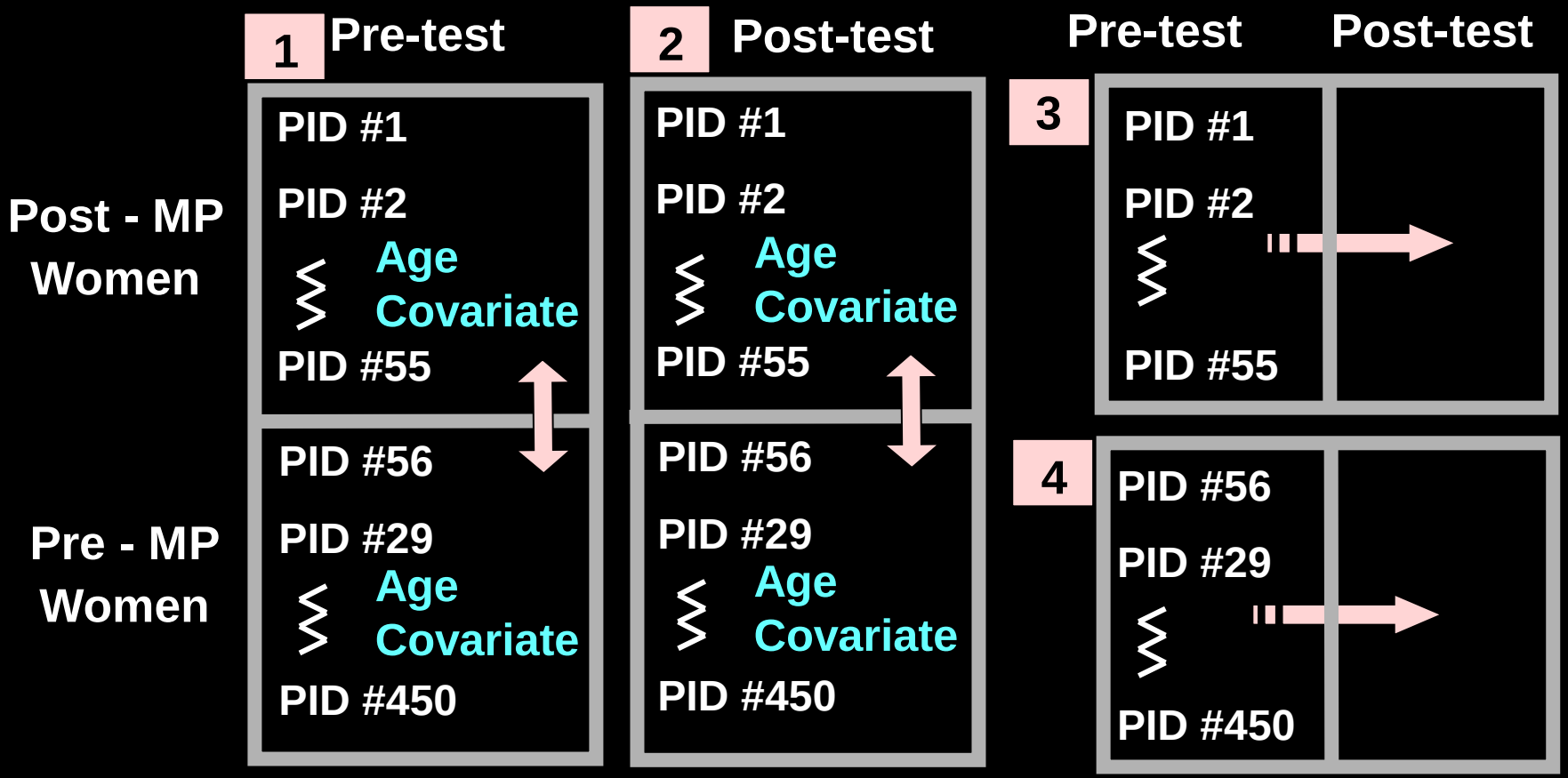


Design & Analysis of Data: Premenopausal vs. Postmenopausal Women

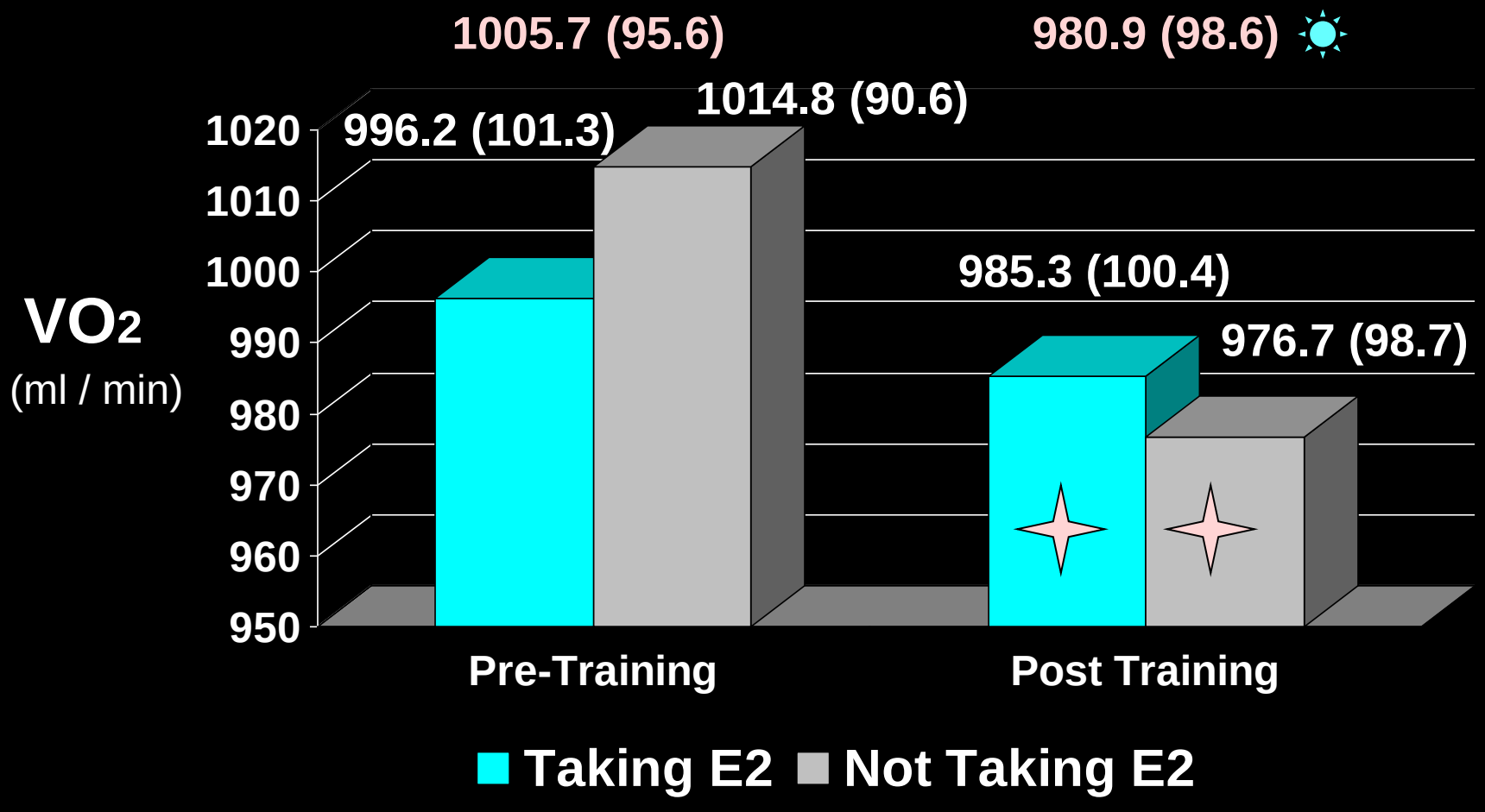
2 One-way Analysis of Co-Variance tests (test #1 and #2)

