

A comparison of accelerometer cut-points to determine moderate-to-vigorous physical activity in adults with Alzheimer's disease and related dementia

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Disclosures: No relationships to disclose.

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Background
information and
research objectives.

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Research methods
and participant
characteristics.

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Cut-point
comparisons with
and without the
low frequency
extension.

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Implications for
physical activity
measurement in
adults with ADRD.

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Background

- Portable accelerometers are widely used to assess free-living physical activity.
- Data from accelerometers are aggregated and expressed in activity counts for a specified time period to represent physical activity intensity.
- Calibration studies are conducted to develop activity count cut-points associated with energy expenditure in metabolic equivalents (METs).



Background

- Cut-points are population specific. Many studies apply cut-points from younger or cognitively normal populations to adults with ADRD.
- Adults with Alzheimer's disease and related dementia (ADRD) differ biomechanically (e.g., higher gait variability) from adults with normal cognition.
- ActiGraph's low frequency extension is designed to improve response to activity and retain data in low activity for older adults.



Objective

- To compare daily minutes of moderate-to-vigorous physical activity (MVPA) derived using different published MVPA cut-points.
- To determine the impact of applying ActiGraph's low frequency extension (LFE) filter on daily MVPA.

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Research Methods

PARTICIPANTS



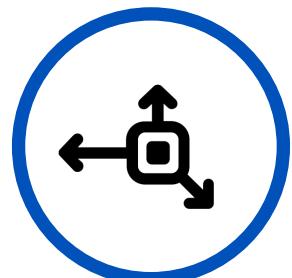
Thirty-seven adults with ADRD wore triaxial accelerometers on a belt around the non-dominant hip during waking hours for 7 consecutive days.

WEAR TIME



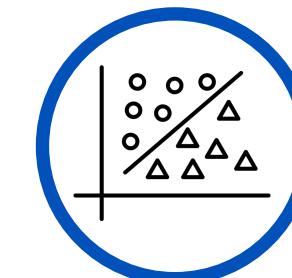
Wear time was determined with the Choi algorithm using the R Physical Activity package. We used 60-minute time frames with a 2-minute allowance of artifactual movement.

SAMPLE RATE



Data were collected at 60 Hertz and processed with and without the low frequency extension filter.

CUT-POINTS



Troiano et al. (2020), Freedson et al. (1997), and Barnett et al. (2013) vertical axis and Freedson (2000) and Barnett (1997) vector magnitude cut-points were compared.

DATA STORAGE



The accelerometers were returned by mail and data stored in Actigraph's AGD file format.

ANALYSIS



Mean absolute percent errors, Wilcoxon signed rank tests^[1], and equivalency tests^[1,2] were used to evaluate mean differences among the cut-points and filter types.

¹ P-values were adjusted for multiple comparisons using the Holm method.

² Equivalency bounds were set at $\pm 10\%$ of pooled MVPA mean (minutes/day).

Participant Characteristics

| Demographics | | Anthropometric and Fitness Characteristics | |
|---|------------|--|--------------|
| Age | 73.2 ± 9.1 | Height (in.) | 67.4 ± 4.15 |
| Gender: Male | 23 (62.2%) | Weight (lbs.) | 168.2 ± 36.1 |
| Race: White | 36 (97.3%) | Body Mass Index (kg/m²) | 25.9 ± 4.2 |
| Ethnicity: Not Hispanic/Latino | 35 (94.6%) | Fitness Assessment | |
| Diagnosis | | Up & Go (sec.) | 12.9 ± 9.0 |
| Alzheimer's disease | 26 (70.3%) | 3-meter walk (sec.) | 3.5 ± 2.4 |
| Lewy Body Dementia | 3 (8.1%) | Gait speed (m/sec.) | 1.0 ± 0.4 |
| Other Dementia or Neurocognitive disorder | 8 (21.6%) | *4-Stage Balance Test | 22 (59.5%) |

Mean ± SD or Frequency (Percentage)

Sample Size: N = 37

* Did not pass 4-Stage Balance Test

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Vertical Axis

| | Normal Filter | | | Low Frequency Extension | | |
|------------------|----------------------|-----------------------|-----------------------------|-------------------------|-----------------------|-----------------------------|
| | Troiano ¹ | Freedson ¹ | Farias-Barnett ¹ | Troiano ¹ | Freedson ¹ | Farias-Barnett ¹ |
| Counts | | 97,747 ± 70,790 | | | 116,619 ± 76,274 | |
| Vector Magnitude | | 258,083 ± 160,788 | | | 303,632 ± 181,923 | |
| Wear Time | | 778.4 ± 158.0 | | | 817.5 ± 175.4 | |
| Sedentary | 598.4 ± 137.5 | 597.7 ± 137.4 | 509.0 ± 139.3 | 604.0 ± 170.1 | 603.2 ± 170.0 | 505.1 ± 172.5 |
| Light | 175.1 ± 101.0 | 175.3 ± 100.9 | 249.6 ± 107.7 | 208.2 ± 107.0 | 208.6 ± 106.8 | 288.1 ± 109.5 |
| MVPA | 5.0 ± 6.6 | 5.4 ± 6.9 | 19.9 ± 21.2 | 5.2 ± 6.1 | 5.6 ± 6.4 | 24.3 ± 25.3 |

¹ Mean ± SD

Counts and vector magnitude are measured in ActiGraph counts per valid day.
Wear time, sedentary, light, and MVPA are measured in minutes per valid day.

