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Guided Breathing and Heart Rate Variability Recovery After Acute Cognitive Stress in Adolescents: A Study Using an Open-Source Earable Platform

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Abstract

Adolescence is a period of increased vulnerability to stress-related problems, but there is limited physiological evidence on adolescents' recovery from stress. This study investigated heart rate variability (HRV), comparing recovery methods (4-7-8 guided breathing and passive rest). Data were collected using an open source earable device (OpenEarable 2.0) and a custom mobile app. Participants (N = 23, age: 9–18 years, M = 14.5, SD = 1.9) undertook a 5-minute gamified cognitive stressor. They were then randomly allocated to either a 2-minute guided-breathing recovery task (n = 14) or a passive-rest recovery task (n = 9). The stressor caused a reduction in standard deviation of normal-to-normal intervals (SDNN) by 46 ms, $t(22) = 9.23$, $p < .001$, $d = 1.92$, and the reduction was evident in all participants. Those in the guided-breathing condition had no significant difference in SDNN and heart rate (HR) during the recovery phase compared to baseline. Participants in the passive-rest condition continued to have lower SDNN and higher HR than baseline. There was a significant difference between conditions for recovery of SDNN ($p = .036$), although this was not significant when accounting for baseline SDNN ($p = .067$). Overall, these results suggest that short guided-breathing interventions may be beneficial for autonomic recovery in adolescents and that open source earables can be used to capture stress physiology in real world settings.

Keywords: Adolescent Stress, Heart Rate Variability, Guided Breathing, Earable Sensing, Stress Recovery