Capturing Contextual Information About Sports and Exercise Using Ecological Momentary Assessment

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Abstract

Accelerometers provide an objective assessment of physical activity but cannot easily distinguish activity types. Ecological momentary assessment (EMA) can prompt participants during changes in physical activity or random time intervals, potentially providing more information than accelerometry alone. High school students were instructed to wear an accelerometer, carry a smartphone with an EMA application, and answer prompts about their activities for 14 days. After adjusting for age and gender, prompts reporting sports or exercise had significantly more MVPA in 60 minutes preceding that prompt than prompts reporting all other types of activities. ($p<0.001$). There were no differences in prior MVPA among any of the types or forms of sports or exercise reported except endurance exercise. The findings provide evidence for the construct validity in EMA-reported sports or exercise and highlight a unique advantage of EMA to capture contextual information about physical activity.

Background

Accelerometers provide an objective assessment of overall physical activity in free-living situations and provide a low burden experience for participants. However, accelerometers are not typically able to distinguish among distinct activity types without advanced algorithms (i.e. neural networks) (1).

Ecological momentary assessment (EMA), a real-time sampling strategy, can prompt participants at context-sensitive moments (e.g. change in physical activity) or random time intervals (2).

Objectives

This study examines the validity of self-reported contextual information about sports and exercise using EMA and the added value of this approach above and beyond accelerometry alone.

Methods

Participants:

Subject-level N: 51 adolescents

- Age: 16.1 years old (14 – 19 years old)
- Gender: 55% Female (N = 28)
- Ethnicity: 57% Hispanic (N = 29)
- BMI: 24.2 (16.8 – 33.6)
- 44% overweight, 19% obese

Prompt-level N: 4,181 (78% compliance)

Methods

Procedure:

For 14 days, participants were instructed to:

- wear an Actigraph accelerometer
- carry an Android smartphone (Nexus 4) with a custom EMA application

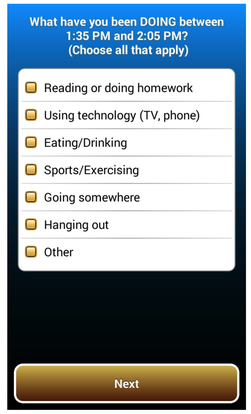
Signal-Contingent Prompting Schedule:

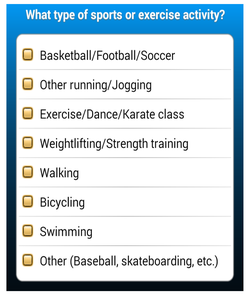
Day	7-9am	9-11am	11am-1pm	1-3pm	3-5pm	5-7pm	7-9pm
Monday					X	X	X
Tuesday					X	X	X
Wednesday					X	X	X
Thursday					X	X	X
Friday					X	X	X
Saturday	X	X	X	X	X	X	X
Sunday	X	X	X	X	X	X	X

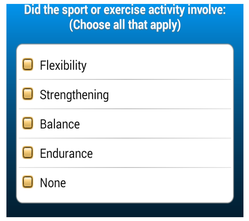
Event-Contingent Prompting Schedule:

Type of Trigger	Triggering Rule
1.Physical Activity Bout	15+ min. of high intensity activity followed by 10+ min. of low intensity activity
2.Sedentary Behavior or Device Non-wear	60+ min. of low intensity activity followed by 1+ min. of moderate intensity activity or greater
3. No Power or Software Crash	10+ min. of no activity data followed by 1+ min. of some activity data

Measures:







Data Analysis:

Multi-level models (Stata 13) compared moderate-to-vigorous physical activity (MVPA) measured by the Actigraph across the 15/30/60 minutes prior to an EMA prompt to activities self-reported during that prompt.

Results

171 prompts (4.1%) reported any sports/exercise activity.

Table 1. Results of multi-level linear regression predicting MVPA as a function of sports/exercise vs. non-sports/exercise

Minutes of MVPA prior to prompt		Beta	S.E.
15 minutes	Between-subject	0.89**	0.30
	Within-subject	-0.17	0.71
30 minutes	Between-subject	1.94***	0.53
	Within-subject	1.58	1.26
60 minutes	Between-subject	4.28***	0.87
	Within-subject	3.39^	2.05

Figure 1. Frequency of reported sports/exercise types

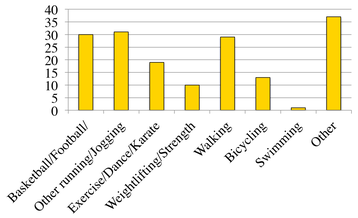


Table 2. Results of multi-level linear regression predicting prior MVPA (60 min) as a function of sports/exercise type

Sports/exercise type	Beta	S.E.
Basketball/Football/Soccer	2.67	3.66
Other running/Jogging	-0.27	3.31
Exercise/Dance/Karate class	-0.77	3.60
Weightlifting/Strength training	-5.12	4.44
Walking	0.59	2.99
Bicycling	-3.08	5.24
Swimming	-6.25	14.49
Other	2.02	3.06

Figure 2. Frequency of reported sports/exercise forms

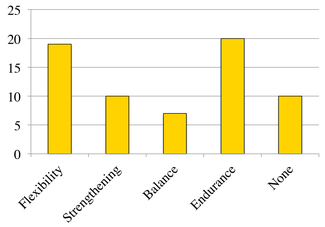


Table 3. Results of multi-level linear regression predicting prior MVPA (60 min) as a function of sports/exercise form

Sports/exercise form	Beta	S.E.
Flexibility	-.89	2.57
Strengthening	-1.58	3.39
Balance	-2.98	4.06
Endurance	4.79*	2.39
None	-4.81	3.29

All models adjusted for age and gender.
^p<0.10, *p<0.05, **p<0.01, ***p<0.001

Summary and Conclusion

- The findings provide evidence for the construct validity in EMA-reported sports or exercise compared to objectively measured MVPA.
- The lack of differences in MVPA among specific types and forms of sports and exercise highlights a unique advantage of EMA to capture contextual information about physical activity beyond the capabilities of an accelerometer.
- The differences in MVPA for endurance exercises vs. all other forms suggests that accelerometry can best differentiate endurance vs. non-endurance exercise.
- The study is limited by a small sample response to sports/ exercise as an activity type and relies on null findings for the conclusion. Nevertheless, there were no observable trends toward significance.

References

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2. Stone, A. A., & Shiffman, S. (1994). Ecological momentary assessment (EMA) in behavorial medicine. *Annals of Behavioral Medicine*.

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