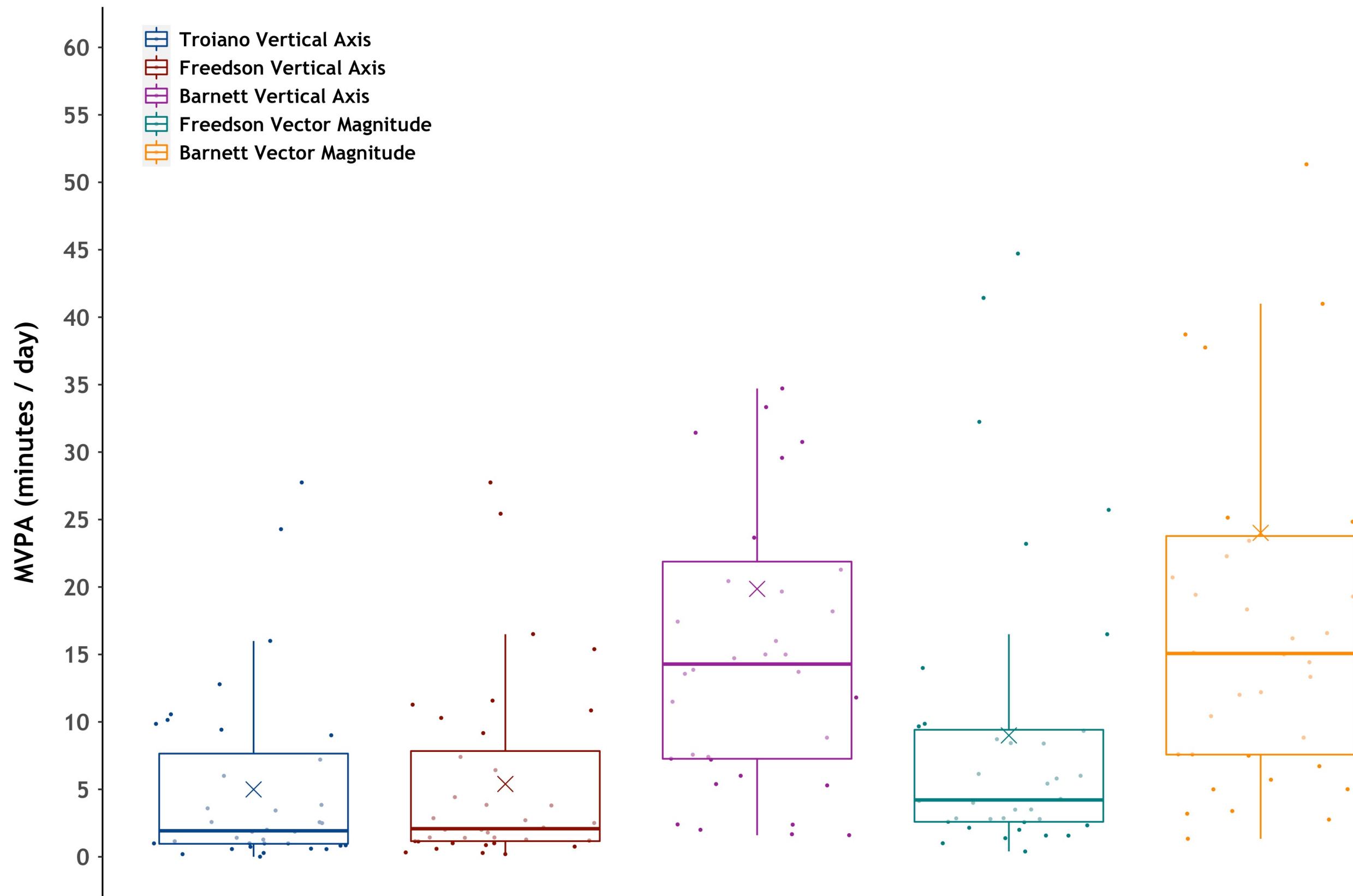
Vector Magnitude

| | Normal Filter | | Low Frequency Extension | |
|---------------------|-----------------------|-----------------------------|-------------------------|-----------------------------|
| | Freedson ¹ | Farias-Barnett ¹ | Freedson ¹ | Farias-Barnett ¹ |
| Counts | 97,747 ± 70,790 | | 116,619 ± 76,274 | |
| Vector Magnitude | 258,083 ± 160,788 | | 303,632 ± 181,923 | |
| Wear Time | 778.4 ± 158.0 | | 817.5 ± 175.4 | |
| Sedentary | 525.7 ± 145.2 | 525.7 ± 145.2 | 545.4 ± 177.8 | 545.4 ± 177.8 |
| Light | 243.8 ± 111.8 | 228.7 ± 95.5 | 260.0 ± 112.4 | 238.6 ± 92.3 |
| MVPA | 9.0 ± 11.1 | 24.0 ± 30.3 | 12.1 ± 15.6 | 33.5 ± 39.8 |

