Determining the Step Count Accuracy of Four Commercially Available Smart Watches

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Determining the Step Count Accuracy of Four Commercially Available Smart Watches

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ABSTRACT

Purpose: The purpose of this study was to determine the step counting accuracy of four commercial smart watches. **Methods:** Twelve adults (mean ± SD, 24.8 ± 8.4 years) completed this two-trial study. Trial 1(T1) occurred indoors and Trial 2 (T2) took place outdoors. During T1 participants were outfitted with four smart watches, two on each arm (Apple Watch Ultra, Coros Vertix 2, Garmin Fenix 6, Polar Grit X) and completed both a treadmill and activities of daily living (ADL) protocol. During T2 they completed a 3.2 kilometer trail run. During TW participants wore a chest harness outfitted with a GoPro camera pointed down at their feet. The GoPro continuously recorded video of all steps taken throughout the run. Steps during both study trials were counted by investigators using a hand tally device, which served as the criterion measure. Both trials were repeated to assess device reliability. We used a Repeated Measures ANOVA and Paired T-Tests for between device comparisons with a post hoc Bonferroni correction. **Results:** There was an overall statically significant difference in total steps between devices and the criterion measure (p<0.01). There were statistical differences between devices across all trials. **Conclusion:** Our findings suggest these devices are most accurate during trail running but struggle to capture non-running activities.

BACKGROUND

- Wearable technology has been steadily increasing in popularity, having been named the "top fitness trend" of 2022 by the American College of Sports Medicine.
- Four of the most popular brands of wearable technology are Apple, Coros, Garmin, and Polar.
- The top tier watches of each brand are marketed towards runners, many of whom are individuals likely to meet physical activity guidelines during training bouts, but who may not obtain consistent activity throughout the day.

Why steps?

- There is a push to create physical activity guidelines centered around "steps" per day.
- Steps are simple, easy to prescribe, and easy to objectively measure.
- It is important to determine the validity of wearable technology devices when it comes to measuring steps.

PURPOSE

The purpose of this project is to examine the validity of step count in multiple smartwatches during walking, running, and activities of daily living.

Figure 1. (from L to R) The Coros ®, Garmin, Polar, and Apple Ultra

METHODS

Part I (Lab Portion)

Treadmill test: Test consisted of 4x2 min stages at 1mph, 3mph, 5mph, and 7mph. Step count was recorded on watch before and after each interval and compared to step counts manually recorded by investigator. This protocol was completed twice.

ADL Test: This test included 1min of vacuuming with alternating hands, 1min of sweeping, 1min of folding laundry, 30 sec of wiping a table with alternating hands, and 1min of washing dishes. Watch step counts were recorded and compared to step counts manually recorded by investigators. Participants completed this test twice.

Figure 2. Participants performed a treadmill and ADL protocol

Part II (Field Portion)

Field Test: Participants ran a predetermined, 2-mile-long course at a self-selected pace. Distance, heart and step counts were recorded on each watch. Participants wore a GoPro secured to their chest, aimed at their feet to record their steps. Investigators reviewed the uploaded footage and manually counted steps with a hand-clicker. If aides step counts were not within 5 steps of each other, the footage was rewatched until to step count was in agreement. Participants completed the course twice.

Figure 3. Participants performed 2 x 2-mile loops at Riley Trails during the field portion.

Table 1. Participant Characteristics reported as means and standard deviation

	Height (cm)	Weight (kg)	Body Comp (%)	Age (y)
Males (n=8)	182.1	81.2	10.6	26.8
	7.8	8.6	2.5	9.8
Females (n=4)	164.7	63.2	22.2	20.8
	5.4	10	5.7	0.9

Statistical Analysis

Repeated Measures ANOVA
Paired T-Tests for between device comparisons with a post hoc Bonferoni correction

RESULTS

- There was an overall statically significant difference in total steps between devices and the criterion measure (p<0.01).

