Cut points matter: Differences in estimates of physical activity engagement using accelerometer data

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INTRODUCTION

- Accelerometers are used to objectively assess physical activity intensity levels and durations across various populations by using cut points.
- There is not a consistent set of cut points for any given population which complicates inter-study comparison.
- Cut points use either vector magnitude (VM) or only the vertical axis (VA) to divide time into intensity levels.

PURPOSE

- The aim of this study was to determine agreement of adolescents' physical activity time at different intensities between four different commonly used cut points using VM or VA measures.

PROCEDURE

PARTICIPANTS

- Data was gathered from a subsample of the NEXT Generation Health Study, a national adolescent cohort (N=150, 83 males).

ASSESSMENT

- Participants wore an ActiGraph GT3X accelerometer (placed on right hip for 7 consecutive days, ≥10 waking hours/day). We then calculated time spent at each PA intensity using cut points from three studies also using ActiGraph GT3X accelerometers; Freedson et al. (2005), Romanzini et al. (2014), and Santos-Lozano et al. (2013). Days with less than 500 minutes of wear time were excluded from the analysis. Participant adherence to CDC physical activity recommendations (total of ≥60 minutes/day) was derived separately for each cut point.

DATA ANALYSIS

- Agreement analyses (simple kappa and McNemar's test) and paired t-tests (with Bonferroni adjustment) were conducted. P values < 0.05 were considered statistically significant.

RESULTS

Table 1: Average PA (minutes/day^{-1}) by each cut point

Cut Points	Light PA	Moderate PA	Vigorous PA	Moderate & Vigorous PA
Freedson VA	57.61 ± 29.11	101.25 ± 59.59	11.93 ± 18.73	113.18 ± 67.94
Romanzini VA	126.96 ± 69.55	14.24 ± 10.90	19.85 ± 23.81	34.09 ± 31.07
Romanzini VM	118.62 ± 72.33	34.82 ± 24.33	24.81 ± 25.72	59.62 ± 43.99
Santos Lozano VA	185.08 ± 94.67	87.17 ± 56.35	6.72 ± 12.95	93.89 ± 61.56

Table 2: Paired t-tests comparing time spent in moderate, vigorous, and moderate & vigorous physical activity by each cut point definition

Intensity Classification	Cut Point Pair		Mean	Std. Dev	t	P
Moderate	Freedson VA	vs. Romanzini VA	87.00	50.88	59.65	<.001
	Freedson VA	vs. Romanzini VM	66.43	38.94	59.51	<.001
	Freedson VA	vs. Santos-Lozano VM	14.08	20.35	24.14	<.001
	Romanzini VA	vs. Romanzini VM	20.57	16.11	44.56	<.001
	Romanzini VA	vs. Santos-Lozano VM	72.92	47.74	53.29	<.001
	Romanzini VM	vs. Santos Lozano VM	52.35	33.72	54.16	<.001
Vigorous	Freedson VA	vs. Romanzini VA	7.92	7.83	35.29	<.001
	Freedson VA	vs. Romanzini VM	12.87	11.87	37.82	<.001
	Freedson VA	vs. Santos-Lozano VM	5.21	9.39	19.37	<.001
	Romanzini VA	vs. Romanzini VM	4.96	8.26	20.93	<.001
	Romanzini VA	vs. Santos-Lozano VM	13.13	15.44	29.66	<.001
	Romanzini VM	vs. Santos Lozano VM	18.09	17.13	36.84	<.001
Moderate & Vigorous	Freedson VA	vs. Romanzini VA	79.09	46.86	58.87	<.001
	Freedson VA	vs. Romanzini VM	53.56	33.25	56.20	<.001
	Freedson VA	vs. Santos-Lozano VM	19.29	18.66	36.07	<.001
	Romanzini VA	vs. Romanzini VM	25.53	19.87	44.83	<.001
	Romanzini VA	vs. Santos-Lozano VM	59.79	39.89	52.29	<.001
	Romanzini VM	vs. Santos-Lozano VM	34.26	22.55	53.00	<.001

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RESULTS cont.

Table 3: Agreement Analysis of meeting CDC guidelines by cut point definition

Cut Point Pair	Simple Kappa	Level of Agreement	Two-sided Pr>|Z|	McNemar's Test Pr>S
FVA vs. RVA	0.12	None	<.0001	<.001
FVA vs. RVM	0.38	Minimal	<.0001	<.001
FVA vs. SLVM	0.81	Strong	<.0001	<.001
RVA vs. RVM	0.42	Weak	<.0001	<.001
RVA vs. SLVM	0.16	None	<.0001	<.001
RVM vs. SLVM	0.51	Weak	<.0001	<.001

Note. Freedson VA: FVA; Romanzini VA: RVA; Santos-Lozano VA: SLVA; Santos-Lozano VM: SLVM

CONCLUSIONS

- When using ActiGraph GT3X accelerometers, cut point selection has large effects on calculated time spent in physical activity at varying intensities in adolescents.
- As physical activity time is often used as an outcome, results based on different cut points need to be interpreted with caution.
- These findings highlight the complication of inter-study comparison when different cut points are used and a need for consistency. Researchers should consider reporting multiple cut points to make inter-study comparison possible.
- It maybe time to rethink the feasibility of assigning one cut points to a large, diverse groups and seek a new strategy for the development of future cut points.

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