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Original Research Article

Feasibility of a self-reported digital fall risk assessment compared with the traditional functional balance and gait assessments performed during student led balance screening: A pilot study

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ABSTRACT

Background: One in four older adults in the age range 65 and above, report falls in the US each year. Some falls cause injuries or even deaths and can pose a significant economic burden on society. This pilot study compares two different methods of measuring fall risk in older adults. The goal of this research is to investigate the feasibility of a digital fall risk assessment tool, compared with the traditional functional gait and balance assessments.

Methods: Community dwelling older adults aged 60 years or older were recruited. Physical therapy students guided the participants through the following traditional paper-based tests: Berg Balance Scale (BBS) or Fullerton Advanced Balance (FAB), 30 Second Chair Stand (30CST), 50-foot Walk Test, Balance Efficacy Scale (BES), and the Center for Epidemiologic Studies - Depression Scale (CES-D). All participants then independently completed the following digitally guided tests using the Health in Motion© (Blue Marble Health) remote therapeutic monitoring platform that comprised of Fall Risk Questionnaire (FRQ), One Leg Stand Test (OLST), 30 Second Sit to Stand Test (30STST), and 2 Question Depression Screen (2QDS).

Results: This pilot study involved six female and one male community-dwelling older adults aged 67-90 years (81.57 ± 8.07). In general, the digital fall risk assessments correlated with some of the traditional paper-based fall risk tests. Specifically, there was a statistically significant moderate correlation between the digital fall risk questionnaire (FRQ) and the paper-based BES (r=0.77, p=0.043), and CES-D (r=0.76, p=.046). There was a statistically significant very strong correlation between the digital OLST and the 50-foot walk preferred speed (r=0.80, p=0.056), fast speed (r=0.92, p=.0009), and moderate correlation with 30CST (r=0.79, p=0.033). Further, there was a 100% match between both digital and paper-based depression tests. In terms of average total duration of administering the test, the digital fall risk assessment takes 7 minutes in comparison to 60 minutes with traditional balance and gait assessment.

Conclusion: During the global COVID-19 pandemic and beyond, digital fall risk self-assessment tools can enable clinicians to collect asynchronous, objective, and standardized assessments prior to their telehealth visits.

KEYWORDS: Fall Prevention, Fall Screening, Self-Assessment Mhealth App, Telehealth, Pro Bono Balance Clinic, Remote Patient Monitoring.

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INTRODUCTION

Falls pose a significant personal and economic burden on society [1]. One in four older adults in the age range 65 and above, report falls in the US each year [2], some of which cause injuries or even deaths. Thirty-seven percent of older adults who fall report an injury that requires medical treatment or restricts their activity for at least one day [3]. The 8 million falls that result in an injury [3] cost nearly $50 billion in medical costs alone [3]. Fall among the older population resulting in deaths cost over $755 million each year and increased 30% from 2009 to 2018. According to the World Health Organization (WHO), if no preventive measures are taken in the near future, It will cause a 100% increase in the number of injuries caused by falls by the year 2030 [4].

The COVID-19 pandemic was associated with rapid decreases in physical activity among many adults aged 50–80 which may have led to reduced physical conditioning and limited mobility [2]. More than one in three older adults reported that they were less active since the beginning of the pandemic in March of 2020. In addition, 35% of older adults spent less time standing or walking in a typical day [3]. Women were more likely than their male counterparts to report being less physically active. More than one in four adults aged 50–80 reported that their physical conditioning (i.e. flexibility, muscle strength, endurance) had declined and also 25% reported falling (ending up on the ground due to a loss o f balance, slip, or trip) at least once from March 2020 to January 2021 [1].

Among older adults who experienced a fall, 12% delayed care and 16% never received the care they felt they needed [1]. The people who reported a fall indicated that the pandemic was the major reason for delaying or forgoing needed care [3].

Recent evidence indicates many falls are preventable and that interventions are cost-effective [4]. Therefore, it is important to identify avenues to support widely disseminated evidence-based fall prevention programs. Effective strategies to address the growing number of deaths in older adults due to falls, can include screening for fall risk and intervening to address risk factors. Screening older patients for fall risk, assessing modifiable risk factors (e.g., use of psychoactive medications or poor gait and balance), and recommending interventions to reduce this risk (e.g., medication management or referral to physical therapy) may result in fewer falls [5].