- There were statistical differences between devices and the criterion measure across devices and trials (See Figures 4, 5, & 6)
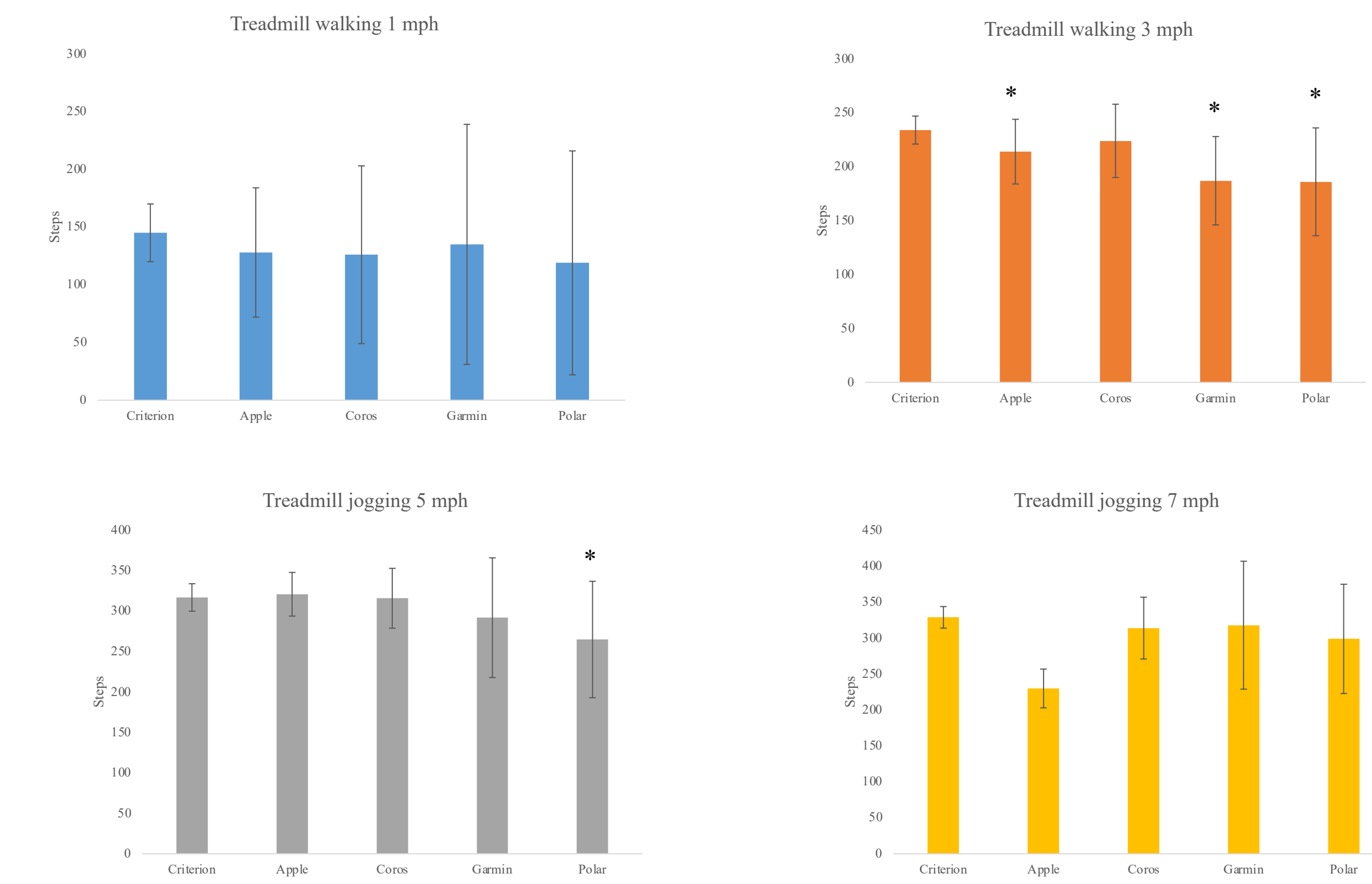
RESULTS

Figure 4. Treadmill Steps at 1,3,5,7 mph. * significant differences from the criterion measure P<0.01
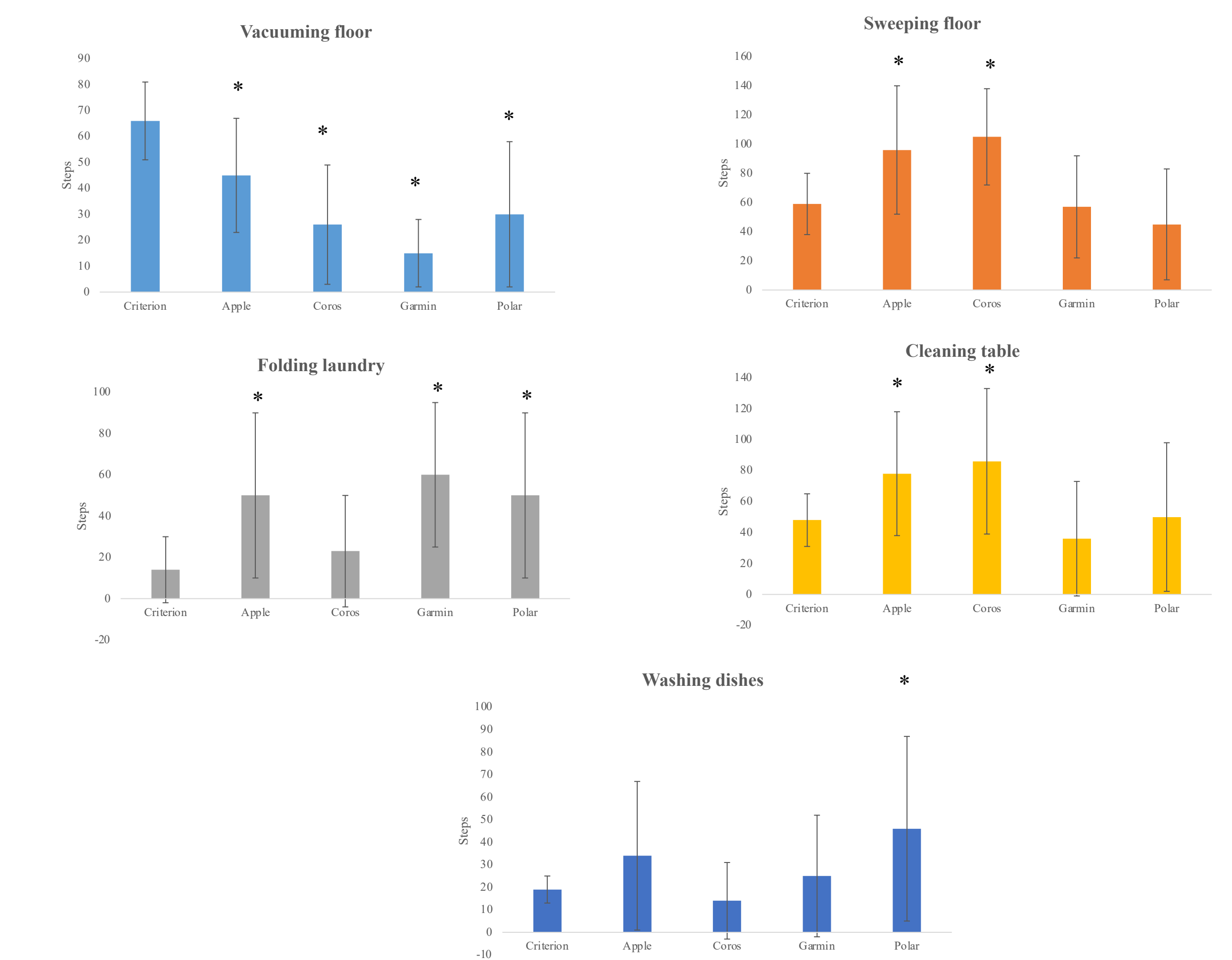

