



## Does 6 weeks of HIIT alter structural and functional cardiac and arterial stiffness in young adults?

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Dear Editor,

We read with great interest the study by Holloway et al. (2018), which evaluated the progression of vascular and cardiac changes over a 6-week high-intensity interval training (HIIT). They found no differences in structural and functional cardiac, arterial stiffness and cardiometabolic risk after 6 weeks of HIIT. We would like to respectfully add some comments and contributions to this article.

Although several studies have investigated the effects of different types of exercise training on arterial stiffness (Ashor et al. 2014; Pierce et al. 2018), few studies have used HIIT protocols. According to Ashor et al.'s (2014) review, only two studies investigated the effects of HIIT on PWV, and none on AIx. In this review, the metaregression and subgroup analyses have shown that changes in PWV were associated with higher values of PWV at baseline ( $> 8$  m/s versus  $\leq 8$  m/s,  $p=0.01$ ). Also, there was statistical tendency of association between the changes in PWV and the length of the aerobic training ( $> 10$  versus  $\leq 10$  weeks,  $p=0.09$ ), and statistical tendency of association between changes in AIx and absolute intensity of aerobic training ( $\beta = -0.19$ ,  $p=0.07$ ). Thus, the absence of changes in PWV after HIIT observed by Holloway et al. (2018) could be associated

with the short length of the program (6 weeks) and the low PWV values of the sample at baseline. However, a reduction in AIx was expected, considering the intensity of training ( $\sim 90\% \text{VO}_{2\text{max}}$ ). AIx has been shown to vary more during the control condition (i.e. at rest) and after exercise in the acute exercise studies than PWV (Pierce et al. 2018). In addition, our research group has observed that augmentation index is reduced until 30 min in the control condition (Fig. 1, data not published). For this reason, it is important to control the rest period prior to collecting this variable, considering that it seems to reduce at 30 min at rest. This can be seen in the review by Pierce et al. (2018), in which although there is no statistical significance in the meta-analysis, it is possible to verify that most of the studies observed a reduction of AIx in the resting condition.

It has been suggested that HIIT could induce greater shear stress in the vessels, stimulating the production and release of NO and consequently lower arterial stiffness, with reduction in PWV and AIx values. This hypothesis has been supported by studies which found that in higher intensity exercises, higher is the shear stress, compared to lower intensity (Padilla et al. 2008). However, the intensity used in this study was not compatible with those used in HIIT protocols ( $> 85\% \text{HR}_{\text{max}}$ ). In addition, the intermittent nature of HIIT could induce greater shear stress and contribute to the reduction of arterial stiffness. In fact, studies comparing low- to moderate-intensity exercise, performed in a continuous or intermittent manner, have shown more favorable results for the interval condition (Tordi et al. 2010). So, could HIIT induce greater shear stress compared to other forms of exercise because of the intense or interval nature of this type of exercise? Or both? This is an unanswered question.

Another interesting parameter that could have been evaluated is cardiac deformation (e.g. strain and strain rate), which has been shown to be a subtle measure and appears to be altered early in sub-clinical conditions, such as obesity or sedentary lifestyle, in comparison to more traditional cardiological measures such as those used by the

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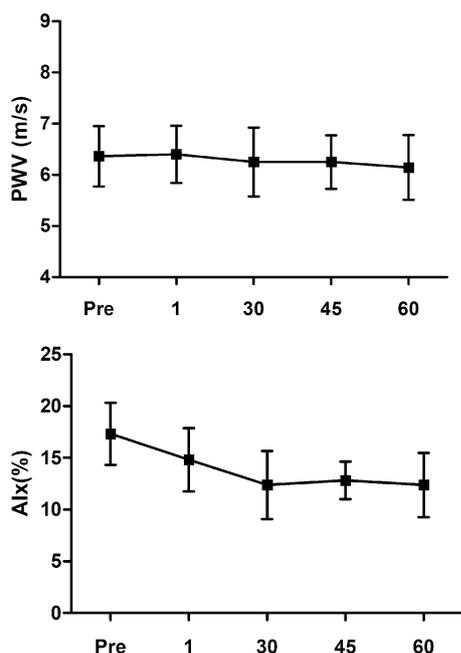
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**Fig. 1** Time course of PWV and AIx 75% of ten subjects after 60-min control condition (sitting at rest)

authors. Longitudinal strain represents cardiac mechanics and has been associated with future changes in cardiovascular functions (O’Driscoll et al. 2018). O’Driscoll et al. (2018) recently showed that only 2 weeks of HIIT induced significant changes in mechanics and myocardial function in healthy young adults. The authors verified a significant change in LV longitudinal strain rate. Perhaps, the absence of changes in cardiac function observed by Holloway et al. (2018) does not mean that 6 weeks of HIIT is not effective, but that the variables used are not sensitive enough to detect possible changes caused by this length of training.

Regarding the changes in  $VO_{2max}$ , it would be interesting to present the changes in body mass, which could impact the values related to  $VO_{2max}$ , especially since there was no evidence of an increase in absolute values.

In summary, in spite of the above mentioned, the study makes an important contribution to the understanding of the short-term effects of HIIT on the cardiovascular system. The points raised here serve as a warning for future studies that seek to investigate the role of HIIT in arterial stiffness

and cardiac function. Also, a review study that verifies the impact of HIIT versus MICT on PWV and AIx becomes urgent, since after Ashor’s review several studies using HIIT have been conducted.

Yours sincerely,  
Wendell Arthur Lopes, PhD

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### Compliance with ethical standards

**Conflict of interest** The authors declare no conflict of interest.

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