2 Dependent (Correlated) t-Tests (test #3 and #4)

(Note inflation of "experimentwise" a level)



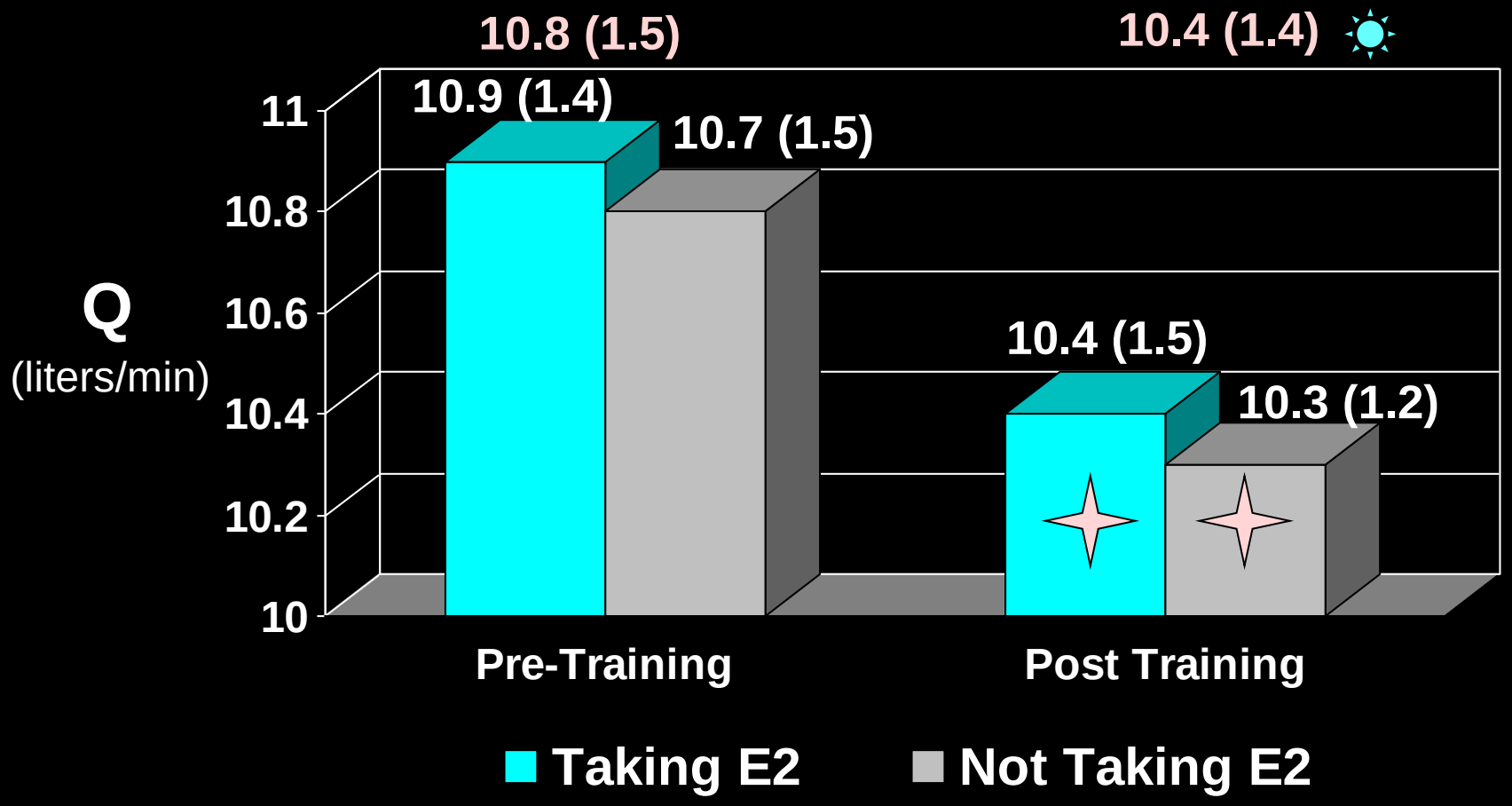
Oxygen Consumption at 50 Watts in Postmenopausal Women Taking vs. Not Taking Supplemental Estrogen



= significantly different from pre-training value (RM analysis)

= significantly different from pre-training value (t-Test analysis)