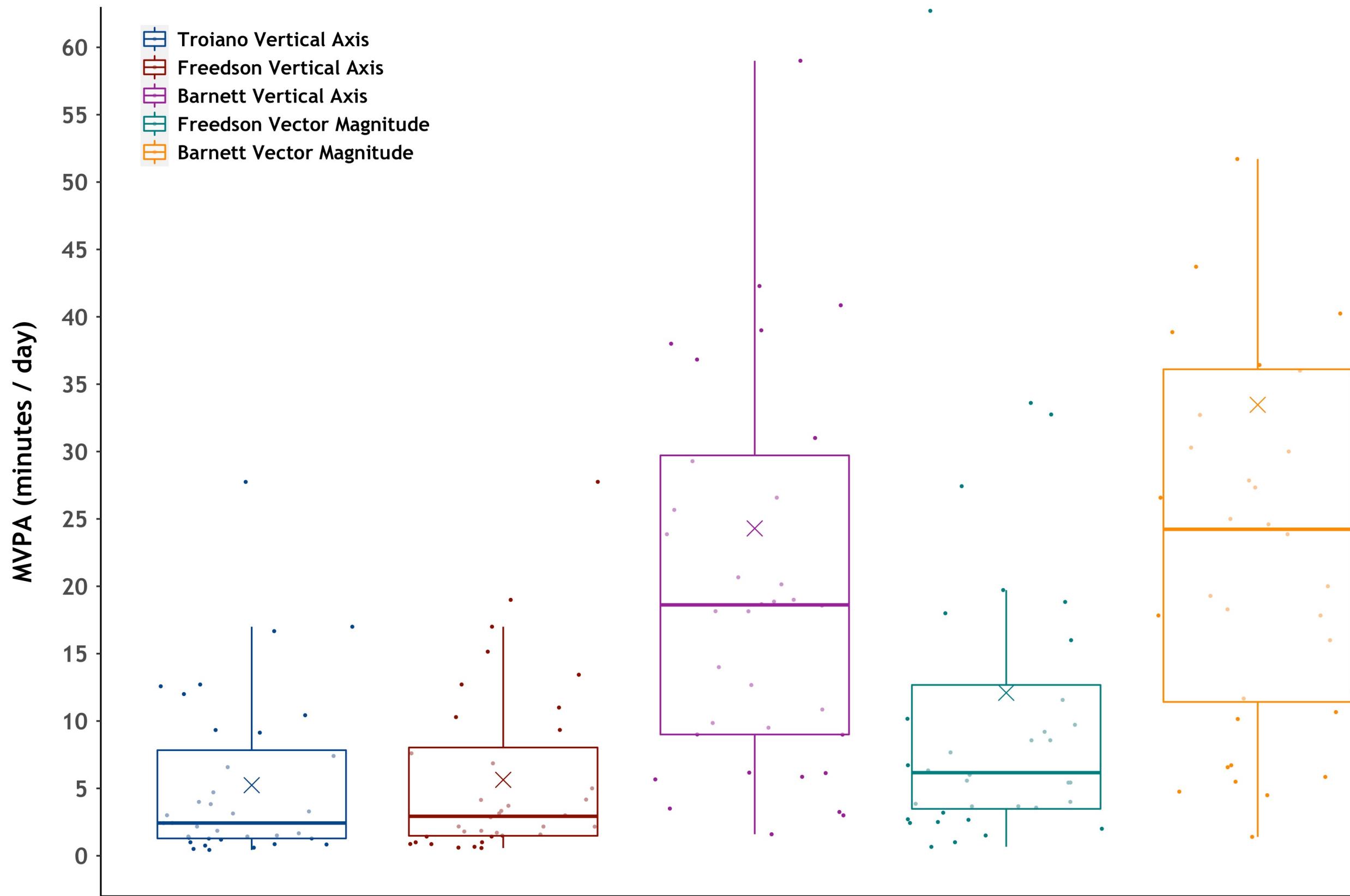
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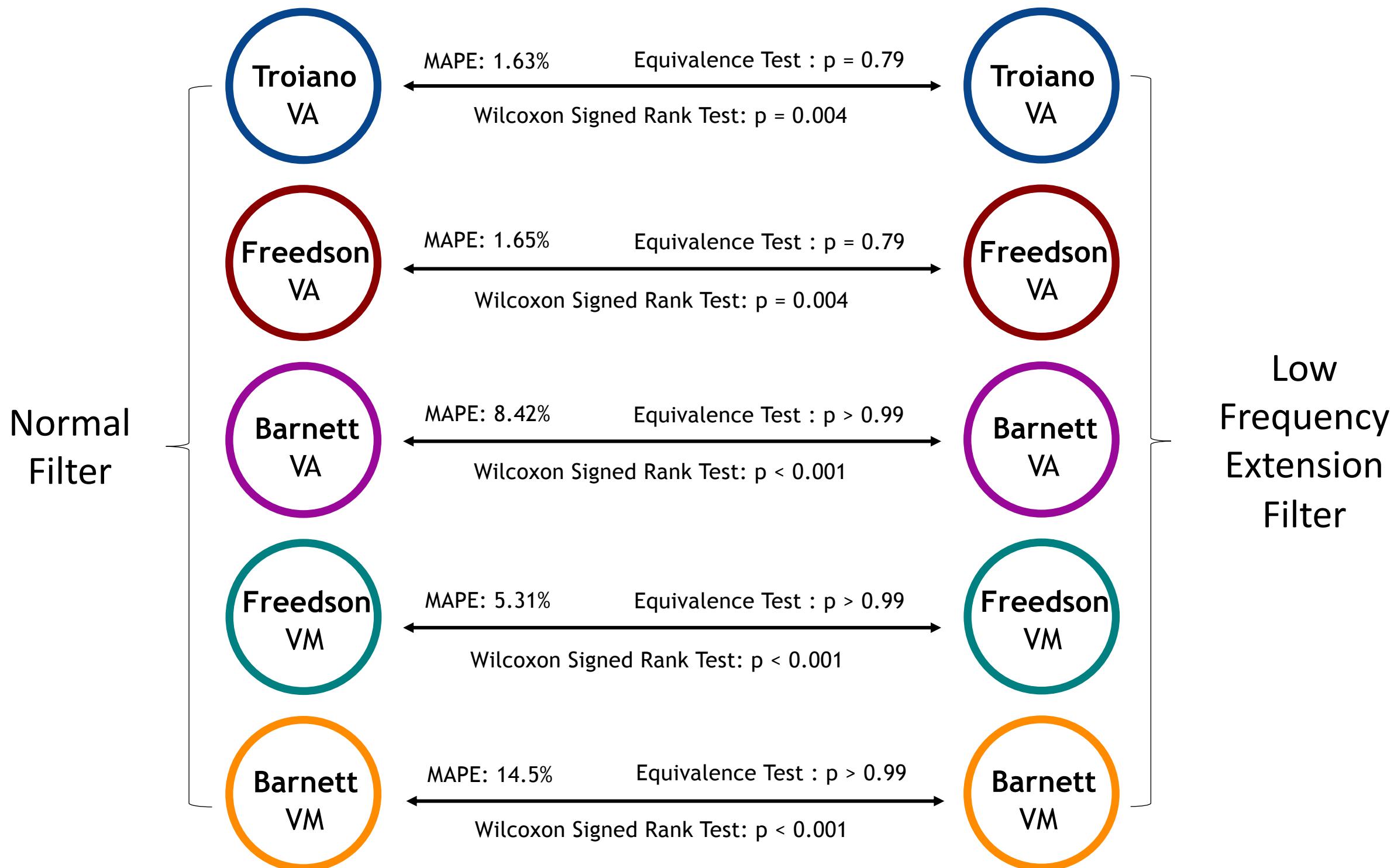
Vertical axis and vector magnitude cut-points applied to Actigraph's normal filter