Community-based fall screenings [6] are beneficial because they inform older adults of their fall risk, however these screens are time-consuming and often inaccessible to many as a limited number of people can be evaluated in a specified time frame [7]. The in-person community balance screening requires allotment of space, resources, and staff. A student run pro bono [8] community balance screening requires that students are supervised by licensed clinical faculty during balance assessments. Taking a more efficient approach to fall risk assessment by leveraging technology is crucial to identify those at risk, offer evidence-based interventions to reduce fall risk and to educate health sciences students in the process of performing a fall screen accurately.

To date there is very limited data on use of digital fall risk screenings during the student run community fall risk screening [7] despite the promise they hold for improving efficiency. Using a digital fall risk mobile application (app) during community clinic can be beneficial for both community dwelling adults and for the students. The students learn how to administer digital fall risk assessments and how to educate older adults about their fall risk. The older adult, in turn, gains the awareness of their fall risk and can take actions to reduce their risk. Health in Motion©, is an accessible and scalable digitally guided fall risk assessment tool that can measure fall risk efficiently and can track a change in fall risk over time. In a previous study [9] the Health in Motion© falls screening tool was found to be a valid and reliable automated at-home self-assessment for fall risk. Using such tools can allow the older population to track their fall risk over time.

The goal of this research is to report results from a pilot study that aimed to investigate the feasibility of integration of a digital fall risk assessment tool during student-led balance screenings and to compare the digital fall risk assessment app outcomes with traditional paper-based functional gait and balance assessments. We hypothesized that the digital tests would have moderate correlation with concurrent paper-based tests and the time taken to complete the digital tests would be less than 15 minutes.

MATERIALS AND METHODS

Study design and subjects: Community-based adults aged 60 and older who were medically stable with no medical condition(s) that would affect their ability to perform the balance assessments, and the ability to speak/read English fluently were recruited. Exclusion criteria included any condition that would interfere with participation as observed by the supervising physical therapist. The study was approved by the Institutional review board at the California State University, Fresno (CSU-Fresno) and all the participants signed the informed consent form before being enrolled. Subjects for this study were recruited at the CSU-Fresno interprofessional balance screening.

Instruments

Digital Fall Risk Assessment Tool: The Health in Motion Platform (Blue Marble Health) consists of a downloadable application (app) and an administrative web-app [10]. The Health in Motion app can be downloaded to any Android, Windows, iOS or MAC device (phone, tablet, laptop, desktop). The app is aligned with the Centers for Disease Control and Prevention's (CDC) STEADI Algorithms for Fall Risk Screening, Assessment, and Intervention [11] recommended fall risk assessments including Fall Risk Questionnaire (FRQ), One Leg Stand Test (OLST), and the 30 Second Sit to Stand Test (30STST), as well as a Two Question Depression Screen (2QDS). The details about each of these are provided below. The web-app enables the clinician to assign each client account specific fall risk assessments. These tests are captured during the student-led community fall screening and can be captured at regular intervals thereafter. Each test consists of an avatar guided test tutorial that instructs the client how to perform the test accurately and the client or clinician captures the test outcomes using large on-screen buttons (Figure 1). Multiple repetitions of the test are permitted to ensure data accuracy. Data is immediately sent to the web-app and displayed on the administrative and population health dashboards (Figure 2) for interpretation. This data can guide the intensity of the fall risk reduction intervention. Outcomes from each test along with the time taken to complete each test were recorded via the app.

Fall Risk Questionnaire (FRQ): The FRQ is a 13 item questionnaire recommended by the CDC for fall risk assessment. The client selects "Yes or No" on the computer screen in response to each of the 13 questions. The FRQ is valid and reliable (coefficient alpha of 0.746) [12]. Scores greater than 4 indicate a higher risk of falls.

Question Depression Screen (2QDS): This NIH recommended quick screen that assesses the need for further assessment for major depression. The client selects a Yes or No response to each of the following two questions: Over the past 2 weeks have you felt down, depressed or hopeless? And over the past 2 weeks have you felt little interest or pleasure in doing things? A yes response to both questions detects depression in 50% of the population [13].

One Leg Standing Test (OLST): The OLST is a measure of static balance with the eyes open. The timer starts when the client lifts one foot off the ground and ends when the foot is put down on the ground. If the client does not lose their balance, the timer will expire in 30 seconds. The score is the longest time of the three attempts, with the foot off the ground [14]. Tests using the best of 3 trials, have shown good inter and intra rater reliability with inter rater ICC ranges of 0.95 - 0.99, and intra rater ICC ranges from 0.73 - 0.93 [15]. Based on the findings mentioned above, normative data has been established and scores less than 5 seconds for OLST indicate higher fall risk [16].