Figure 5. Activities of Daily Living Steps (Vacuuming, Sweeping, Laundry Folding, Wiping, and Dishwashing)
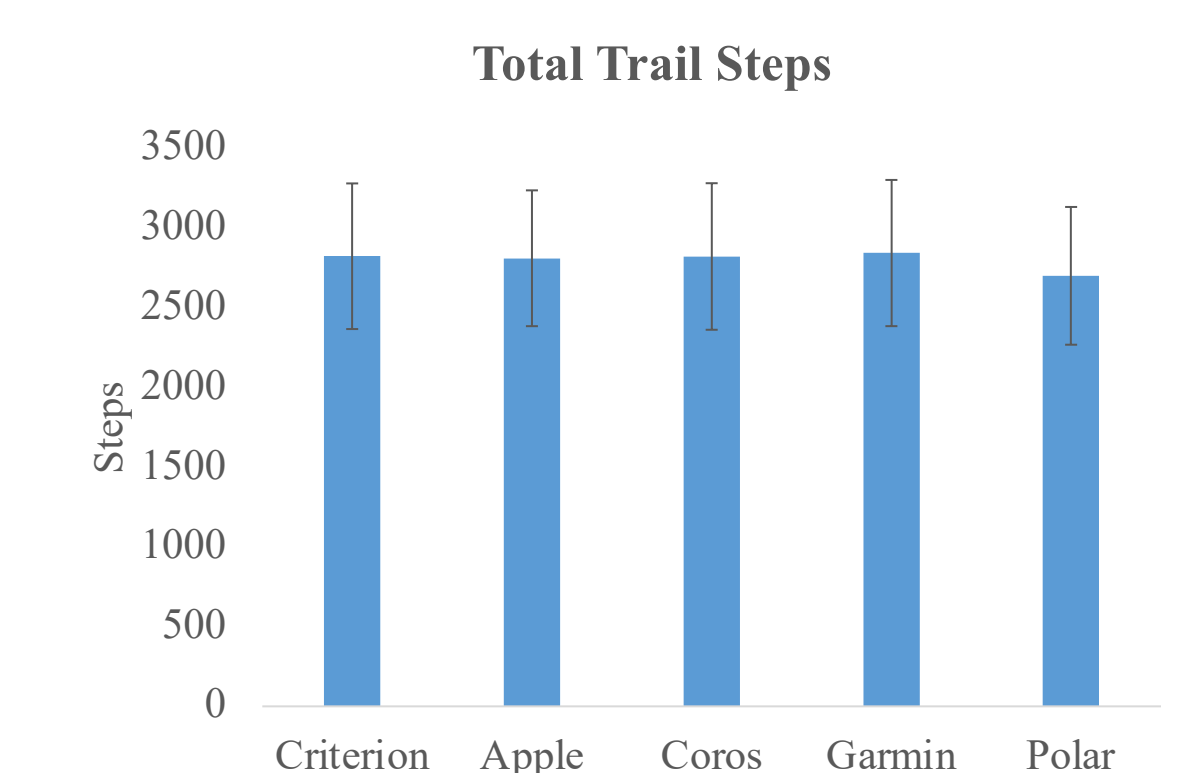* significant differences from the criterion measure P<0.01

Figure 6. Trail Running Steps. * significant differences from the criterion measure P<0.01

CONCLUSIONS

- These watches perform well during ambulatory activities but struggle with activities of daily living.
- Future studies should examine the ability of the watches to accurately monitor steps over a free living 24-hour period.