

APNEA TRAINED ATHLETES: RATHER MARINE MAMMALS THAN HUMANS?

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THE DIVING RESPONSE [1, 2]

- Bradycardia (slow heart rate)
- Peripheral vasoconstriction
 - ~ Human diving response
- Initiated by apnea ⇒ Augmented by facial immersion
- Water temperature ≤ 15°C ⇒ Maximal expression of the response
- Apnea trained athletes ⇒ More pronounced response
- Redistribution of blood flow ⇒ Brain & heart
 - ~ O₂-conserving effect

AIMS

[1] Are there any differences in cardiovascular response to apnea with facial immersion in cold water compared to apnea without facial immersion during prolonged exercise?

[2] Are there any differences in cardiovascular response to dynamic apnea in apnea trained athletes compared to matched controls during prolonged exercise?



SUBJECTS

10 ♀ apnea trained athletes (APTR)
= synchronized swimmers (Fig. 5)

10 ♀ physically active matched controls (CTL)

Age 16.8 ± 1.4 y
Height 164.2 ± 6.7 cm
Weight 58.7 ± 6.3 kg
VO₂max 43.4 ± 5.1 ml/min/kg

METHODS

TEST PROTOCOL (Fig. 2)

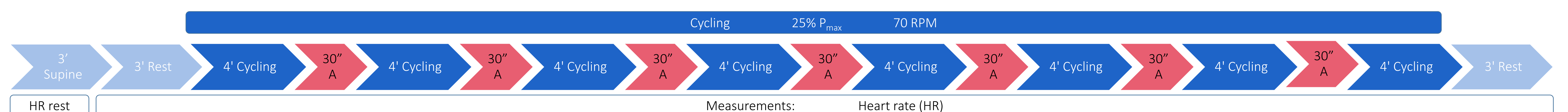
4' cycling (25% P_{max}) + 30" apnea (A) ⇒ Repeated 7 times during both tests

Apnea with facial immersion (15°C) (FIA) } Random assignment
Apnea without facial immersion (18°C) (AA)

Both tests were performed during the same time of day, at least one week apart

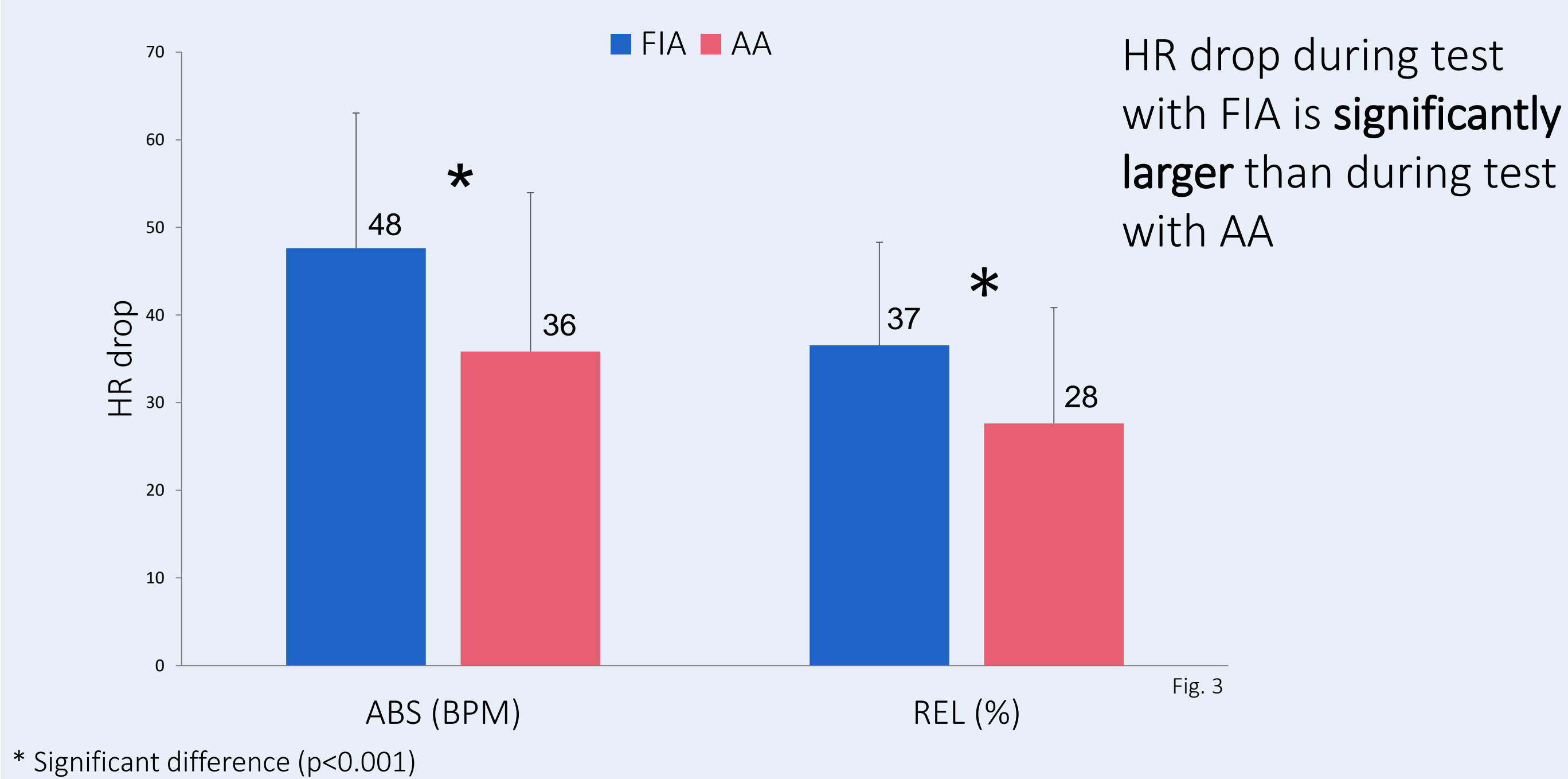
STATISTICAL ANALYSIS

HR drop = average HR plateau – lowest HR measured during A
Repeated Measures (M)ANOVA