30 Second Sit to Stand Test (30STST): The 30STST measures endurance and leg strength. The avatar instructs the client to stand up and sit down safely as many times as they can in 30 seconds without the use of their hands, if possible. Fall risk thresholds are based on average scores of others of the same gender and age. Adults scoring below average may be at an increased risk of falling [17].

Traditional Paper-based Functional Gait and Balance Assessments: Department of physical therapy faculty prepared for the community balance screening by printing a number of standardized assessments. On the day of the balance screening, the physical therapy students performed each of the following tests using standard practices under the supervision of a licensed clinical faculty. Participants were provided with a clipboard and pen to fill in the questionnaires independently. Physical therapy students used their observational skills and a stopwatch to perform the balance tests. A standard chair without wheels was used when required. The 50-foot walk test distance set-up was used for all participants. Outcomes from each test were recorded on paper.

Balance Self-Efficacy Scale (BES): The BES is an 18-item questionnaire that asks how confident one feels while completing 18 specific tasks without losing their balance. They are asked to answer, "as you feel, not how you think you should feel". Each response ranges from 0% to 100% in the increment of 10%. The possible outcome score range is 0-1800 divided by 1800 to get the total score. The test is recorded on paper. Scores < 50% are associated with fall risk [18].

Berg Balance Scale (BBS): This 14-item test was used to measure the ability to maintain balance across a series of progressively more challenging static and dynamic balance activities. Each item is measured on a 5-point scale, 0 indicating the lowest functional level and 4 being the highest. The outcomes were recorded on paper. Internal consistency, measured with Cronbach's alpha, is greater than 0.97 for older adults [19]. Scores <40 on BBS have almost 100% risk of falling [20].

Fullerton Advanced Balance (FAB) Scale: The FAB measures static and dynamic balance under varying sensory conditions and is designed to measure balance in higher-functioning active older adults [21]. The outcomes are recorded on paper. FAB has excellent test-retest reliability for the total score *r*=.96, and for the individual test items r=0.52–0.82 [18]. The FAB has good interrater reliability ICC=0.955–0.999 in community dwelling adults. It also has good test-retest reliability for total score when administered by trained raters *r*=0.94-0.97. A score $\leq$ 25⁄40 is considered a higher fall risk [22] and the client is encouraged to seek for strategies that help with balance and gait.

50 Foot Walk Test: Gait speed measured in feet/second is a valid, reliable, sensitive, and specific measure for both preferred and fast walking speeds [23]. Self-selected/preferred walking speed reflects both functional and physiological changes and aids in prediction of falls [24] and fear of falling [25]. Walking speed is safe, requires no special equipment, adds no significant cost to an assessment, requires little additional time, and is easy to calculate (distance/time). The score is recorded on paper. The client begins to walk "at a comfortable pace" a few feet in front of the start line, then continues walking until they reach the end of a 50-foot walking path. The clinician records the time it takes to traverse the 50 feet, starting a stopwatch as soon as the client's limb crosses the first marker and stopping the stopwatch as soon as the client's limb crosses the second marker. This test was done under two conditions: self-selected/preferred walking speed and fast walking speed [26]. Fall risk thresholds are based on average scores of others of the same gender and age. Adults scoring below average may be at an increased risk of falling.

30 second Chair Stand Test: Similar to the digital version, the participant completes as many sit-to-stand repetitions as quickly and safely as they can in 30 seconds (Figure 3). This test required one trial. The number of stands completed in 30 seconds is recorded on paper. The CST has excellent test-retest reliability r=0.89 with 95% confidence interval (0.79 - 0.93) and interrater reliability r=0.95 with 95% confidence

interval (0.84 - 0.97) [27].