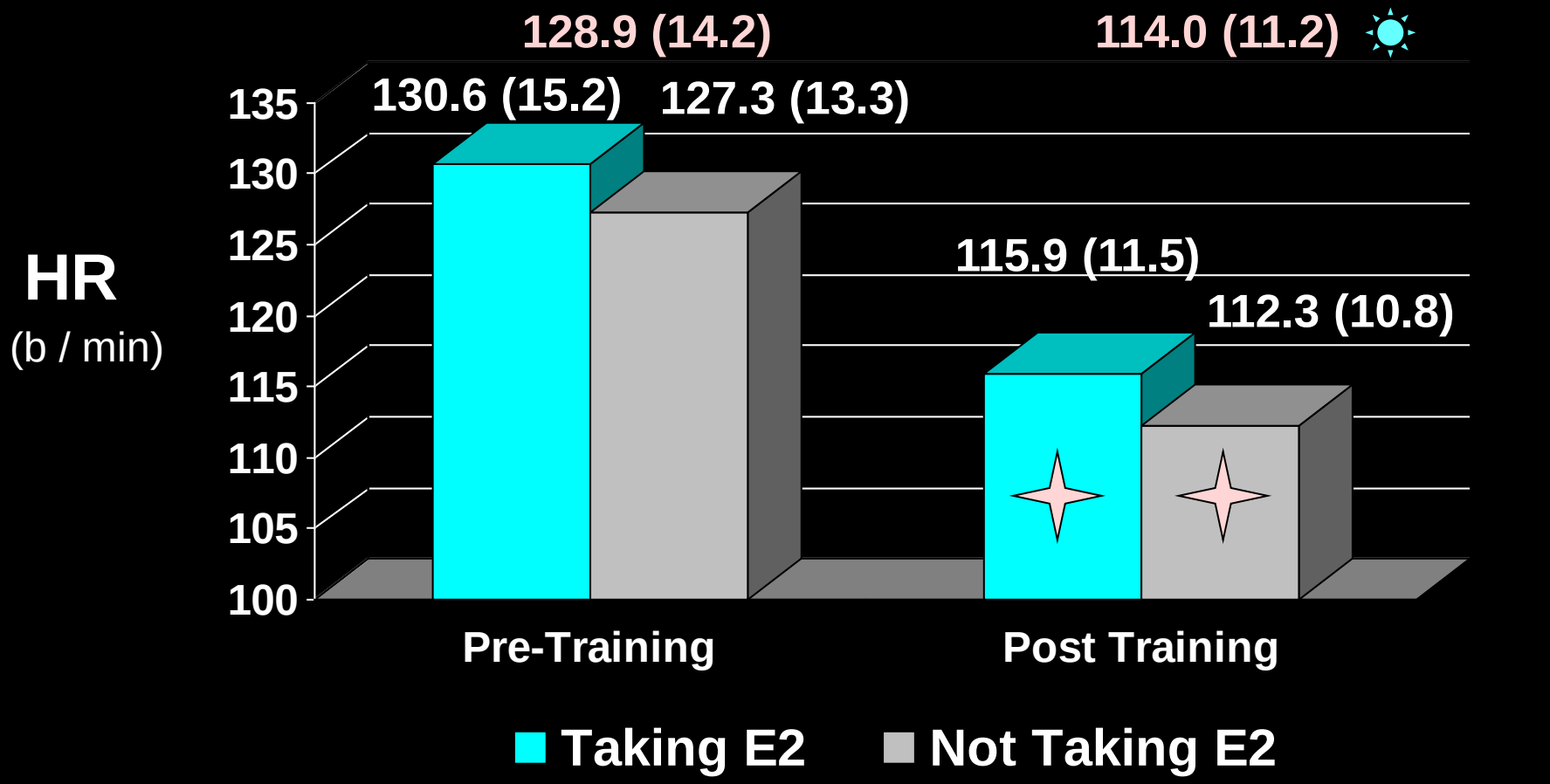
Cardiac Output at 50 Watts in Postmenopausal Women Taking vs. Not Taking Supplemental Estrogen



= significantly different from pre-training value (RM analysis)

= significantly different from pre-training value (t-Test analysis)

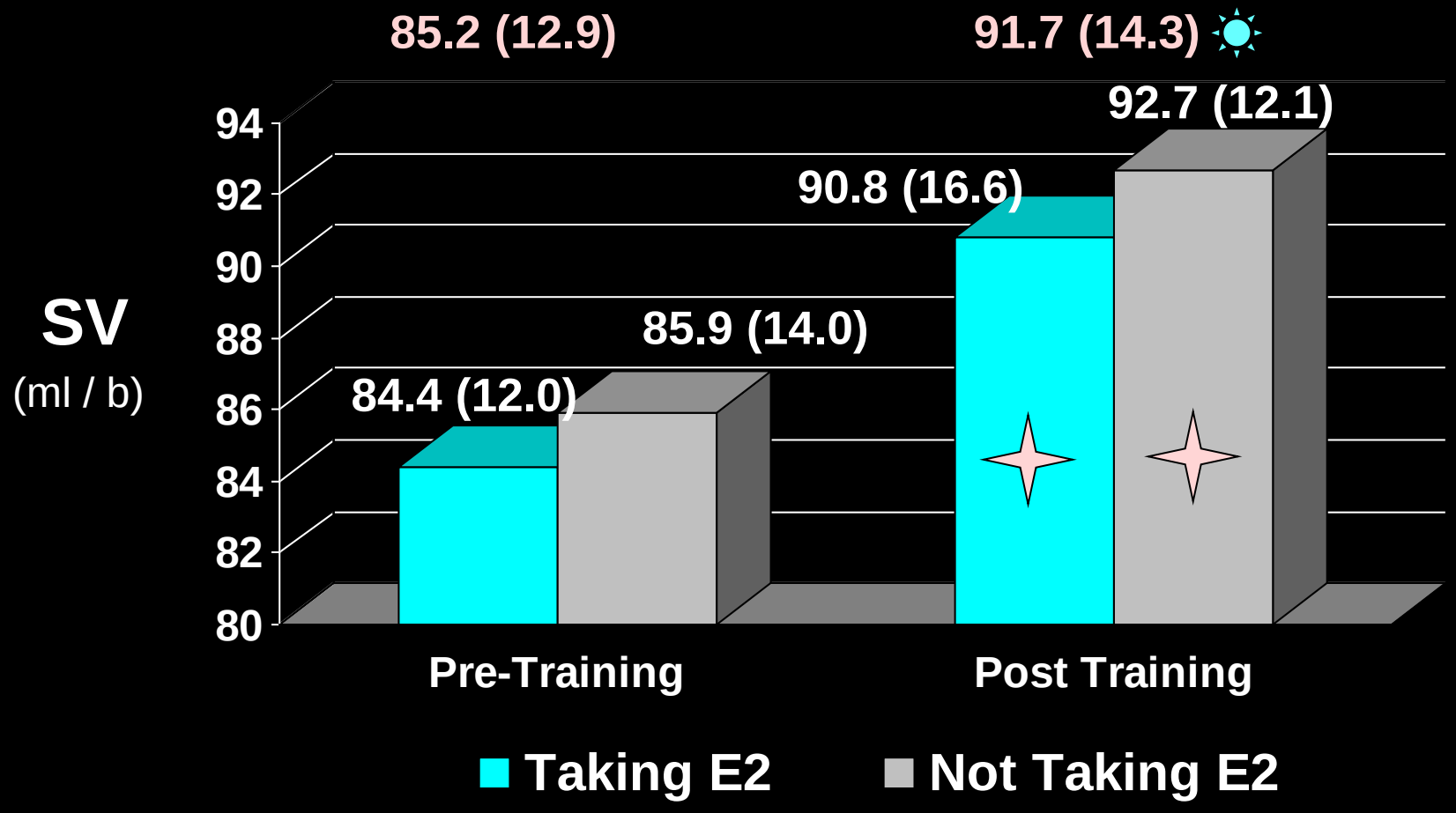
Heart Rate at 50 Watts in Postmenopausal Women Taking vs. Not Taking Supplemental Estrogen



