VALIDATION OF GARMIN FITNESS TRACKER (FENIX 3 HR) BIOMECHANICS

Bryson Carrier, BS, Tim Holmes, Lauren Williams, Siri Dahl, Libby Weber, Andrew Creer, PhD, Tyler Standfield, PhD
Department of Exercise Science, Utah Valley University, Orem, UT

INTRODUCTION

Fitness trackers are becoming common-place in society, and biomechanical data that used to be available only for elite athletes, is now becoming available for anyone with an activity tracker. Fitness trackers have the possibility of revolutionizing health, fitness, physiologic and pathophysiologic research and understanding of the general health of society (Wright et al., 2017).

Stride length, run cadence, vertical oscillation and ground contact time, if known, can help to drive training adaptations (Adams et al., 2018), improve running economy (Folland et al., 2017), help prevent injuries (Schubert, Kempf, Heiderscheit, 2013), and aid in the recovery of injuries (Willy, 2017)

The need for independent validation has become more important to drive accuracy in training decisions and physiologic research.

METHODS

17 healthy, recreational runners (9 male, 8 female, 28.11 ± 7.38 yrs, 70.26 ± 10.76 kg, 173.77 ± 5.96 cm) were recruited for this study. Three running conditions (flat, incline, and decline) were performed, each trial went for approximately 2:15.

An instrumented treadmill (Bertec Inc., Columbus, OH) was used to collect ground reaction force data. Infrared markers were placed on the foot and trunk and tracked with a 16 camera Vicon Nexus 2.3 (Vicon, Inc., Oxford, UK) system to collect run cadence, stride length and vertical oscillation. Collections were taken every 30 seconds for 10 seconds.

The data was compiled and processed using Visual 3D software (5.0, C-Motion, Inc., Germantown, MD,USA) and variables extracted were compared to the data collected by the Garmin Fenix 3 HR (Garmin Ltd., Olathe KS). The user information in the Garmin watch was changed for each participant before the trials began.

Run cadence, stride length, vertical oscillation, and ground contact time were collected from the Garmin Fenix 3 HR. We then extracted the data from the corresponding data collection times from the Vicon Nexus system to compare the data.

After data was collected and compiled, we determined the stride length, run cadence, vertical oscillation, and ground contact time in Visual 3D (V3D), for each trial and condition (flat, incline and decline).

Paired t-tests were run for each of the 4 variables and 3 conditions separately (table 1), as well as an overall t-test for each of the variables with combined conditions (table 2).

RESULTS

Overall, the Garmin was accurate for stride length and run cadence, but underestimated vertical oscillation and overestimated ground contact time.

The Garmin was found to be accurate for the following variables: flat & declined stride length, incline & declined run cadence, and inclined ground contact time.

The Garmin was NOT found to be accurate for the following variables: incline stride length, flat run cadence, flat, incline & declined vertical oscillation, and flat & declined ground contact time.

Overall, we can state with confidence that when used on varied running levels (incline, decline and flat), which would be found during real-world running, the Garmin Fenix 3 HR would accurately estimate a runners stride length and run cadence; however, it may not accurately estimate vertical oscillation or ground contact time.

Future considerations: As our study was conducted using a treadmill with the Garmin foot pod, HR strap and Fenix 3 HR, the next step would be to carry out the study outdoors, over ground, to determine if the GPS would assist in the accuracy of the measured variables.

REFERENCES


ABSTRACT

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<table>
<thead>
<tr>
<th>Stride Length (m)</th>
<th>Run Cadence (steps/min)</th>
<th>Vertical Oscillation (cm)</th>
<th>Ground Contact Time (ms)</th>
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</thead>
<tbody>
<tr>
<td>V3D</td>
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Table 2. Statistics and data from Visual 3D and Garmin Fenix HR. The data is compiled from the 3 conditions for each variables (flat, incline and decline). *P value determined via a paired t-test.

Table 1. Averages from all conditions, collected by the Garmin Fenix 3 HR and Vicon Nexus, Bertec Instrumented treadmill and compiled in Visual 3D (V3D). *P value was determined on a paired t-test.