Center for Epidemiologic Studies - Depression Scale (CES-D): The CES-D is a 20-item questionnaire that can be used to identify people at risk for clinical depression. The client uses a 4-point scale to rate the amount of time they experience loneliness, poor appetite, sleep restlessness among other items. A score of 0 indicates rarely or none of the time, while a score of 3 indicates most or almost all of the time (28). The threshold for risk of clinical depression is [16]

Procedures:

Interprofessional pro bono community balance screening: This balance screening was a part of the Senior Awareness & Fall Education (S.A.F.E) program that is held twice a year to determine fall risk and provide education to older adults in the community. An Interprofessional team consisted of health sciences faculty and students from two institutions i.e. physical therapy (PT) and nursing (from CSU Fresno) and pharmacy (from CHSU). All the students and faculty participated and attended an evening of orientation session prior to the actual balance screening. Orientation to PT students involved watching videos of PTs conducting balance assessments and looking at demonstrations from their clinical instructors and then practicing administering the balance assessments. They also learned how to interpret the scores from the pen and paper-based assessments. The graduate students were supervised by physical therapy, nursing, and pharmacy faculty during balance and gait evaluations.

Older adults were given a comprehensive screening incorporating elements from each health area, starting with nursing students completing a medical screening of the client which included a health history, blood pressure check, a vision check, and a cognitive screen. Then the physical therapy students performed a variety of traditional paper and pencil based functional gait and balance assessments (described above). Next, the pharmacy students completed a medication review of prescribed medications for dosage and compliance. Based on data collected, the students from three disciplines then met with the patient for a debrief session and provided the client with their assessment and intervention strategies in terms of education, strategies, resources and information on campus gait and balance clinic and off campus fall prevention programs.

Lastly, all of the older adults who volunteered for the study and signed the informed consent, completed the battery of self-administered digital fall risk screening described above as well as a short demographic questionnaire during a single session. This was done under the supervision of clinical faculty.

Statistical Analysis: Data was analyzed with IBM SPSS Statistics Software (version 26). Descriptive statistics were used to determine general participant demographics and characteristics. Pearson correlation coefficients (29) were used to determine the relationship between the digital self-reported tests and the traditional clinical functional balance and gait related outcome measures. As per interpretation of Pearson correlation coefficients for medical research, correlation value of 0.9 - 0.8 is indicated as very strong correlation, whereas correlations 0.7 - 0.6 indicate moderate correlation, and 0.5 - 0.3 is considered fair and anything below 0.3 is considered poor or no correlation (30). Statistical significance level was set at $p<0.05$. A high, positive Pearson value indicates that high scores on the paper version of one measure are correlated with high scores on the potentially concurrent digital measure, and the same would be true for low scores between measures(31).

The outcome measures used included digital FRQ score (points 0-52), OLST maximum time in seconds (0-30 seconds), 30STST the highest rep count (0-30), 2QDS outcome score points (0-2), and paper-based BES score points (0-100), BERG score (0-56), FAB score (0-40), and 50ft Walk Test score (time in seconds for fast and preferred walking speeds).

RESULTS

This pilot study involved six female and one male community dwelling older adults aged 67-90 years (mean 81.57 ± 8.07), who participated in a community-based fall risk screen and study. Table 1 summarizes the participants'

demographics (mean, standard deviation and range) Table 2 summarizes the correlation of the digital and traditional pen and paper-based balance and gait assessments.

Digital Fall Risk Questionnaire (FRQ): The FRQ was statistically significantly moderately correlated with the pen and paper-based BES, and CES-D. The digital FRQ was moderately correlated with the 50ft walk test (preferred), the BBS, and the FAB but the correlation was not statistically significant. Notably, while the scores on the FRQ and BES are moderately correlated, n=5 participants scored in the higher fall risk range for the digital FRQ while none of the participants scored in the <50% range for higher fall risk using the BES.

Digital One Leg Stand Test (OLST): The OLST score was statistically significantly very strongly correlated with paper-based 50 Foot Walk (preferred and fast) and moderately statistically significantly correlated with 30 CST. The digital OLST was moderately correlated with the paper-based BBS and FAB however the correlation was not statistically significant. Digital 30 Second Sit to Stand Test (30STST): The digital 30STST, was moderately correlated with the 50 Foot Walk Test (fast speed) and fairly correlated with 50 Foot Walk Test (preferred) and 30CST. Notably, the scores from n=5 of 7 participants matched in fall risk when using the 30STST and 30CST. For the two participants that did not match, the participants performed more stands in the earlier standard pen and paper-based test than when performing the digital test.

Question Depression Screen: The 2QDS was moderately statistically significantly correlated with the CES-D. Notably, there was a 100% match between the 2 tests as an indication of depression.