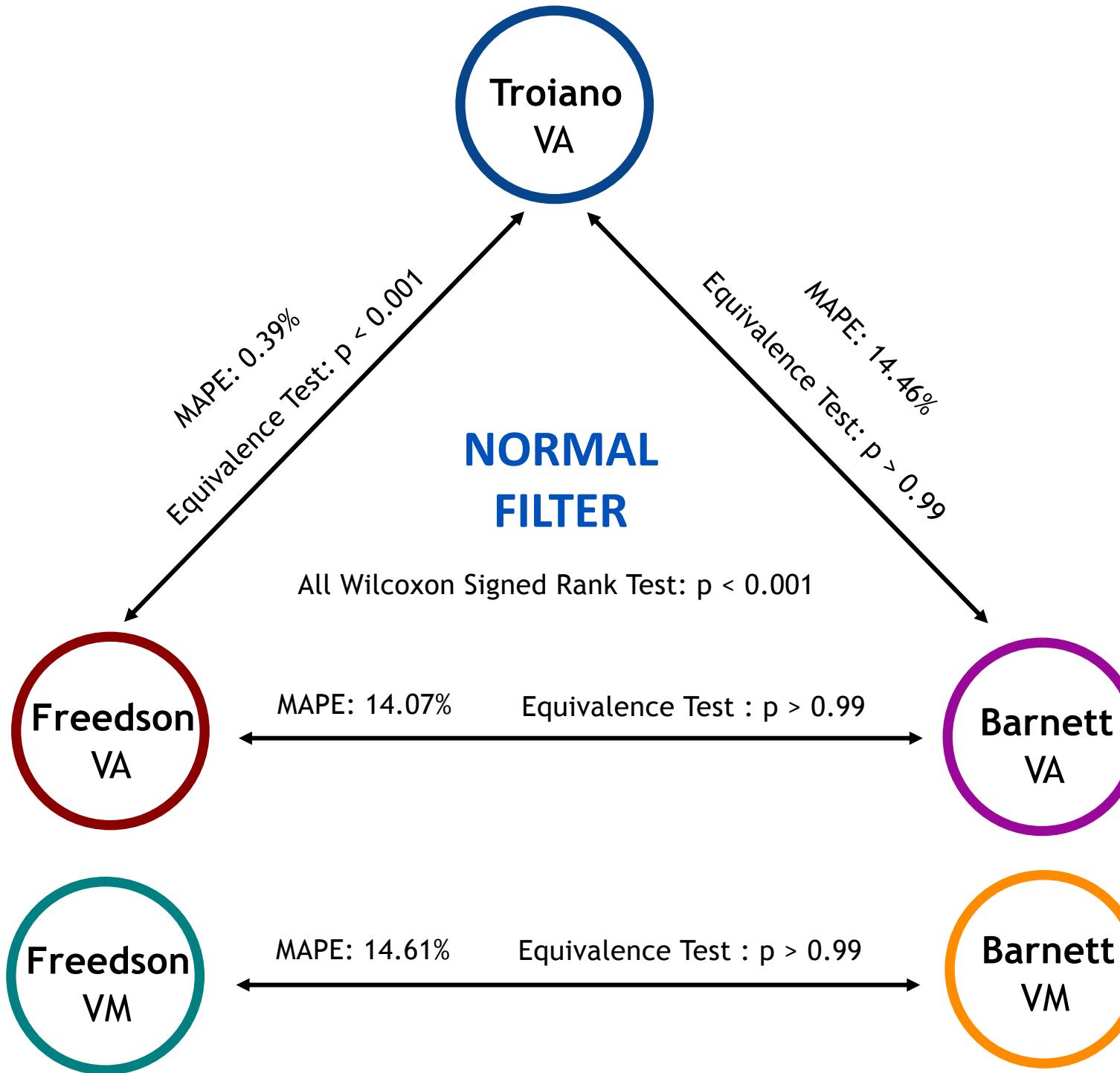
Vertical axis and vector magnitude cut-points applied to Actigraph's low frequency extension filter