= significantly different from pre-training value (RM analysis)

= significantly different from pre-training value (t-Test analysis)

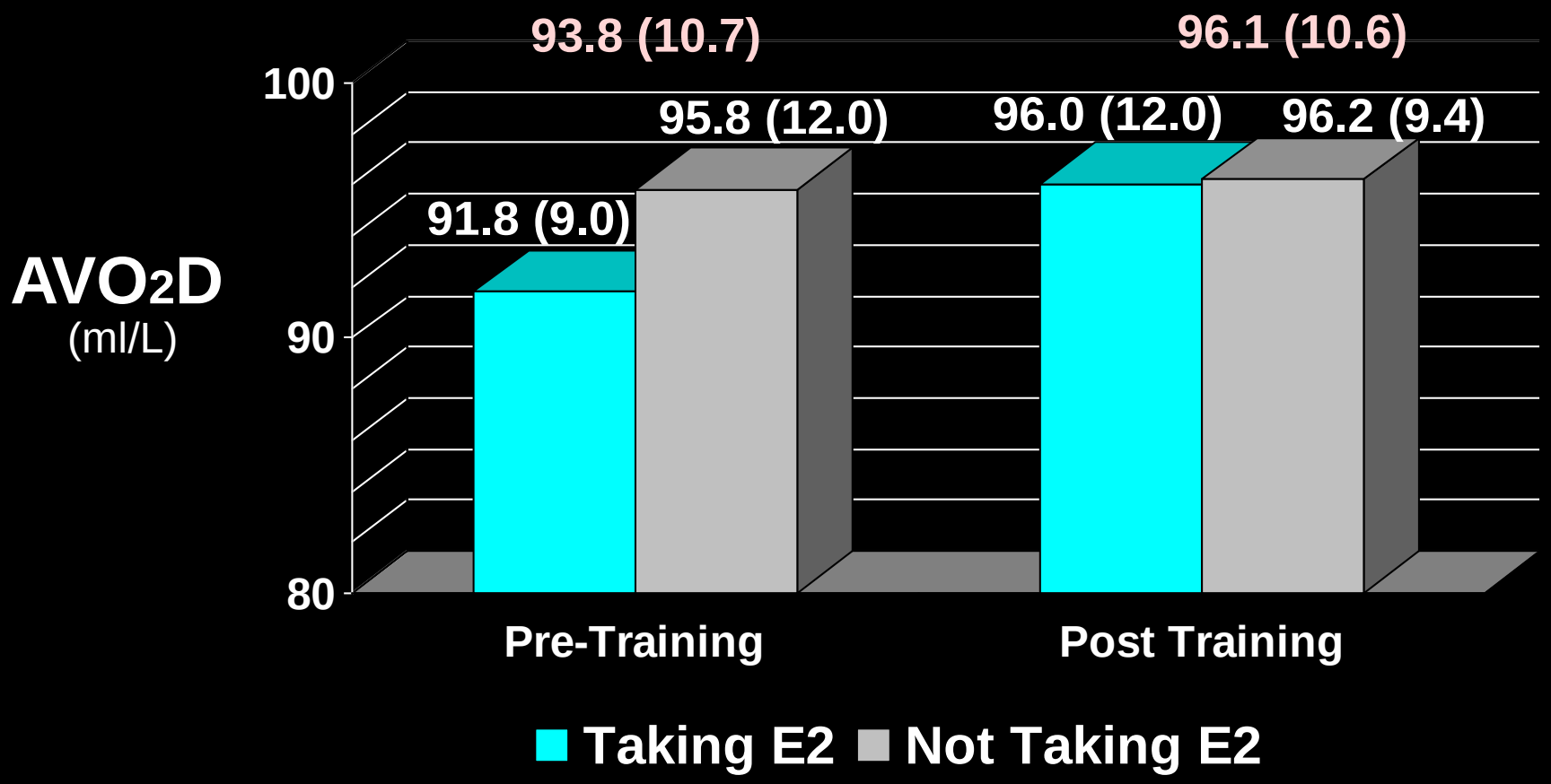
Stroke Volume at 50 Watts in Postmenopausal Women Taking vs. Not Taking Supplemental Estrogen



= significantly different from pre-training value (RM analysis)

