Gait Test or No Gait Test: Do We Need Walking Assessment to Determine Physical Frailty?

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Dear Editor,

Piau and Wild [1] have raised some concerns about the conclusions of our recently published study [2], in which we have proposed a quick and practical test, named “Instrumented Trail-Making Task” or “iTMT,” to determine frailty status and to distinguish between presence and absence of key performance-based frailty phenotypes including “slowness,” “exhaustion,” “weakness,” and “inactivity” using a non-walking-based wearable platform. The iTMT test includes reaching to 5 indexed circles in a sequential order, which virtually appear on a computer-screen, by rotating one’s ankle-joint while standing. By rotating the ankle joint, the subject navigates the computer cursor from the home circle to the center of target circles alternating between numbers and letters, defined as the iTMT trial. In our proposed test protocol, we asked participants to perform three iTMT trials. The test protocol was chosen as an alternative to the traditional walking test to determine “slowness.” More specifically, the presence or absence of “slowness” is determined by quantifying ankle-rotation velocity during the iTMT (iTMT velocity) measured by a single gyroscope attached to subject’s lower shin. The

platform also provides other performance-based phenotypes including “exhaustion” (measured by magnitude of the iTMT velocity decline from the first iTMT trial toward the last iTMT trial), “weakness” (measured by estimation of power generated during ankle rotation), and “inactivity” (measured by quantification of ankle rotation inefficiency). The preliminary results from 61 older adults (age = 72.8 ± 9.9 years) suggested that the average completion of the iTMT test is about 2 min and the iTMT test has large to very large effect size (Cohen’s d effect size = 0.90–1.40) to distinguish between presence and absence of each performance-based phenotypes determined by Fried Frailty Criteria (FFC) [3]. We have also demonstrated that there is a significant correlation between the iTMT velocity and over-ground habitual gait speed ($r = 0.684$, $p < 0.001$). Finally, the iTMT-derived parameters and age together enabled identifying non-robust cases (frail or pre-frail) with an area under the curve of 0.834. We concluded that this non-walking-based wearable platform for assessing physical frailty could be able to address the hurdles of conventional physical frailty phenotype methods by reducing

the time to assess, computerizing the test to improve objectivity, and replacing the conventional frailty walking test with a practical test that requires less space and is potentially more practical for routine screening in a clinical setting.

Our conclusion was, however, challenged by Piau and Wild’s letter to the editor [1] by emphasizing the importance of walking speed as “one of the strongest parameters to predict adverse outcomes” and raising concerns about the limitations of our study such as low sample size. In addition, they questioned our claims about difficulty of administration of walking test in geriatric population as well as the ability of iTMT to reduce time to assess physical frailty compared to FFC. While we do agree with some of the raised concerns such as small sample size and need of further assessment of the iTMT’s effectiveness in predicting adverse outcomes, as we have acknowledged them in our discussion section, we believe, however, our proposed platform could be a step forward to facilitate integration of technology to screen frailty as a part of routine assessment, in particular in clinical settings.

A demographic shift in geriatric patients undergoing surgical interventions has spurred the urgent need to provide clinicians with a quick and practical tool to determine whether surgical interventions will result in better quality of life for patients [4]. The proposed iTMT test takes approximately 2 min, which is more time-efficient than FFC. In our previous study [5], we assessed frailty in a hospital setting. We have demonstrated that 57% of geriatric inpatients in a trauma setting were not able to perform walking tests. Moreover, assessing “slowness” by walking tests could be invalid or inaccurate in those with concurrent parenteral IV therapies, need of walking assistance, or on ventilator support. Even if a patient can walk, because of financial or hospital ranking penalties of hospital-acquired conditions including falls with injury, hospital staffs often hesitate to administer walking tests, in particular among those with cognitive deficits, to prevent falls [6]. This is probably why recently the focus has shifted toward developing quick and objective tools to evaluate physical frailty based on a single frailty phenotype: the non-walking-based phenotype such as grip strength, which is more practical for a hospital setting [7]. However, as Piau and Wild [1] indicated without the determination of presence of “slow-

ness,” the predictive power for adverse outcomes might be reduced [8]. In our study [2], we have demonstrated that the iTMT is able to identify presence of four key performance-based phenotypes including “slowness,” “weakness,” “exhaustion,” and “inactivity” using a non-walking-based test and thus might open new avenues to measure main performance-based phenotypes as a part of routine assessment, particularly in a hospital setting. More importantly, according to our previous studies [9, 10], the iTMT does also enable quantifying cognitive function, which together may assist in identifying cognitive frailty. This is clinically important because cognitive impairment is known to be an independent risk factor of postoperative adverse health outcomes [11], which is often neglected in conventional physical frailty screening tools.

We, however, agree with Piau and Wild [1] that recent advances in wearables and eHealth have opened opportunities to remotely monitor physical frailty in-home and during activities of daily living, which could be superior to the iTMT platform, in particular for unsupervised assessment of frailty. But at the same time, the value of immediate and accurate assessment of frailty in a clinical setting cannot be neglected. For instance, integration of frailty

assessment as a part of routine preoperative assessment could empower patients and their families when making decisions regarding surgical versus non-surgical interventions and will help surgeons to improve the clinical prediction of surgical risk-to-benefit ratio.

Disclosure Statement

The iTMT is protected by a patent (pending). H.Z. and B.N. are listed as co-inventors. However, they do not claim any financial conflict of interest relevant to this study.

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