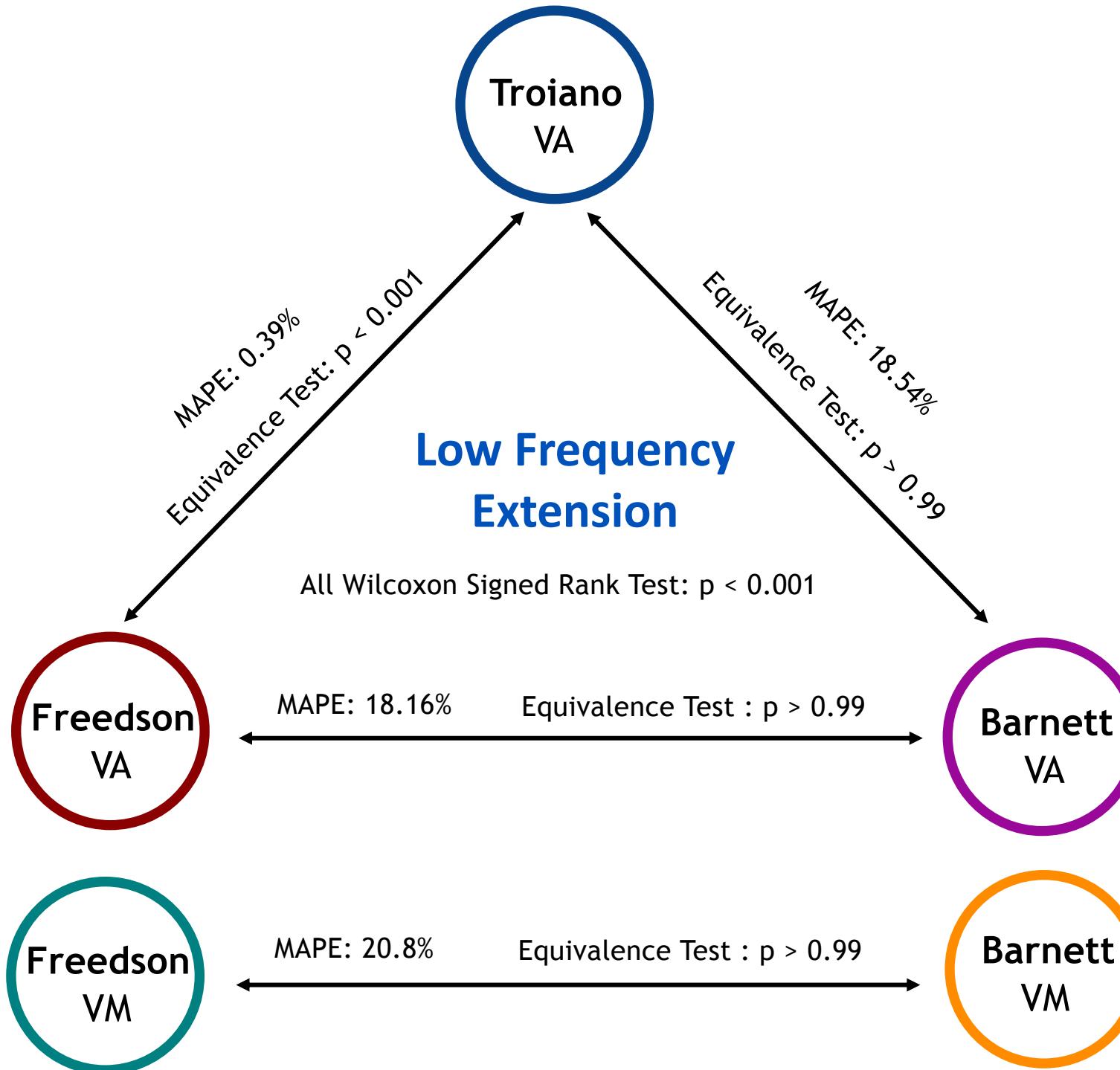
Mean Absolute Percent Error and Equivalency Testing