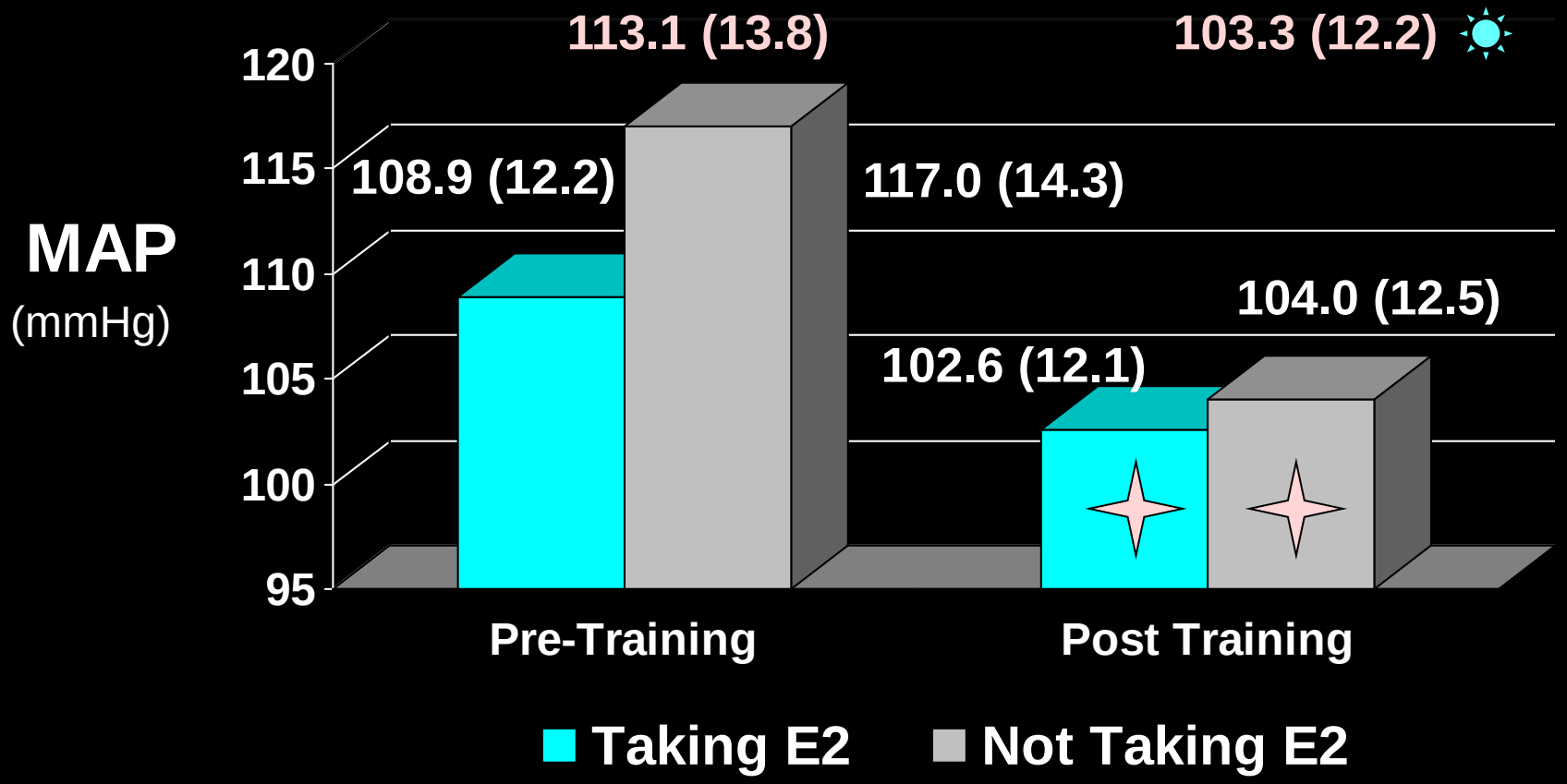
= significantly different from pre-training value (t-Test analysis)

AVO_2 - Difference at 50 Watts in Postmenopausal Women Taking vs. Not Taking Supplemental Estrogen



No differences noted in either type of analysis

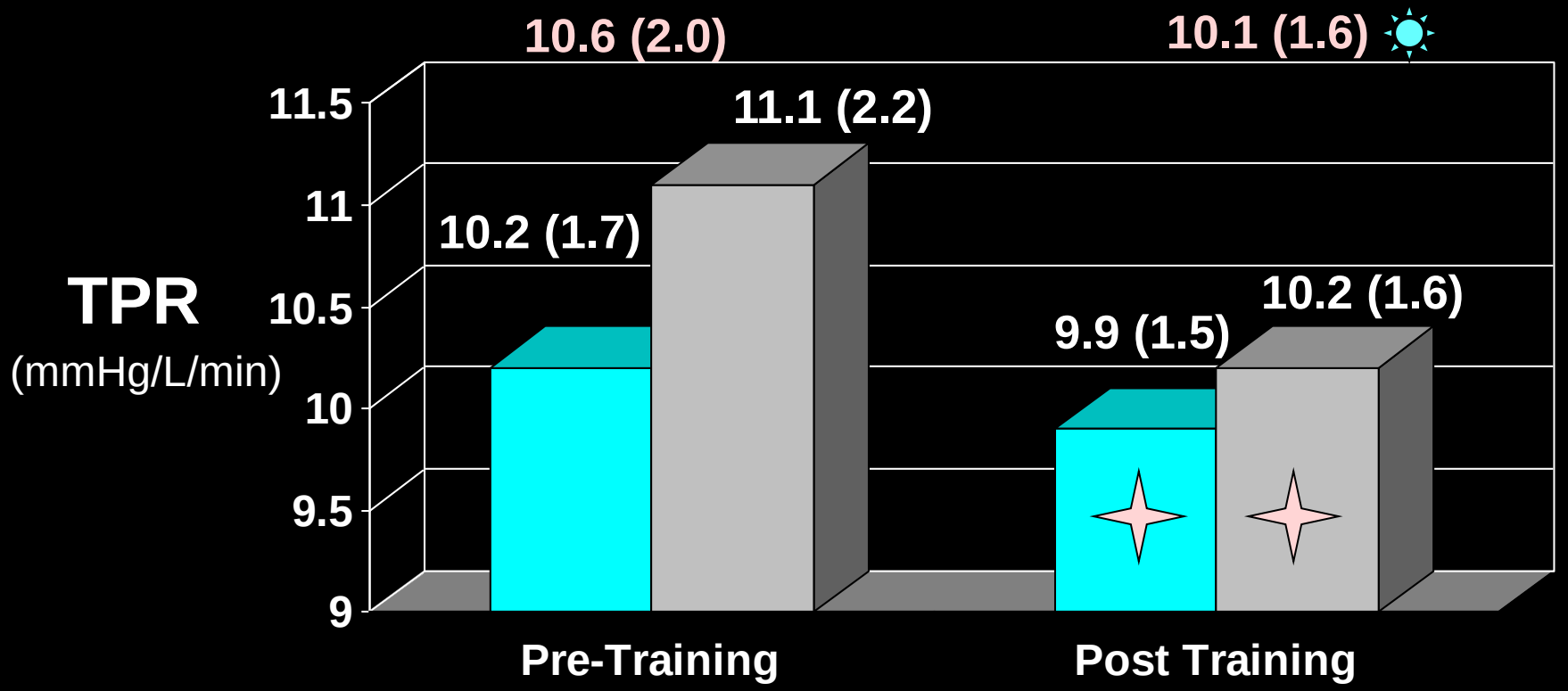
Mean Arterial Pressure at 50 Watts in Postmenopausal Women Taking vs. Not Taking Supplemental Estrogen