Time to complete the digital tests: In terms of total duration of administering the test, the digital fall risk assessment took an average of 7 minutes and 19 seconds (range: 5 - 9 min) from launch of the tests to end of the last test. In comparison, the entire battery of tests for pen and paper-based balance and gait assessment typically took between 1 hour to 1 hour and 30 minutes from start to the end.

Fig. 1: Example of in-app avatar guided digital fall risk assessments - 1A 30 Second Sit to Stand Test,1BOne Legged Stand Test.

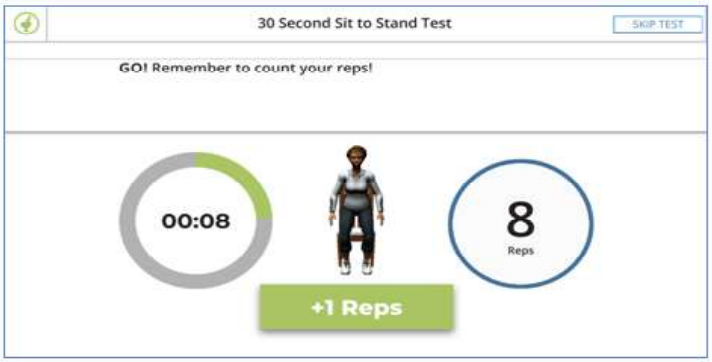

Fig. 1A: 30 Second Sit to Stand Test.

Figure 1B: One Legged Stand Test

Fig. 2: Health in Motion Fall Risk Assessment [shown on tablet) and administrative web-portal dashboard [shown on computer).

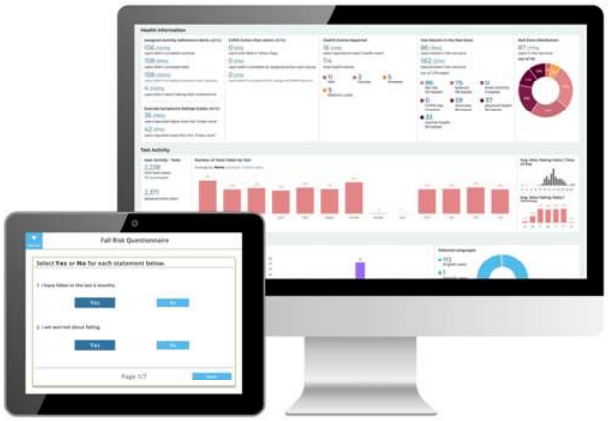

Fig. 3: Traditional pen and paper-based Balance test - 30 sec chair stand test.

DISCUSSION

This pilot study supports the feasibility of a relatively quick [less than 10 minutes] self-reported, avatar-guided, fall risk assessment that can be successfully incorporated into a community balance screening led by doctor of physical therapy students. Older adults performed similarly on assessments delivered via a digital fall risk self-assessment tool and traditional paper-based functional balance and gait assessments. The study adds additional support for the use of digital self-reported fall risk assessment as they correlate with concurrent paper-based assessments that require additional human resources and time. An additional benefit to the use of digital tools is that the delivery of the assessments is standardized and repeatable [32]. Once the older adult learns how to use the tool, they can potentially track their fall risk over time and take a proactive approach towards fall prevention [33].

Specifically, the digital FRQ was statistically significantly correlated with paper-based BES. Based on this finding, the clinicians may opt for either digital FRQ or BES since both provide a similar level of fall risk. Additionally, moderate correlation between the digital FRQ and paper-based CES-D are aligned with existing studies that describe the bidirectional relationship between falls and depression. Both depression and fear of falling are associated with impairment of gait and balance [34] . Findings from our study further suggest the need to evaluate depression and therefore aligns well with the Health in Motion Fall Risk Screening app features which includes 2QDS as part of its digital assessment battery. The findings from the current study suggest that clinicians can opt for digital mode of fall risk screening which includes a depression screen to get the objective data on clients' fall risk if an in-person visit is not warranted. In addition, the 2QDS is recommended by the National Institutes of

Table 1: Descriptive Statistics and Clinical Characteristics.