Mean Absolute Percent Error and Equivalency Testing



Mean Absolute Percent Error and Equivalency Testing



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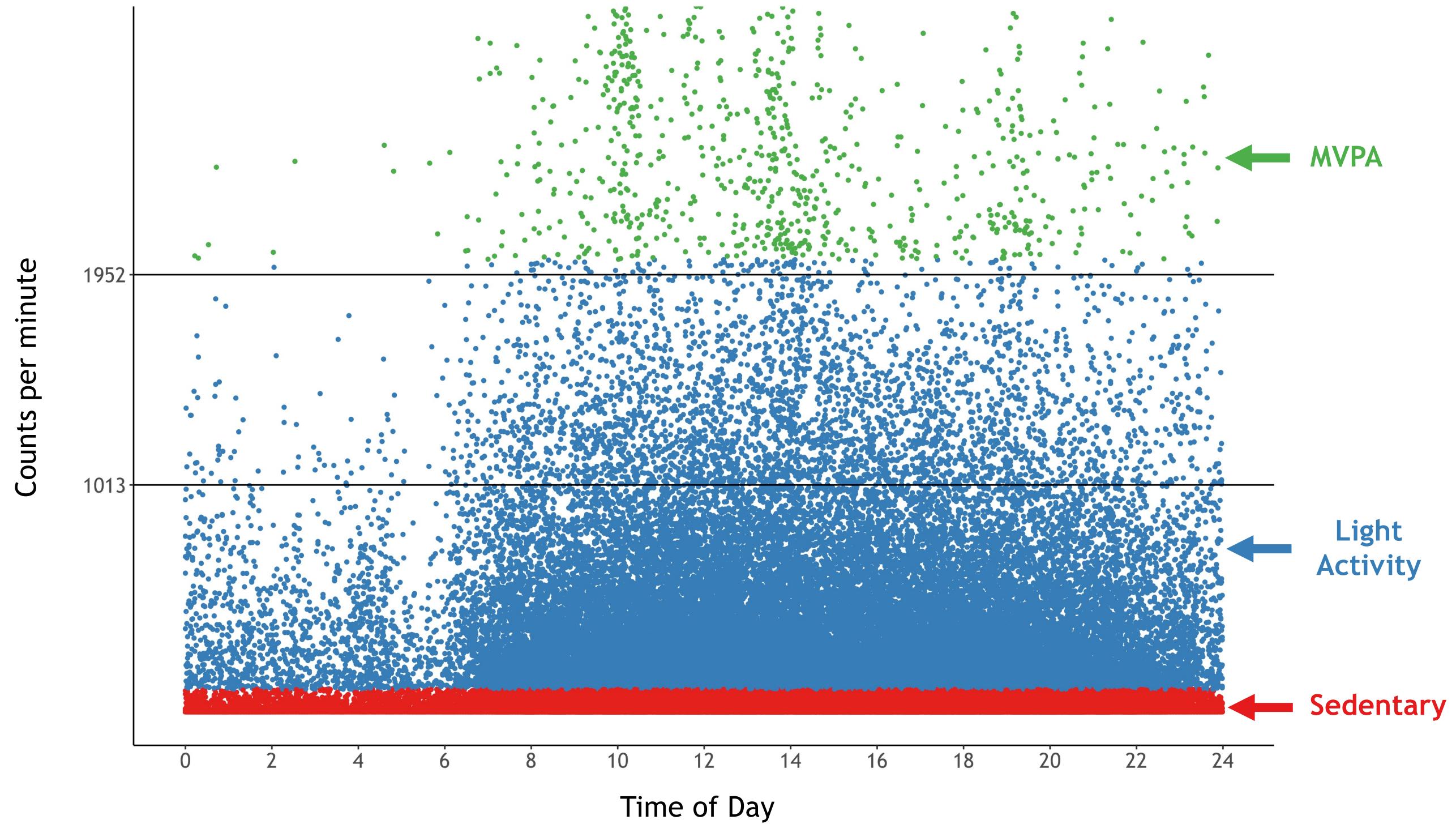
