Functionality Variables and Accelerometry Energy Expenditure Estimate Improvement in Individuals with Locomotor Dysfunction

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ABSTRACT

The act of walking is a complex series of actions involving a number of different body systems and is considered a critical contributor to quality of life. One’s gait, the manner of walking, can therefore be used by healthcare providers to evaluate patient health, functionality, and prognosis.

Accelerometers serve as both a valid and reliable instrument to measure activity level in able-bodied persons over extended periods of time. Currently, the Actical® (Mini Mitter, Bend, OR, USA) accelerometer includes age, gender, height, and weight data in its calculation of EE. The inability of individuals with locomotor dysfunction, however, current algorithms do not suffice for accurate estimates they underpredict actual energy expenditure. Thus, there is a need for a variable(s) to take into account the magnitude of gait impairment and produce a revised equation to accurately estimate energy expenditure.

In search of those variables this study explored various functionality measurements of subjects(n=35) with gait impairments diverse in both etiology and extent. The Timed Up and Go (TUG), 10 Meter Walk (10mW), 30-second Chair Stand (30CS), 4 stage standing balance (4SB), and Six Minute Walk (6MWT) tests were used. Using the conservative statistical model of backwards regression analyses produced an R²=0.78 by taking into account variables of gender, weight, age, 30CS, 4SB, the fast 10mW, and its difference to the slow 10mW. The best regression model produced an R²=0.724 and included height, TUG, and 6MWT in addition to those variables of the more conservative model.

Demand for accelerometer use in gait impaired individuals requires a revised equation taking into account important frequently tested functionality variables. These variables demonstrate themselves as quality tests for better energy expenditure estimates and can lead physical therapists and healthcare professionals to the potential of providing gait impaired patients Actical® technology for more accurate results and therefore improve care.

RESULTS

• Regression equations A through E produced significantly similar predictions of AEE (R²=0.525) and used all variables except 10mW-p (R²=0.020) as shown in Figure 8 and 9.

• Two cohorts of ambulatory subjects with diverse degrees of gait impairment (Thai and U.S.) — both static and dynamic balance assessed — essentially a complete chair-stand with an inserted 6m walk — subject walks at normal pace using his regular walking aid and normal footwear — walking speed landed by some as the “six vital sign” — predicts and assess functionality, fall risk, and health status at a gross-systems level — five vital signs: temperature, pulse and respiration rate, blood pressure, and pain level — high inter-rater and test-retest reliability

• Two flaws: 10mW4 (10mW4-sec) — at a quick but safe speed 10mW-p (10mW-preferred) — at a quick but safe speed 10mW-difference is also a revealing measure

• 6MWT — (6 Meter Walk Test) — measures distance covered in 6 minutes — tracking aids stopping/resisting are allowed whenever subject feels necessary — self-paced, therefore a better reflection of daily life activities than other walking tests — test commonly used to assess chronic heart failure patients — predictor of morbidity and mortality from heart or lung disease

CONCLUSIONS

• Actical® accelerometers underpredict energy expenditure estimates when used by individuals with locomotor dysfunction (abnormal gait)

• Regression equations with variables of the 5 functional tests (30CS, 4SB, TUG, 10mW, and 6MWT)—as well as with the conventional age, gender, weight, and height—produce improved energy expenditure estimates for gait impaired individuals in comparison to Actical® estimates — these standard and simple tests are fitting variables to be incorporated into Actical® calculations for those with abnormal gait

• future studies with much larger sample sizes would be desired to improve R² values