Hear Better, Live Better: Starkey Hearing Aids Detect Falls Accurately and Alert Others

Justin R. Burwinkel, Au.D. | **Buye Xu, Ph.D.**

Introduction

Accidental falls are a significant health risk for older adults, can often lead to a loss of independence, and frequently shape the course of a person's later years of life. Previous reports have shown that 40% of individuals who live at home, after reaching the age of 65, will fall at least once each year[1]. The risk of falling has also been shown to be greater among patients who would benefit from treatment in hearing clinics than among their age-matched peers[2]. In fact, a study conducted by Dr. Frank Lin, at John Hopkins University's Cochlear Center for Hearing and Public Health, identified a 1.4-fold increase in incidence of falls for every 10 decibels (dB) of measured hearing loss[3].

The Livio Edge AI Healthable hearing aid – the world's first, ear-level fall detection and alerts system – offers peace of mind in a miniaturized and convenient package. Unlike other fall-detection devices, which hang around the neck or are worn on the wrist, Livio Edge AI benefits from the anatomy and physiology of the human body. During typical, daily activities and instances of falls, muscles in the neck work with the balance system of the inner ear to protect and stabilize the head. Since hearing aids are worn on the head, they are naturally less prone to mistake daily activities for falls than the devices worn on other parts of the body[4]. Instead, head-worn fall-detection devices may be tuned to capture a greater number of falls, while still having a low number of false alarms.

To objectively evaluate the accuracy of Livio Edge AI, a laboratory study was conducted*. Participants wore binaural Livio Edge AI hearing aids and the Philips Lifeline® AutoAlert, a pendant-style fall-detection device, during simulated falls and daily activities. The Philips Lifeline AutoAlert is classified by the U.S. Food and Drug Administration (FDA) as a Class II (Exempt) medical device intended for continuous operation as a personal emergency response system**. The results follow.

Method

Ten young participants each experienced eight types of Falls and Near-falls. The participants also performed eight different types of Activities of Daily Living (ADLs). The conditions each participant undertook are summarized in Table 1. Three trials were acquired for each condition. The fall-detection state of the Livio Edge AI hearing aids and the fall-detection pendant were recorded for each trial. The analysis consisted of 240 Falls, 240 Near-falls, and 240 ADLs.

The data were collected at the Injury Prevention and Mobility Laboratory at Simon Fraser University. All participants provided written, informed consent, and the experimental protocol was approved by the Research Ethics Board of Simon Fraser University.

*Study completed using Livio AI 2400 devices, which are now currently branded as Livio Edge AI 2400.

**Evolv AI and Livio Edge AI are not a substitute for emergency services and will not contact emergency services if a fall is detected.

Falls	1	Slip forward on moving platform
	2	Slip backward on moving platform
	3	Trip by ankle tether
	4	Incorrect weight transfers due to a misstep
	5	Incorrect weight transfer while rising from sitting
	6	Incorrect weight transfer while descending from standing
	7	Hit or bumped by padded object
	8	Loss of consciousness/Collapse
Near-falls	1-8	Same as fall conditions, but the participant was able to recover balance before reaching the ground
ADLs	1	Normal walking
	2	Standing quietly
	3	Descending from standing to sitting on a chair
	4	Descending from standing to lying on the ground
	5	Rising from sitting to standing
	6	Picking an object up from the ground
	7	Ascending stairs
	8	Descending stairs

Table 1. Summary of Fall, Near-fall, and Activities of Daily Living (ADLs) trials performed by each participant

Results

The Livio Edge AI hearing aids were more accurate at detecting falls than the Philips Lifeline AutoAlert fall-detection pendant. Both systems were robust against false-positive detections during activities of daily living. A summary of sensitivity and specificity across all participants and trials is provided in Table 2. A breakdown of sensitivity rate for each type of fall is provided in Table 3.

	Philips Lifeline AutoAlert	Starkey Livio Edge AI
True falls detected (Sensitivity rate)	198 (82.5%)	221 (92.1%)
False positives during Near-fall trials (Specificity rate)	1 (99.6%)	6 (97.5%)
False positives during ADLs trials (Specificity rate)	0 (100%)	0 (100%)

Table 2. Sensitivity and specificity rates of Starkey Livio Edge AI hearing aids and Philips Lifeline AutoAlert pendant across all participants and trials. A total of 240 trials took place for each of: Falls, Near-falls, and ADLs.

Fall type	Philips Lifeline AutoAlert Sensitivity (%)	Starkey Livio Edge AI Sensitivity (%)
Backward slip	93.3	96.7
Forward Slip	53.3	90.0
Trip	66.7	100
Incorrect transfer due to misstep	73.3	93.3
Incorrect transfer during rising from sitting	93.3	93.3
Incorrect transfer during descending from standing	96.7	90.0
Hit or bump	86.7	86.7
Loss of consciousness or lower limb collapse	96.7	86.7
Mean	82.5	92.1
Range	53.3 – 96.7	86.7 – 100

Table 3. Breakdown of Starkey Livio Edge AI hearing aids and Philips Lifeline AutoAlert pendant sensitivity during the trials for each fall type. A total of 30 trials took place for each fall type.

Discussion

Both the Philips Lifeline AutoAlert pendant and Starkey Livio Edge AI hearing aids performed perfectly during the Activities in Daily Living in the present study. The Starkey Livio Edge AI hearing aids produced a slightly higher false-positive rate during trials where the participants began to fall but recovered their balance before reaching the ground. The Starkey Livio Edge AI hearing aids were able to detect more of the falls than the Philips Lifeline AutoAlert pendant and were an overall more accurate fall-detection device than the Philips Lifeline AutoAlert pendant.

Addendum

In 2021, with the release of the Evolv AI** product family, the Fall Detection and Alert feature was updated. In addition to being available on all technology tiers of Evolv AI, the fall detection parameters were improved using additional sensor data obtained from thousands of experimental trials of falls, near falls, and activities of daily living collected at Starkey Global Headquarters in Eden Prairie, MN and at our Advanced Development center in Tel-Aviv, Israel.

Specifically, numerous types of falls, as well as activities reported to result in occasional false alarms, were completed and analyzed and used to fine-tune the parameters of the Fall Detection algorithm. Data was collected from 30 additional participants who completed numerous activities reported to result in false-positive classification of falls: ascending and descending stairs, bumping into objects, sitting down hard on a chair or bed, getting in or out of a car, jumping, exercising, taking off or securing the hearing aids, sitting down on the floor, and numerous near falls, trips, or slips. Information about other types of actual falls, such as tripping, or fainting were also collected to fine-tune the parameters to differentiate falls from non-falls. By focusing on the activities most likely to result in false-positive reports of a fall, the improved Fall Detection parameters for Evolv AI increased the detection of actual falls (i.e., true-positives) by as much as 1.1% and decreased false-positives by up to 1.7%. When one considers the number of activities a hearing aid wearer completes in a given day, the result for a given individual prone to false positives may be noticeably fewer false notifications over time.

Conclusion

Starkey Livio Edge AI** hearing aids detected falls as well as or better than the traditional fall detection device studied.

References

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