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Reply

Response to "Considerations for Transcranial Direct Current Stimulation to Improve Gait Performance in the Elderly"

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We sincerely thank the authors for the valuable comments and constructive suggestions. The concerns raised by the authors are important and meaningful considerations for future studies investigating transcranial direct current stimulation (tDCS) and gait performance for older adults. We would emphasize that our meta-analysis study focused on identifying the effects of tDCS on gait performance in healthy older adults by statistically synthesizing findings from individual studies in the literature.

First, we defined healthy older adults as those who may exhibit normal age-related changes in motor functions, consistent with previous suggestions [1,2]. The qualified studies in our meta-analysis recruited participants without pathological changes who were capable of independent locomotion, and we confirmed that all studies excluded individuals with neurological and musculoskeletal diseases such as sarcopenia [3–13]. As the authors indicated, neuromuscular impairments associated with sarcopenia may affect gait performance [14–16]. Further, sarcopenia is characterized by decreased excitability in the premotor cortex during dual tasks and progressive impairments in muscle function and morphology [17,18]. These findings suggest that the effects of tDCS on gait performance may be different for sarcopenic individuals, so future studies should investigate this possibility.

Previous studies reported that tDCS is a safe technique with minimal incidence of serious adverse events even after administering multiple sessions [19,20]. The guidelines of tDCS protocols indicated that the profile of adverse events was comparable across younger and older adults [21]. Traditional tDCS protocols, including a session duration $\leq$40 min and stimulation intensity $\leq$4 mA per day, are normally recommended for healthy individuals [19]. In fact, all included studies in our meta-analysis used more conservative stimulation parameters (i.e., a session duration = 20 min and a range of stimulation intensity = 0.6–2 mA), and excluded older adults with seizure history or tDCS contraindications [4,6,8–13]. Nevertheless, we agree with the potential occurrence of seizures in older adults after tDCS protocols. Thus, future tDCS studies for older adults may consider implementing standardized screening questionnaires to identify medical and pharmacological conditions, using neuroimaging techniques to optimize stimulation parameters, and conducting real-time monitoring via pain scales to ensure physiological tolerance.

Finally, we synthesized findings from randomized controlled trials to minimize the potential bias of information and enhance reliability [22]. However, our meta-analytic findings tentatively suggest potential effects of tDCS on gait improvement in older adults because of the limited number of included studies and heterogeneity of the tDCS protocols. Thus, more studies are necessary to identify optimal tDCS protocols for gait improvements in the aging population, including stimulation area, session duration, and stimulation intensity using randomized and double-blind controlled designs.

Author Contributions

BJC, HL, and NK wrote the reply and contributed to editorial revisions. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest. Nyeonju Kang is serving as one of the Guest editors of this journal. We declare that Nyeonju Kang had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Bettina Platt.

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