Variables	Mean ± SD [range: min -max) or Frequency [%) n= 7
Demographics	
Age	81.57 ± 8.07 [67- 90)
Gender	n=2 Male [14.3%)
	n= 5 Female [85.7%)
Ethnicity	Hispanic [14.3%)
	Non-Hispanic [85.7%)
Race	White [100%)
Primary Language	English [100%)
Traditional Paper-based Test Outcomes	
Balance Self-Efficacy Scale [BES)	75.68 ±13.72 [60 - 92.8)
Berg Balance Scale [BBS)	39.75 ± 6.07 [34 - 45)
Fullerton Advanced Balance [FAB)	28.25 ± 5.25 [21- 33)
30 sec Chair Stand Test [30CST)	9.71 ± 2.75 [6 -14)
50ft Walk Test [preferred speed)	9.79 ± 2.20 [7.63 - 13.44)
50ft Walk Test [fast speed)	7.95 ± 2.11 [6.15 - 11.79)
Center for Epidemiologic Studies -Depression Scale [CES-D)	9.86 ± 5.87 [2- 20)
Digital Test Outcomes	
Fall Risk Questionnaire [FRQ)	6 ± 3.61 [0-10)
30 Sec Sit to Stand Test [30STST)	8.43 ± 3.50 [5-16)
One Leg Stand Test [OLST) - Right	23.2 ± 10.23 [7-30)
One Leg Stand Test [OLST)- left	17.6 ± 12.38 [3-30)
2 Question Depression Screen [2QDS)	0. 28 ± 0.75 [0-2)
Health Status	
Have you ever been diagnosed with a heart attack?	Yes [14.3%)
	No [85.7%)
Have you ever been diagnosed as having an angina?	No [100%)
Have you ever been diagnosed with heart disease?	No [100%)
Have you ever been diagnosed as having hypertension	Yes [57.1%)
	No [42.9%)
Have you ever been diagnosed as having peripheral vascular disease	No [100%)
Have you ever been diagnosed as having respiratory disease	Yes [28.6%)
	No [71.4%)
Have you ever been diagnosed as having Parkinson's Disease?	No [100%)
Have you ever been diagnosed as having a stroke?	No [100%)
Have you ever been diagnosed as having multiple sclerosis?	No [100%)
Do you use assistive devices for walking?	No [28.6%)
	Sometimes [71.4%)
Do you require hearing aids?	Both ears [28.6%)
	None [71.4%)
Do you wear glasses?	Yes [100%)
Do you wear bifocals/trifocals?	Yes [85.7%)
	No [14.3%)
Do you have any corrected visual problems?	Yes [16.7%)
	No [83.3%)
Have you ever been diagnosed as having back problems?	Yes [14.3%)
	No [85.7%)
Have you ever been diagnosed as having arthritis?	Yes [57.1%)
	No [42.9%)
Have you ever been diagnosed as having osteoporosis?	Yes [28.6%)
	No [71.4%)
Have you ever been diagnosed as having cognitive/mental disorder?	No [100%)
Have you ever been diagnosed as having movement disorder?	No [100%)
Have you ever been diagnosed as having epilepsy/ seizures?	No [100%)
Have you ever been diagnosed as having diabetes?	Yes [28.6%)
	No [71.4%)
Have you ever been diagnosed as having numbness/ tingling in your feet?	Yes [28.6%)
	No [71.4%)
Have you ever been diagnosed as having inner ear problems?	Yes [28.6%)
	No [71.4%)
Have you ever been diagnosed as having dizziness?	Yes [28.6%)
	No [71.4%)
Have you ever been diagnosed as having chronic depression?	No [100%)
History of Falls	Less than 2 falls in last year [28.6%)
	2 or more falls in last year [71.4%)
Exercise status	Mild exercise [28.6%)
	Occasional Vigorous Exercise [14.3%)
	Regular Vigorous Exercise [14.3%)

Table 2: Pearson Correlation Coefficient [r) outcomes.

Digital vs Pen and Paper-based Tests	Pearson correlation coefficient [r) P value [<0.05)
FRQ vs BES	r=0.77
	p=0.043*
FRQ vs CES-D	r=0.76
	p=0.046*
FRQ vs 50 ft walk test preferred	*r=0.67*
	p=0.146
FRQ vs 50 ft walk test fast	r=0.56
	p=0.241
FRQ vs BBS/FAB	r=0.63
	p=0.127
OLST vs 50 ft walk test preferred	r=0.80
	p=0.056*
OLST vs 50 ft walk test fast	r=0.92
	p=0. 0009*
OLST vs 30 sec Chair Stand Test	r=0.79
	p=0.033*
OLST vs BBS/FAB	r=0.72
	p=0.067
30STST vs 50 ft walk test preferred	r=0.39
	p=0.43
30STST vs walk test fast	r=0.76
	p=0.08
30STST vs 30 CST	*r=0.55*
	p=0.20
2QDS vs CES-D	r=0.76
	p=0.047*

