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LETTER TO THE EDITOR

COMMENT ON "CHARACTERISTICS AND CORRELATES OF REHABILITATION CHARGES DURING INPATIENT TRAUMATIC BRAIN INJURY REHABILITATION IN SINGAPORE"

We read with interest the paper by Chua et al. (1). As a developer of the Modified Barthel Index (MBI) (2) I take issue with a number of the comments regarding the MBI, which was used as an outcome measure in their study. Despite their study findings that: (*i*) 78% of all their patients showed statistically significant change from admission status; (*ii*) the MBI manifested itself as the principal outcome measure that strongly correlated with most dependent variables; and (*iii*) the MBI has a highly significant predictive ability, the authors speculate that the MBI should not be the measure of choice when compared with the speculative beliefs regarding the Functional Independence Measure (FIM). The authors also speculate that lack of significant change found in the high admission score of the remaining 12% of patients must have been due to the MBI ceiling effect. The authors also assert that the MBI has rapid floor and ceiling effects and that it is insensitive to cognitive gains and language impairments. Note that the word "rapid" remains unsubstantiated.

Given the many publications on the MBI, Chua et al. (1) should realize, on all counts, the inaccuracies within their chosen citations (3). This citation, in fact, refutes all speculative claims on the FIM and the MBI made by the authors. The authors beliefs regarding floor and ceiling effects and insensitivity of the MBI have been rebutted by evidence in this and other MBI research (3–6). The appropriate evidence to cite on the MBI would have been our research published in the *Journal of Clinical Epidemiology* (2). Our 3 research publications (4–6) on inpatient traumatic brain injury also addressed the non-empirical comments made by the authors. In reference (4) we address the issue of floor and ceiling effects and the overall MBI score as the most effective way to predict outcome in traumatic brain injuries (TBI). Any dependency outcome measure, whether it is the FIM or the MBI, with a numeric value would have a ceiling effect. However, since the relationship between admission and recovery on discharge is non-linear (from many confounders), it is important to demonstrate how to accommodate for non-linearity of recovery in high admission scoring patients with mild TBI, stroke and other impairments. We demonstrated that the fourth root of the MBI admission score alone explains 84% of the variance when the admissions score are low or high following TBI rehabilitation (5). Our paper (2) outlines cross-validation of a regression equation that predicts length of stay from TBI patients' admission scores. In addition, we have provided the relationship between real length of stay and that predicted by the rule-of-thumb formula. Their research would have contributed more if the authors had cross-validated their findings with our published findings for possible generalizations.

The authors then suggest that the MBI is insensitive to cognitive gains and language impairments, which indicates that they are unaware of the uniqueness of the MBI, which is its unidimensionally, designed to measure only the dependency needs of persons with disability. The research has also shown that one could not add items that measure different constructs, such as dependency, cognition and language, and summate the obtained score. Since such a score has little meaning and, as discussed at length in various issues of the *Archives of Physical Medicine and Rehabilitation*, might actually impugn the credibility of rehabilitation. The MBI, for example, is a dependency in self measure and should not be expected to measure stress experienced by a caregiver or to report inability to interact with the environment. For such outcomes one has to use a specific outcome measure.

We were disappointed that, despite the fact that Singapore has been using MBI as an outcome measure for more than a decade, and despite the nationally funded research on the MBI at the Singapore community hospitals including Tan Tock Seng, the authors have speculated about the benefits of the introduction of the FIM and, without evidence, have cast doubt on the superiorly performing MBI in their own study. A search on the web would show hundreds of articles that show the clinical utility of the MBI and its demonstrated psychometric and biometric properties. On another aspect of the methodology, it was puzzling to read that, in this time of evidence-based medicine, the rehabilitation intervention approach of choice was the neuro-developmental (NDT) one. A great deal of published scientific evidence from the past two decades (7) shows that NDT has too many limitations, compared with other rehabilitative approaches for it to become an approach of choice in TBI.

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RESPONSE TO LETTER TO THE EDITOR BY SHAH

On behalf of my co-authors, I wish to give the following response: In this above paper (1) the authors acknowledge that global rehabilitation outcome and functional change during inpatient rehabilitation was reflected in highly significant changes in the Modified Barthel Index (MBI) during the inpatient rehabilitation stay, i.e. discharge MBI – admission MBI. The MBI was sensitive in tracking global change (effectiveness) after ~30 days of inpatient rehabilitation. In addition, on multivariate regression analyses, the admission (initial) log scale MBI, together with the rehabilitation length of stay were the only two variables that showed highly significant correlation with total rehabilitation charges (p. 31, Table IV). These findings are in concurrence with an earlier paper by Shah et al. (8).

We acknowledge that ceiling and floor effects are present for any functional score, including the FIM score. For the 12% of patients who did not show gains in MBI at discharge, several factors could have accounted for this: a shorter rehabilitation length of stay, and hence less time to demonstrate MBI gains and ceiling effects of MBI (mean 9 days (range 3–38) for these 11 patients). For patients who scored < 10 on the initial MBI, all showed positive MBI gains indicating lack of floor effect for this cohort (p. 29).

For this study, the main advantage of using the FIM would be to determine the relative impact of either motor-FIM or cognitive-FIM subscores on the final outcome of total rehabilitation charges (Discussion, p. 33). The MBI, which is a good measure of physical dependency, could not allow us to comment on the relative contribution of cognitive impairment to total rehabilitation costs in this study. This, we felt was a potential limitation in the current study.

The neurodevelopmental approach is used as one of the rehabilitation centre's approaches to motor neurorehabilitation for brain injury clients with neurorehabilitation needs. The subsequent statement documents the other components of the comprehensive brain injury rehabilitation programme (Methodology, p. 28).

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