Supplementary Material

On the Reliability of Motor Evoked Potentials in Hand Muscles of Healthy Adults: A Systematic Review

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# Supplementary Results

## Chipchase rating frequencies & Inter-rater agreement

During the critical evaluation of 28 studies with the standardized checklist of Chipchase et al. (2012), a heterogeneity in the methods of the studies was found. This makes it difficult - in combination with the heterogeneity of statistical reliability and technical parameters - to compare the results of the individual subcategories. The absolute frequencies of either reported or controlled items of the Chipchase et al.’s checklist are depicted in the supplementary **Table S3** as well as the inter-rater agreement of the ratings expressed via Cohen´s Kappa and corresponding confidence intervals in the supplementary **Table S4**. A mean amount of 68.3% (range 3.6-100%) of all items was rated as reported and a mean of 25% (range 0-61%) as controlled. The item with the lowest total score, therefore which was rated the least as reported or controlled, was the level of relaxation of muscles other than those being tested (1.8%). The item stimulation intensity had the highest total score (78.6%).

The mean relative sum of reported plus controlled items per study was 46.8% (29.2-74%) of the total applicable items. Of all 28 identified studies, 17 reached a value of ≥ 50%. At this point, no ordinal scale exists to put the checklist scores in relation. Since there is no classification or comparison of the number of fulfilled checklist criteria, an interpretation of the results is not possible and the results are merely descriptive. Cohen’s Kappa agreement ranged from −0.23, which can be classified as poor, to an almost perfect correlation of 1.00 (mean 𝜅 = .87) (Landis and Koch, 1977). The average 𝜅-value indicates a high degree of agreement, thus increasing the transparency and objectivity of the rating procedure.

Due to technological development and research advancements, it was assumed that more criteria of the Chipchase checklist are met, the later the study was published. No significant correlation was evident between the publication year and the number of fulfilled Chipchase’ criteria (*r* = .052, *p =* .794*)* or between publication year and mean intra-class correlation coefficient (ICC) values (*r* = .054, *p =* .808). Due to the lack of significant correlations, no further analyses were carried out.

**Supplementary Table S3**

*Absolute & relative frequencies of the Chipchase’ items*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Reported**  **(n/N)** | | **Controlled**  **(n/N)** | | **Total**  **(%)** | |
| **Participant factors** | | | | | | |
| Age of subjects | | 27/28 | | 2/28 | | 51.8% |
| Gender of subjects | | 28/28 | | 14/28 | | 75.0% |
| Handedness of subjects | | 26/28 | | 15/28 | | 73.2% |
| Use of CNS active drugs/prescribed medication | | 9/28 | | 2/28 | | 19.6% |
| Presence of neurological/psychiatric disorders when  studying healthy subjects | | 13/28 | | 2/28 | | 26.8% |
| Any medical condition | | 5/28 | | 2/28 | | 12.5% |
| History of specific repetitive motor activity | | 2/28 | | 0/28 | | 3.6% |
| **Methodological factors** | | | | | | |
| Position and contact of EMG electrodes | | 22/28 | | 6/28 | | 50.0% |
| Amount of relaxation/contraction of target muscles | | 16/28 | | 9/28 | | 44.6% |
| Prior motor activity of the muscle to be tested | | 10/28 | | 10/28 | | 35.7% |
| Level of relaxation of muscles other than those being tested | | 1/28 | | 0/28 | | 1.8% |
| Coil type | | 25/28 | | 1/28 | | 46.4% |
| Coil orientation | | 24/28 | | 2/28 | | 46.4% |
| Direction of induced current in the brain | | 18/28 | | 2/28 | | 35.7% |
| Coil location and stability | | 27/28 | | 13/28 | | 71.4% |
| Type of stimulator used | | 25/28 | | 2/28 | | 48.2% |
| Stimulation intensity | | 28/28 | | 16/28 | | 78.6% |
| Pulse shape (monophasic/biphasic) | | 11/28 | | 2/28 | | 23.2% |
| Determination of optimal hotspot | | 21/28 | | 9/28 | | 53.6% |
| Time between MEP trials | | 26/28 | | 17/28 | | 76.8% |
| Time between days of testing | | 21/21 | | 11/21 | | 76.2% |
| Subject attention (level of arousal) during testing | | 8/28 | | 4/28 | | 21.4% |
| Method for determining threshold | | 25/26 | | 4/26 | | 55.8% |
| Number of MEP measures made | | 24/28 | | 13/28 | | 66.1% |
| **Analytical factors** | | | | | | |
| Method for determining MEP size during analysis | | 27/28 | | 13/28 | | 71.4% |

CNS = central nervous system; EMG = electromyography; MEP = motor evoked potential; n = number of times that the item was rated as reported or controlled; N = number of times that the item was applicable over all studies.