= significantly different from pre-training value (RM analysis)

= significantly different from pre-training value (t-Test analysis)

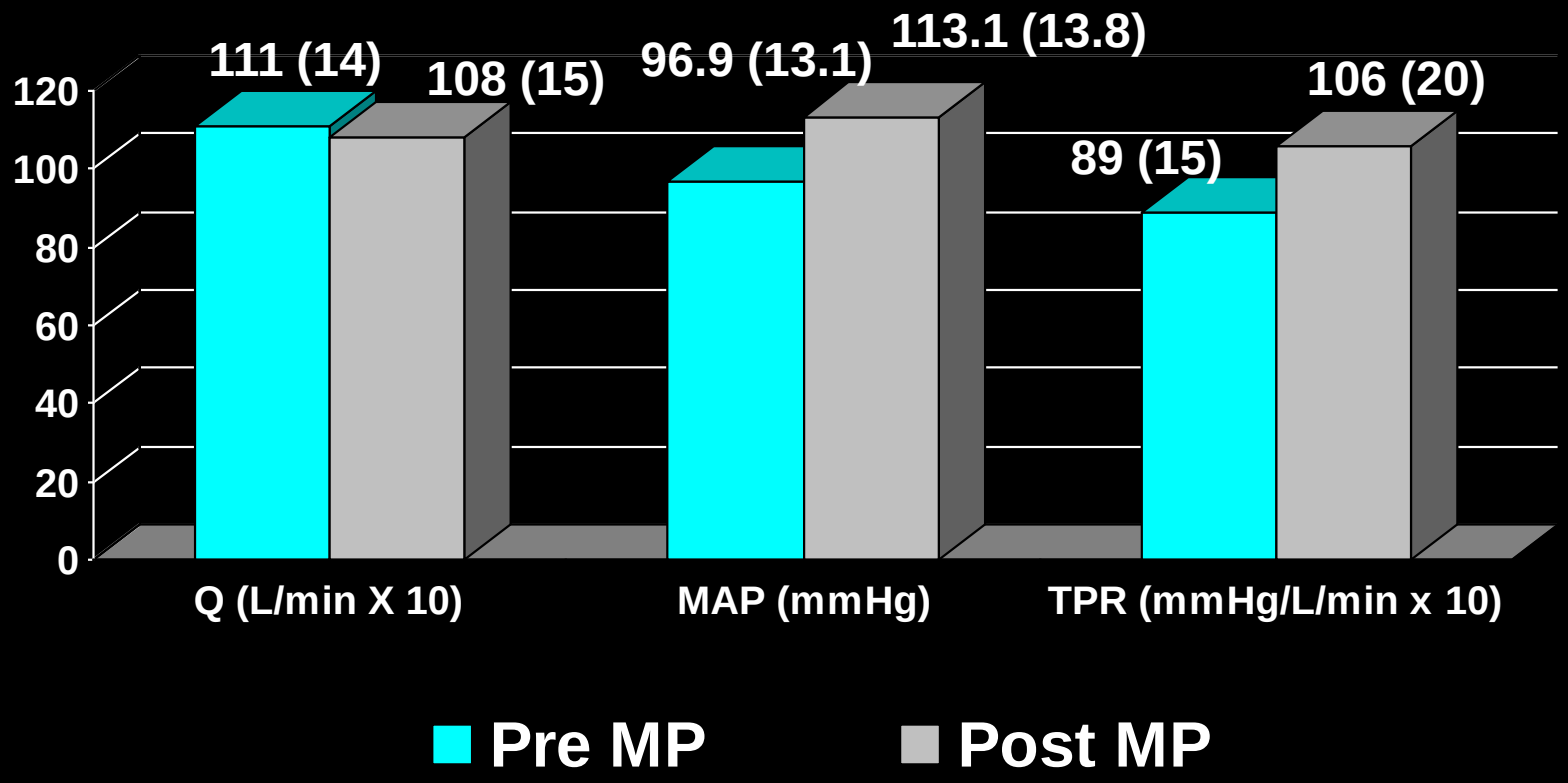
Total Peripheral Resistance at 50 Watts in Postmenopausal Women Taking vs. Not Taking Supplemental Estrogen



= significantly different from pre-training value (RM analysis)

= significantly different from pre-training value (t-Test analysis)