Fall Risk Questionnaire [FRQ), 2 Question Depression Screen [2QDS), One Leg stand Test [OLST), 30 Second Sit to Stand Test [30STST), Balance Self-Efficacy Scale [BES), Berg Balance Scale [BBS), Fullerton Advanced Balance [FAB) Scale, 30 Second Chair Stand Test, 50 Ft Walk Test [preferred speed and fast speed). Note: correlation value of 0.9 - 0.8 Very Strong correlation, 0.7 - 0.6 Moderate correlation, 0.5 - 0.3 Fair, and 0.2 -0.1 Poor correlation [Chan 2003). *Indicates the level of significance is $p < 0.05$.

Health [NIH] as a quick screen to let the health care practitioner know if further assessment for major depression is indicated [13] [15]. While the digital FRQ was moderately correlated with the 50ft walk test [preferred], the BBS and the FAB, the correlation was not statistically significant suggesting that a higher-powered study is needed to potentially strengthen this correlation.

Given the strong correlation between the OLST and the 50-foot walk [fast and preferred] a clinician may elect to use the digital OLST instead of the 50-foot Walk test, especially if the 50ft Walk Test is not feasible due to space or other constraints. This is helpful as it may encourage clinician and student-led community clinics to conduct remote fall risk screening safely. Given that the digital OLST is a sensitive measure of fall risk, it would be helpful in telehealth clinics especially when the client lives alone and safety of the client is a priority. These findings are substantiated by similar findings suggesting that the 50 m walk test is reflective of physical function and balance ability in community dwelling older adults [35]. The moderate correlation between the digital OLST, a measure of upright postural control, and paper-based BBS and FAB was not statistically significant and suggests that these tests may measure different elements of balance [36].

The 30STST and the 30CST were only fairly correlated. This may have been due to a number of reasons. One reason could have been an order effect and the possibility that the older adult was fatigued when performing the 30STST [digital test] as it was always performed after all of the other paper-based tests were completed. Alternatively, the digital version requires that the client either press the screen each time they stand or to remember the number of stands and enter the number into the app at the end of the test. However, for the standard CST, the student PT scored the test, and the older adult did not have to count the number of reps for themselves. The act of tapping the screen or the cognitive challenge of remembering the count of reps may have resulted in a slower sit to stand and therefore fewer total stands. Therefore, there is a need for future study to investigate inter-rater reliability of the two modes of assessment i.e. digital vs paper-based.

The moderate correlation between the 2QDS and the CES-D suggests that the 2QDS has the potential to provide similar information related to depression as part of a quick digital fall risk assessment.

Technology Enabled Fall Risk Assessment and Student Training: Smartphone apps [37] for

assessment of balance and falls risk could be used as part of a remote therapeutic monitoring platform for remote functional assessment [32]. One of the efficient ways to reduce the healthcare burden of care for fall induced injuries among older populations is to engage individuals to use self-guided fall risk assessment by using technology enabled tools and to increase awareness about fall risk thereby reducing such incidences. The Health in Motion© falls screening tool is validated, reliable [9] and effective tool for identifying potential fall risks and may easily be used by older adults in the convenience of their home. Further, physical therapists can use it as a fall risk tracking tool between in person and telehealth visits[38] so that therapists can get a complete history of a patient's balance deficits and fall risks if their current health or medical condition changes as they age [9].

The community dwelling older adults typically come for balance assessment only once a semester or twice a year. Introducing the digital tools at a community balance screening provided an opportunity to become educated about their fall risk and try the digital fall risk assessment tool in a safe place under the supervision of a licensed physical therapist. It also allows the opportunity to determine if the respective elderly is the right candidate for the self-assessment tool. It's important to note that older adults can use this type of self-assessment test battery to evaluate and track their balance and then take advantage of fall prevention programs by being proactive about their balance needs. Having completed these assessments at home prior to the in-person visit makes the visit more efficient and enables the clinician to focus their time for more in-depth diagnosis thereby optimizing patient outcomes.

