

A Quantitative Study On The Physiological Changes And Effects Of Different Deep Breathing Durations On Cognitive Control

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ABSTRACT

Deep breathing brings positive effects on the physiological state of the body, however, the current literature does not have a consensus on how long it is necessary. Furthermore, there is no study linking deep breathing to the cognitive control. In this study, questionnaires, cerebral oxygen delivery (CDO₂), heart rate variability (HRV), electroencephalogram (EEG) and event related potential (ERP) in a Go/NoGo paradigm to quantify the cognitive control were investigated for different deep breathing durations. 50 participants were recruited and randomised into one of the four groups of control (Con, n = 12), Deep breathing for 5 minutes (DB5, n = 12), 7 minutes (DB7, n = 13) and 9 minutes (DB9, n = 13). The period of interest included the baseline (R1), first Go/NoGo task (T1), during deep breathing (INT), post deep breathing (R2), second Go/NoGo task (T2), follow-up baseline (R3) and third Go/NoGo task (T3) during the follow-up session. During R3, a positive trend between the CDO₂ and the deep breathing duration was evident. For the HRV indices during INT, all three DB groups had a significantly larger SDNN (all three $p < 0.05$) and nLF (all three $p < 0.001$) and a significantly smaller nHF (all three $p < 0.001$) compared to Con. This indicated that the DB groups had a greater activation of the parasympathetic nervous system. For the EEG, DB5 and DB9 had a significantly larger frontal relative theta power as compared to that of Con (both $p < 0.05$) whereas DB7 and DB9 groups achieved a centrally dominant topography. The overall beta power was lower in all three DB groups (all three $p < 0.05$). These showed that the DB groups' participants achieved a 'focused yet not anxious' state of mind. For the ERP, results showed that during T3, the NoGo N2 amplitude of the DB5 group was significantly larger than that of Con ($p < 0.05$) and an inverse relationship between the NoGo N2 amplitude and the deep breathing duration was observed. This indicated that the DB5 group had an enhanced conflict monitoring ability. Regarding the optimum deep breathing duration, the current study revealed that the optimum duration is either 5 or 9 minutes.