**Supplementary Table S4**

*Inter-rater agreement of Chipchase’ rating per study*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study** | **R -R1** | **C-R1** | **R-R2** | **C-R2** | | **Total Score** | **κ** | **Confidence Interval** | | **Limits of Agreement** |
| [1] | 20 | 5 | 19 | 5 | 50.0 % | | 1.00 | [0.86 | 1.00] | almost perfect | |
| [2] | 19 | 6 | 19 | 4 | 50.0 % | | 0.86 | [0.75 | 0.98] | almost perfect | |
| [3] | 20 | 5 | 18 | 5 | 50.0 % | | 0.78 | [0.64 | 0.92] | substantial | |
| [4] | 17 | 9 | 16 | 7 | 52.0 % | | 0.91 | [0.73 | 1.00] | almost perfect | |
| [5] | 17 | 6 | 17 | 6 | 46.0 % | | 1.00 | [0.86 | 1.00] | almost perfect | |
| [6] | 19 | 5 | 19 | 5 | 50.0 % | | 1.00 | [0.87 | 1.00] | almost perfect | |
| [7] | 15 | 4 | 15 | 4 | 39.6 % | | 1.00 | [0.88 | 1.00] | almost perfect | |
| [8] | 12 | 2 | 12 | 2 | 29.2 % | | 1.00 | [0.87 | 1.00] | almost perfect | |
| [9] | 17 | 6 | 17 | 6 | 47.9 % | | 1.00 | [0.86 | 1.00] | almost perfect | |
| [10] | 21 | 9 | 21 | 9 | 60.0 % | | 1.00 | [0.81 | 1.00] | almost perfect | |
| [11] | 13 | 2 | 10 | 1 | 32.0 % | | -0.11 | [-0.16 | -0.05] | poor | |
| [12] | 18 | 7 | 17 | 7 | 50.0 % | | 0.91 | [0.74 | 1.00] | almost perfect | |
| [13] | 18 | 5 | 18 | 5 | 46.0 % | | 1.00 | [0.87 | 1.00] | almost perfect | |
| [14] | 15 | 3 | 14 | 3 | 36.0 % | | 0.86 | [0.75 | 0.98] | almost perfect | |
| [15] | 19 | 8 | 19 | 8 | 54.0 % | | 1.00 | [0.82 | 1.00] | almost perfect | |
| [16] | 14 | 4 | 14 | 4 | 36.0 % | | 1.00 | [0.90 | 1.00] | almost perfect | |
| [17] | 19 | 7 | 19 | 7 | 52.0 % | | 1.00 | [0.84 | 1.00] | almost perfect | |
| [18] | 13 | 5 | 13 | 4 | 37.5 % | | 0.86 | [0.75 | 0.98] | almost perfect | |
| [19] | 19 | 9 | 18 | 9 | 60.9 % | | 0.91 | [0.72 | 1.00] | almost perfect | |
| [20] | 15 | 2 | 14 | 3 | 34.0 % | | 0.78 | [0.70 | 0.85] | substantial | |
| [21] | 20 | 12 | 20 | 12 | 64.0 % | | 1.00 | [0.80 | 1.00] | almost perfect | |
| [22] | 14 | 6 | 14 | 5 | 40.0 % | | 0.88 | [0.75 | 1.00] | almost perfect | |
| [23] | 13 | 5 | 14 | 5 | 36.0 % | | 0.86 | [0.75 | 0.98] | almost perfect | |
| [24] | 13 | 6 | 13 | 6 | 38.0 % | | 1.00 | [0.85 | 1.00] | almost perfect | |
| [25] | 16 | 7 | 15 | 5 | 46.0 % | | 0.78 | [0.63 | 0.92] | substantial | |
| [26] | 22 | 15 | 20 | 8 | 74.0 % | | 0.40 | [0.27 | 0.53] | fair | |
| [27] | 20 | 6 | 20 | 4 | 54.0 % | | 0.56 | [0.44 | 0.68] | moderate | |
| [28] | 18 | 4 | 18 | 4 | 44.0 % | | 1.00 | [0.89 | 1.00] | almost perfect | |

C-R1 = sum of items rated as controlled by rater 1; C-R2 = sum of items rated as controlled by rater 2; κ = Cohen´s Kappa; R-R1 = sum of items rated as reported by rater 1, R-R2 = sum of items rated as reported by rater 2; total score = sum of per study reported or controlled items divided by the sum of applicable items. [1] Bashir et al. (2017); [2] Bastani & Jaberzadeh (2012); [3] Biabani et al. (2018); [4] Brown et al. (2017); [5] Carroll et al. (2001); [6] Chang et al. (2016); [7] Christie et al. (2007); [8] Cueva et al. (2016); [9] Cuypers et al. (2014); [10] Davila-Pérez et al. (2018); [11] Dyke et al. (2018); [12] Fleming et al. (2012); [13] Goldsworthy et al. (2016); [14] Hashemirad et al. (2017); [15] Hassanzahraee et al. (2019); [16] Julkunen et al. (2009); [17] Jung et al. (2010); [18] Kamen (2004); [19] Kukke et al. (2014); [20] Liu & Au-Yeung (2014); [21] Malcolm et al. (2006); [22] McDonnell et al. (2004); [23] Ngomo et al. (2012); [24] Nguyen et al. (2019); [25] Pellegrini et al. (2018b); [26] Schambra et al. (2015); [27] Therrien-Blanchet et al. (2022); [28] Vaseghi et al. (2015).

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