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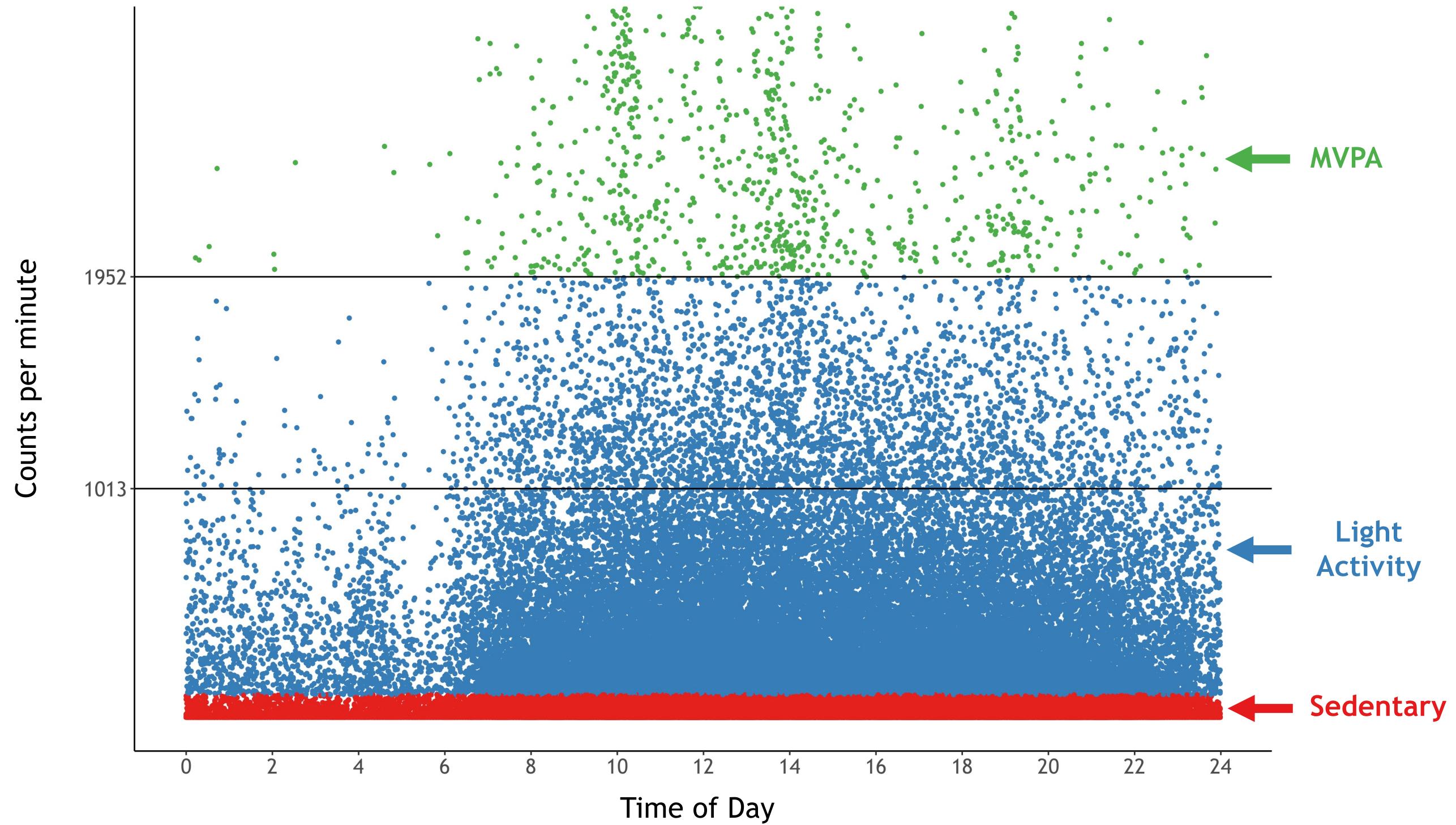
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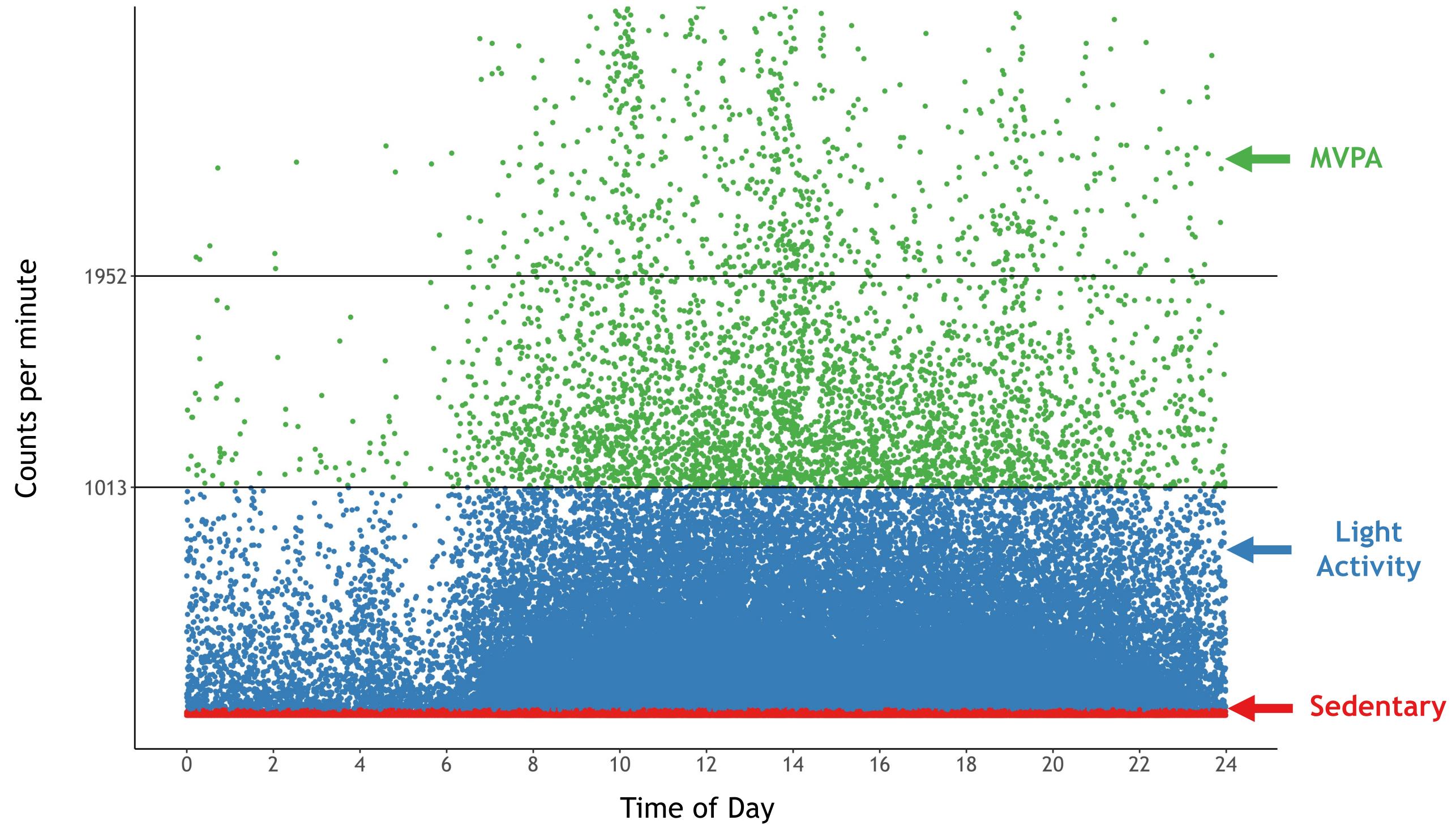
Troiano cut-points for MVPA (2020) compared to Freedson (1952) and Barnett (1013)



