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**Title: The accuracy and precision of kinesiology-style manual muscle testing: designing and implementing a series of diagnostic test accuracy studies**

Abstract:

**Introduction:** Kinesiology-style manual muscle testing (kMMT) is a non-invasive assessment method used by various types of practitioners to detect a wide range of target conditions. It is distinctly different from the muscle testing performed in orthopaedic/neurological settings and from Applied kinesiology. Despite being estimated to be used by over 1 million people worldwide, the usefulness of kMMT has not yet been established. The aim of this thesis was to assess the validity of kMMT by examining its accuracy and precision.

**Methods:** A series of 5 diagnostic test accuracy studies were undertaken. In the first study, the index test was kMMT, and the target condition was *deceit* in verbal statements spoken by Test Patients (TPs). The comparator reference standard was a true gold standard: the actual verity of the spoken statement. The outcomes of the muscle tests were interpreted consistently: a weak result indicated a Lie and a strong result indicated a Truth. A secondary index test was included as a comparator: Intuition, where Practitioners used intuition (without using kMMT) to ascertain if a Lie or Truth was spoken. Forty-eight Practitioners were recruited and paired with 48 unique kMMT-naïve TPs. Each Pair performed 60 kMMTs broken up into 6 blocks of 10, which alternated with blocks of 10 Intuitions. For each Pair, an overall percent correct was calculated for both kMMT and Intuition, and their means were compared. Also calculated for both tests were sensitivity, specificity, positive predictive value and negative predictive value.

The second study was a replication of the first, using a sample size of 20 Pairs and a less complex procedure. In the third study, grip strength dynamometry replaced kMMT as the primary index test. In the fourth study, the reproducibility and repeatability of kMMT were examined. In the final study, TPs were presented with emotionally-arousing stimuli in addition to the affect-neutral stimuli used in previous studies, to assess if stimuli valence impacted kMMT accuracy.

**Results:** Throughout this series of studies, mean kMMT accuracies (95% Confidence Intervals; CIs) ranged from 0.594 (0.541 – 0.647) to 0.659 (0.623 - 0.695) and mean Intuition accuracies, from 0.481 (0.456 - 0.506) to 0.526 (0.488 - 0.564). In all studies, mean kMMT accuracies were found to be significantly different from mean Intuition accuracies ( $p \leq 0.01$ ), and from Chance ( $p < 0.01$ ). On the other hand, no difference was found between grip strength following False statements compared to grip strength following True statements ( $p = 0.61$ ). In addition, the Practitioner-TP complex accounted for 57% of the variation in kMMT accuracy, with 43% unaccounted for. Also, there was no difference in the mean kMMT accuracy when using emotionally-arousing stimuli compared to when using affect-neutral stimuli ( $p = 0.35$ ). Mean sensitivities (95% CI) ranged from 0.503 (0.421 - 0.584) to 0.659 (0.612 - 0.706) while mean specificities (95% CI) ranged from 0.638 (0.430 - 0.486) to 0.685 (0.616 - 0.754). Finally, while a number of participant characteristic seemed to influence kMMT accuracy during one study or another, no one specific characteristic was found to influence kMMT accuracy consistently (i.e. across the series of studies).

**Discussion:** This series of studies has shown that kMMT can be investigated using rigorous evidence-based health care methods. Furthermore, for distinguishing lies from truths, kMMT has repeatedly been found to be significantly more accurate than both Intuition and Chance. Practitioners appear to be an integral part of the kMMT dynamic because when replaced by a mechanical device (i.e. a grip strength dynamometer), distinguishing Lies from Truth was not possible. In addition, since specificities seemed to be greater than sensitivities, Truths may have been easier to detect than Lies. A limitation of this series of studies is that I have a potential conflict of interest, in that I am a practitioner of kMMT who gets paid to perform kMMT. Another limitation is these results are not generalisable to other applications of kMMT, such as its use in other paradigms or using muscles other than the deltoid. Also, these results suggest that kMMT may be about 60% accurate, which is statistically different from Intuition and Chance; however it has not been established if 60% correct is "*good enough*" in a clinical context. As such, further research is needed to assess its clinical utility, such as randomised controlled trials investigating the effectiveness of whole kMMT technique systems. Also, future investigators may want to explore what factors, such as specific Practitioner and TP characteristics, influence kMMT accuracy, and to investigate the validity of using kMMT to detect other target conditions, using other reference standards and muscles other than the deltoid.

**Summary:** This series of diagnostic test accuracy studies has found that kMMT can be investigated using rigorous methods, and that kMMT used to distinguish Lies from Truths is significantly more accurate than both Intuition and Chance. Further research is needed to assess kMMT's clinical utility.

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