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Real World Accuracy and Use of a Wearable Fall Detection Device by Older Adults

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To the Editor

A significant danger with falling is the inability to get up afterwards, which is reported to occur in as much as 30% of falls (1). Individuals have been shown to have better chances of survival the faster they are discovered following a fall (5,7). Thus, there have been several devices designed to detect a fallen individual. We conducted a pilot study to investigate the real world use and accuracy of a wearable fall detection (FD) device with community dwelling older adults (OAs). The device had the ability to automatically detect falls using a combination of accelerometer, magnetometer and gyroscope. It also had audio feedback and GPS capabilities. The company reported training their device in a laboratory setting with subjects performing prescribed falls, ADLs, and stumbles. The system was subsequently tested on an independent data set and yielded results of sensitivity range from 94.1-94.4% and specificity from 92.1-94.6%.

Eighteen participants participated in the four month study (8 completers). Of the 10 Partial Completers, 9 voluntarily left the study, while one was unable to complete due to an injurious fall. Participants had the device for an average of 80.7 days (range 8-124). A total of 84 alarms indicating a fall were recorded, of which 83 were false alarms. The largest percentage of false alarms (42.2%) were during normal device use. Another 16.9% of false alarms occurred when the participant dropped the device. Device misuse and putting down the device each constituted 10.8% of false alarms. Finally 19.3% of false alarms occurred for unknown reasons. Table 1 shows the binary classification measurements for the study.

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Completers had 58 false alarms over 812 days (7.1%) and Partial Completers had 25 false alarms over 263 total days (9.5%) (p=0.31).

Overall only a single true positive was recorded when a participant fell backwards and hit her head. Three additional falls were reported by participants while wearing the device, although device did not identify them as such. In one situation a participant reported *"a light fall into a person's lap"*. The other two falls occurred from a seated position. Finally, 8 falls were reported that occurred while participants were not wearing their devices. Half of these occurred with the device in the charger, either early morning or nighttime hours.

Device adherence was a binary measurement where if the participant was seen to remove the device from its charger for at least 20 minutes they were recorded to use the device on that day. Partial Completers had significantly less adherence (p = 0.003) although Completers showed a drop in adherence similar to Partial Completers around halfway through the trial. In order to examine the influence of false alarms on adherence, a paired t-test was used to compare adherence five days prior and after a false alarm (p=0.67). We also compared use of the device five days prior to and following a fall (p=0.63).

Our findings suggest that the device is inaccurate in real world settings given the very low sensitivity observed. The manufacturer reported training their device using 59 volunteers. Based on this testing the company reported a sensitivity ranging from 94.1% to 94.4% and specificity ranging from 92.1% to 94.6%. Although the specificities match fairly closely between the lab and real-world settings, the difference in sensitivities is stark. While it is difficult to compare the two studies given the difference in sample size and fall data, such a comparison would appear to match previous evidence suggesting that real world falls are more difficult to accurately detect (2-4). This finding points to necessary improvements to the accuracy of the FD feature and a need for real world testing prior to deployment.

The similar decrease in adherence between the two groups around the halfway point of device usage might indicate that participants either grew weary of using the device or forgot to use the device as the study continued regardless of their willingness to continue with the study. There is a need for more research to better understand what motivates OAs to use these devices so as to encourage greater use (5-7).

Even with limitations of a single device and a relatively short observation period (4 months), this study demonstrates the critical need for real world testing of FD devices by OAs, as well as the need to gather data regarding the actual usage of these devices by their intended audience. Clinicians working with OAs need to assess for the availability (and accuracy) of real-world testing of any FD devices prior to recommending them to patients.

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Table 1

Binary Classification Analysis between Groups*

Completers (n=7)			Partial Completers (n=8)		
	Fall	**No Fall**		**Fall**	**No Fall**
Device Alarm	1	53	Device Alarm	0	11
No Device Alarm	3	649	No Device Alarm	0	85
Sensitivity	0.25		Sensitivity	N/A	
Specificity	0.92		Specificity	0.89	
Positive predictive value	0.02		Positive predictive value	<0.01	
Negative predictive value	>0.99		Negative predictive value	>0.99	

*3 participants were excluded from this analysis for carrying their devices off their body