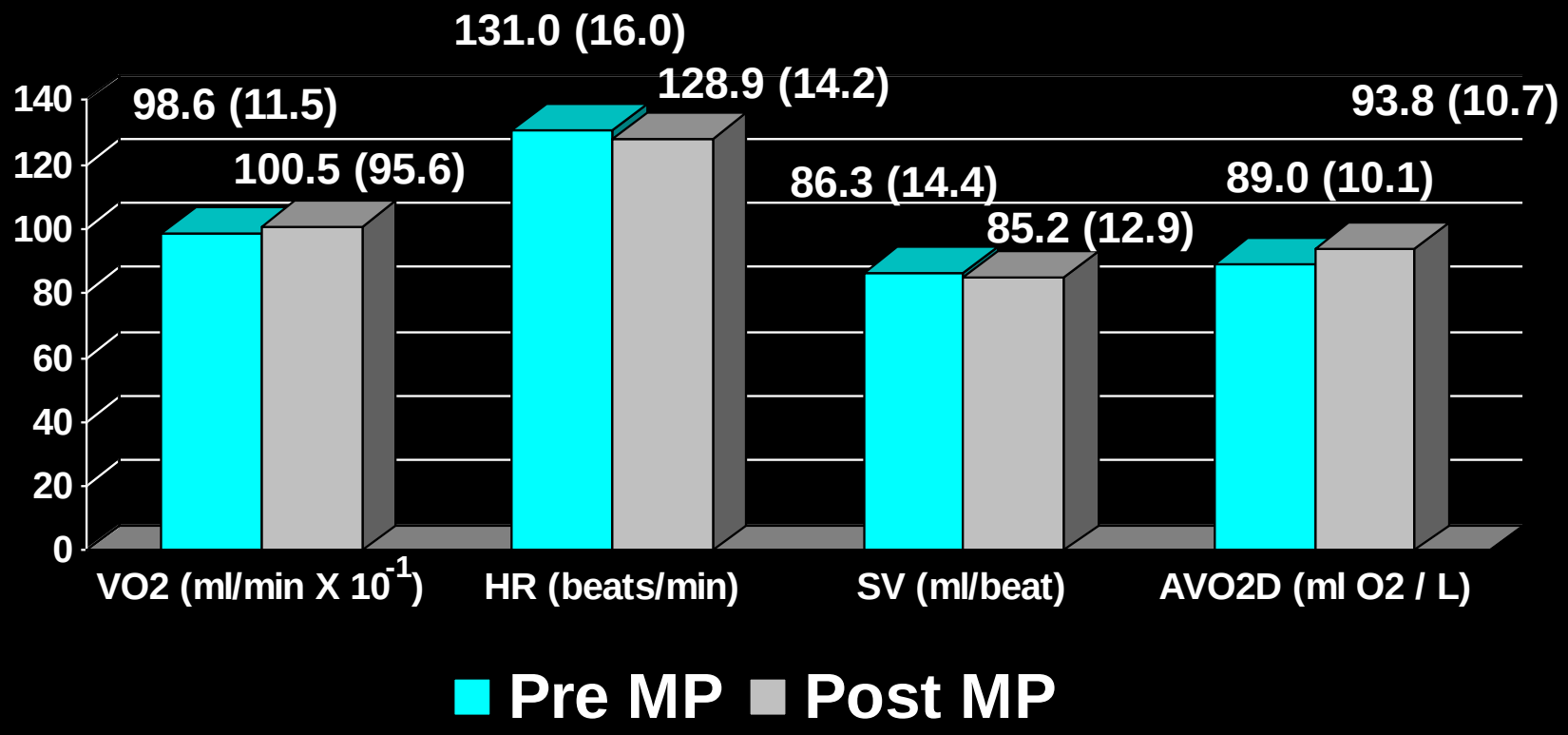
Pre-training Hemodynamics at 50 Watts in Premenopausal vs. Postmenopausal Women



No significant menopause difference (ANCOVA p < .05)

(Means shown are unadjusted for age)

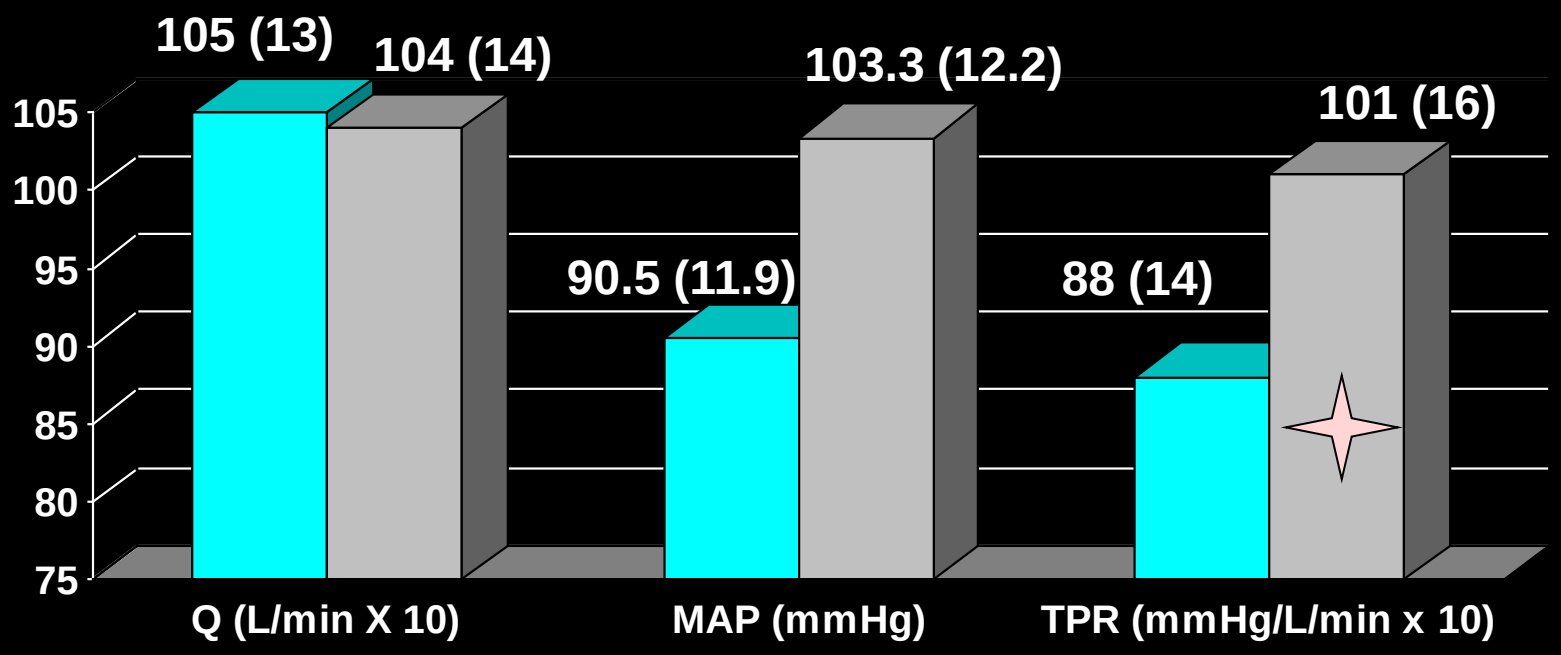
Pre-training VO_2, HR, SV, and AVO_2D at 50 Watts in Pre vs. Postmenopausal Women