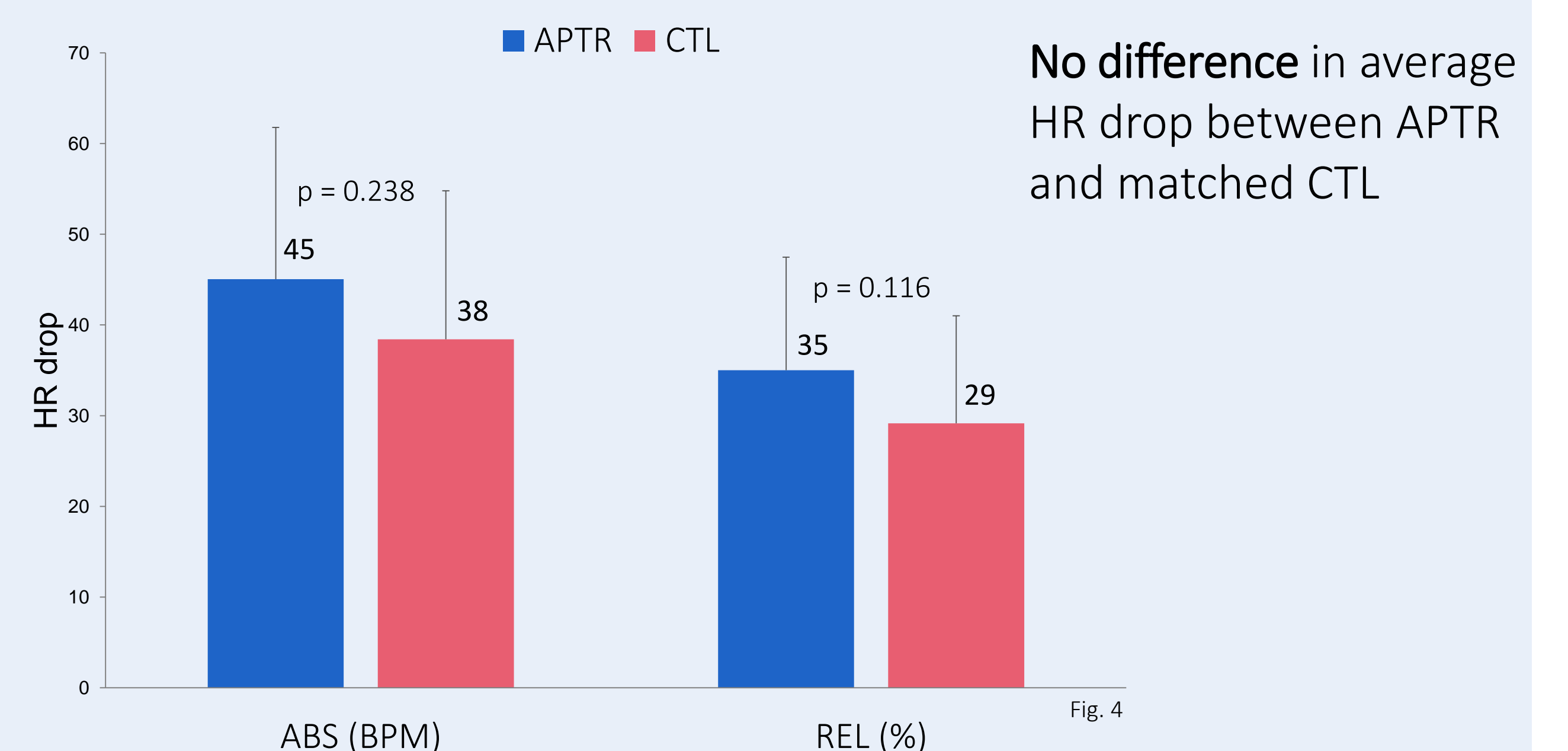


RESULTS

[1] Comparison of average HR drop between FIA and AA



[2] Comparison of average HR drop between APTR and CTL



CONCLUSIONS

[1] Apnea without facial immersion is sufficient to elicit bradycardia as a part of the human diving response during exercise

Facial immersion in cold water (15°C) enhances the diving response, resulting in a larger drop in HR
⇒ Stimulation of facial cold receptors (Trigeminal nerve)

[2] No differences in average HR drop were found between apnea trained athletes and controls

- ⇒ Apnea was too short to elicit a complete diving response ?
- ⇒ Test conditions differed too much from training conditions of the apnea trained athletes ?
- ⇒ Absence of hydrostatic pressure ?

Apnea trained athletes: humans or marine mammals?

⇒ Rather humans with marine mammal characteristics



REFERENCES

- ¹ Foster, G.E., Sheel, A.W. (2005). The human diving response, its function, and its control. *Scandinavian Journal of Medicine in Science and Sports*, 15, 3 - 12
- ² Schagatay, E., van Kampen, M., Emanuelsson, S., Holm, B. (2000). Effects of physical and apnea training on apneic time and the diving response in humans. *European Journal of Applied Physiology*, 82, 161 - 169