Finally, based on the conceptual framework representing excellence in physical therapist education, three dimensions of the model are: culture of excellence, praxis of learning, and organizational structures and resources [39]. This study addresses one of the fundamentals of this model i.e. "praxis of learning". Training physical therapy students to learn how to administer the digital tools in a standardized way is an important step towards preparing the future healthcare task force to embrace innovation and technology. Emergence of new technologies and digital applications [40] is evident and necessary in the area of fall prevention as it will lead to improved outcomes[41], thereby contributing to good quality of life for community dwelling elderly populations. The interprofessional balance clinic provided this type of experiential learning with respect to using the digital tool and education provided by students to their clients[42]. This has created a real-world environment for entry-level physical therapy students to exercise knowledge gained in the classroom (42).

Strengths and limitations: The strengths of this research include the contribution of new knowledge regarding the feasibility of using technology-based self-assessment falls risk screening tools by older people who were in the age range of 67 to 90. The study demonstrated the ease and efficiency with which it could be incorporated into a pro bono community balance screening clinic. This balance screening was led by students in an interprofessional setting and helped expose students to a new type of technology enabled fall risk assessment tool. Additionally, this research study helped shed light on the successful and feasible induction of digital fall risk assessments at a student-led pro bono balance clinic. This information may help other physical therapy education programs who provide student-led pro bono balance clinics [43] to their respective communities and will investigate integrating such digital balance assessments tools to screen more clients. This would allow physical therapy programs to thereby help a larger pool of the older adult population struggling with balance issues who may be at risk for falls. In addition, this would allow such community balance screenings as a place for seniors to learn about such digital self-assessment tools and try them so that they can use it to track their own fall risk over a long period of time.

Limitations of this study include the small sample size and the gender bias of more

female than male participants. This limits its application to a wider population. The sequence of data collection between paper-based and digital fall risk assessment was not randomized i.e. paper-based gait and balance assessment were always completed before the digital assessments and therefore pose an order effect bias [44]. This order would further contribute to participants being tired by the time they did the digital tests and therefore there is a need for studies that randomize the order in which paper-based and digital tests are administered. In addition, all fall related questionnaire data were self-reported and is thereby more subjective. Furthermore, due to the nature of the sample population, self-reported data on falls, particularly using retrospective falls history, can be unreliable and under-report the incidence of falls.

Clinical and Future Implications: During COVID-19 pandemic and beyond digital tools like Health in Motion© Fall Risk Assessment can help older adults with remote unsupervised self-assessment and treatment [9]. The advantage of using such self-assessment tools[37] is that they are time efficient and can screen more older adults. This would allow more older adults with balance issues to be helped by physical therapists and other medical health professionals in a timely manner. It also allows older individuals who are at risk of falls to take proactive steps to reach out to their respective health care provider and physical therapists. In the times where the pandemic is ongoing, where new variants and virus waves keep looming, the digital fall risk self-assessment allows the older adult population to be part of the evaluation process by tracking their own fall risk remotely and getting help via telehealth platforms in the safety of their homes[38]. The caregivers of older adults can also be made part of the solution by training and educating caregivers about how to use digital fall risk tools so that these caregivers become part of the client's recovery process [45].

Finally, future studies are needed that can help determine the threshold score for fall risk so people using the app can self-assess their fall risk and then would contact their physical therapist if their scores decline or drop below the lower fall risk threshold. Given the strong correlations between many tests, clinicians can obtain beneficial information from the older adult prior to a telehealth visit and can follow their clients over a longer period. Clinical physical therapy faculty should include education and training of technology enabled balance and gait assessment for their students[43]. Training current and future medical professionals about the importance of early fall risk screenings and prevention focused intervention is also very important [5].

CONCLUSION

In summary, the overall findings from this pilot study support our hypotheses related to feasibility and efficiency of digital fall risk assessments introduced by students at a pro bono community fall screening. The outcomes contribute significantly to the current body of literature, as results demonstrate moderate or strong correlation between self-reported digital fall risk assessment and traditional student -led pen and paper-based balance and gait assessment even in this small pilot study. This study further challenges the breadth of environments in which digital fall risk assessment can be performed i.e. both during in person and remote visits [46) and highlights the importance of training physical therapists in emerging areas of digital fall risk assessment along with balance and gait education. Patient driven initial fall risk assessment is an important step towards reducing fall related injuries and improving fall awareness.

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Dr. Nupur Hajela and Dr. Peggy Trueblood have no conflict of interest to disclose.

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