Effect of Long-Duration Standing and Sitting On Vascular Function

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INTRODUCTION

• Siting for extended periods of time induces endothelial dysfunction in the lower limbs due to a decrease in shear stress on vasculature.
• To combat the negative effects of sitting, people are encouraged to stand more.
• It is unknown if standing is beneficial to arterial health.
• Pulse wave velocity (PWV) and flow-mediated dilation (FMD) provide quantifiable measures of endothelial function and are valid indicators of arterial health.
• PWV is a measurement of arterial stiffness as it shows the velocity of pressure waves from the heart as they move throughout the arteries.
• FMD measures the change in diameter of an artery due to an acute increase in blood flow.
• The purpose of this study was to compare the effects of long-duration sitting versus sanding on lower body vasculature as assessed by PWV and FMD.

METHODS

Subjects

• N=26, with 13 males and 13 females
• Ages 14-40

Protocol

• 3 visits, including one familiarization visit and two experimental visits alternating between one standing trial and one seated trial
• Baseline measurements of FMD, heart rate, blood pressure, and PWV were measured 20 minutes prior and post each experimental trial with the participant lying supine.
• PWV was also measured at min 10, 55, and 115.

Measurements

• PWV was measured using doppler ultrasound, and calculated as the distance between the femoral and dorsalis pedis arteries divided by the time delay from the R-wave to the foot of the pulse wave.
• FMD was measured at the superficial femoral artery (SFA) with baseline hemodynamics to return.
• PWV and FMD were measured using duplex-ultrasound incrementally throughout the trials.
• PWV was calculated as the direct distance between the sites of the femoral and dorsalis pedis arteries divided by the time delay from the R-wave to the foot of the pulse wave.
• PWV was recorded on the superficial femoral artery (SFA) on both legs with 2 minutes of baseline data, followed by 5 minutes of occlusion by an automatic blood pressure cuff at 250 mmHg for 3 minutes post-inoculation to measure the vasodilatory response.
• Other variables measured throughout the trial included mean arterial pressure (MAP) and heart rate (HR).

RESULTS

• Pre-and post-sutaneous measures of heart rate and mean arterial pressure did not differ between trial (P>0.05; Figure 1 and 2).
• However during the seated and standing trials heart rate increased 10 BPM and 30 BPM respectively (P<0.05).
• Mean arterial pressure increased 7 mmHg in the seated group and 10 mmHg while standing (P<0.05).
• Flow-mediated dilation decreased from baseline to post trial within the seated group (P<0.05), however the same effect was not seen in the standing trial (Figure 3).
• Alternatively, pulse wave velocity increased from baseline in the standing trial (P<0.05), yet did not change in the seated trials (Figure 4).

CONCLUSIONS

• Long-duration sitting reduced flow-mediated dilation (FMD), and this could be a result of the arterial angulation of the SFA at the hip created by a seated posture.
• A reduction in FMD signifies less dilation in response to the ischemic stimulus and sequentially lower vascular health.
• The standing trial attenuated the reduction in FMD that occurred while seated, which suggests there may be some benefit to standing.
• However, PWV increased while standing indicating more arterial stiffness. This increase can have a negative impact on systolic blood pressure and promote endothelial dysfunction as well as atherogenic lesion formation.
• This data signifies that long-duration standing and sitting have different effects on endothelial function and more research is needed to accurately assess the risks and benefits of each posture. It is possible that regular posture changes could attenuate the negative effects observed in both groups.

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