No significant menopause difference (ANCOVA $p < .05$)

(Means shown are unadjusted for age)

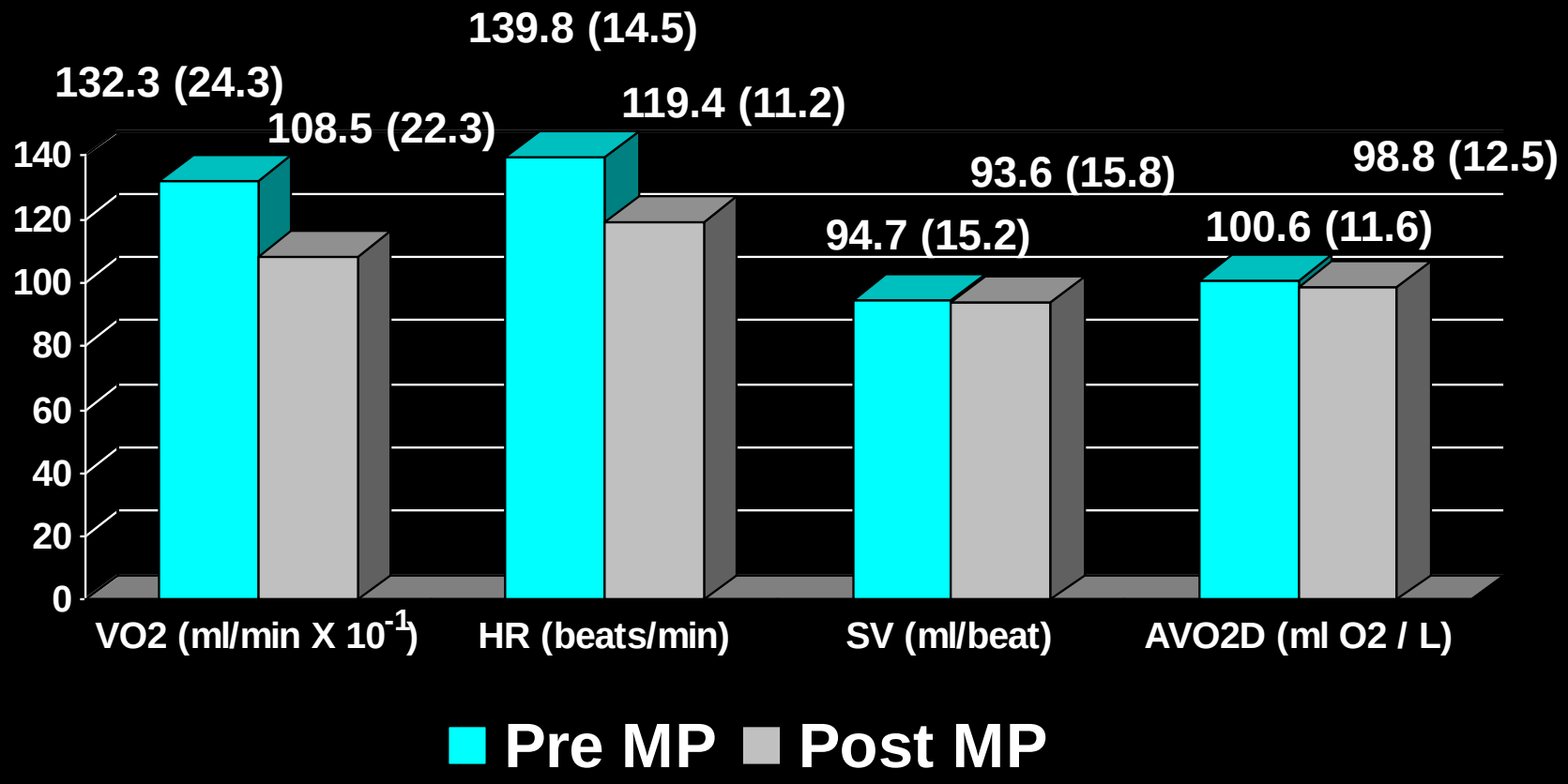
Post-training Hemodynamics at 60% VO_2max in Premenopausal vs. Postmenopausal Women



= significantly different from Pre MP value (ANCOVA $p < .05$)

(Means shown are unadjusted for age)

Post-training VO_2, HR, SV, and AVO_2D at 60% VO_2max in Pre vs. Postmenopausal Women



No significant menopause difference (ANCOVA $p < .05$)

(Means shown are unadjusted for age)

Conclusions

- Estrogen replacement does not significantly alter submaximal exercise hemodynamics in postmenopausal women

- At baseline or in response to endurance exercise training, there are no significant differences in relative or absolute submaximal exercise hemodynamics between premenopausal and postmenopausal women, once age has been accounted for. The only possible exception being a slightly higher resistance to flow in postmenopausal women at a relative percentage of VO_{2max}

Conclusions

- At a given absolute submaximal workload in both premenopausal and postmenopausal women, endurance exercise training may facilitate….
  - smaller VO_2's and associated Q's with concomitant reduction in MAP and a slight reduction in TPR (which may be due, in part, to a training mediated increase in ergonomic efficiency)
  - a substantial reduction in HR accompanied by a modest increase in SV

Conclusions

- At a given relative submaximal workload in both premenopausal and postmenopausal women, endurance exercise training may facilitate….
  - higher VO_2's and associated Q's (which may be due, in part, to the substantial increase in VO_{2max} seen in both stratifications (= 18 %), accompanied by a reduction in TPR
  - a reduction in HR accompanied by an increase in SV
  - an increase in AVO_2 difference