Troiano cut-points for MVPA (2020) compared to Freedson (1952) and Barnett (1013)



Troiano cut-points for MVPA (2020) compared to Freedson (1952) and Barnett (1013)

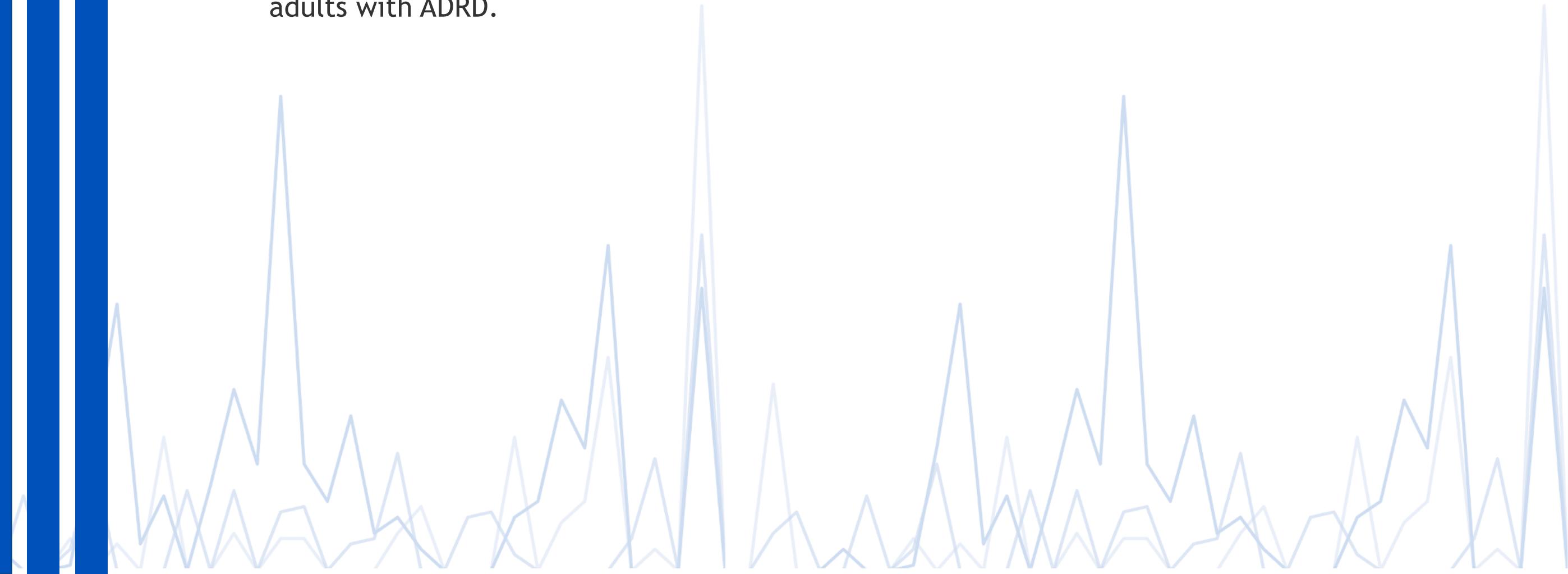


Summary of the Results and Limitations

- Estimates of MVPA ranged from 5.0 min./day (Troiano [VA]) to 33.5 min./day (Barnett [VM]).
- Applying the LFE increased MVPA between 0.2 min./day (Troiano [VA]) to 9 min./day (Barnett [VM]).
- Statistically significant differences in medians among all cut-point comparisons using Wilcoxon signed rank tests and adjusting for multiple comparisons using the Holm method.
- Differences between Troiano [VA] and Freedson [VA] showed evidence of being statistically equivalent to zero when the equivalence bounds are set at $\pm 10\%$ of the pooled MVPA mean.
- Limitations
 - No criterion measure (e.g., energy expenditure, direct observation).
 - Not exhaustive list of cut-points and the Barnett cut-points differ greatly from Troiano and Freedson.

Conclusions

- Accelerometer derived estimates of MVPA in adults with ADRD vary depending on the accelerometer cut-points applied and whether the low frequency extension is used.
- Research to evaluate the validity of currently available cut-points for the assessment of MVPA are warranted prior to using accelerometers in research to describe MVPA or to assess associations between MVPA and health, functional, or cognitive parameters in adults with ADRD.



Cut-point References

1. Troiano RP, Berrigan D, Dodd KW, Mâsse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc.* 2008;40(1):181-188. doi:10.1249/mss.0b013e31815a51b3
2. Freedson PS, Melanson E, Sirard J. Calibration of the Computer Science and Applications, Inc. accelerometer. *Med Sci Sports Exerc.* 1998;30(5):777-781. doi:10.1097/00005768-199805000-00021
3. Sasaki JE, John D, Freedson PS. Validation and comparison of ActiGraph activity monitors. *J Sci Med Sport.* 2011;14(5):411-416. doi:10.1016/j.jsams.2011.04.003
4. Barnett A, van den Hoek D, Barnett D, Cerin E. Measuring moderate-intensity walking in older adults using the ActiGraph accelerometer. *BMC Geriatr.* 2016;16(1):211. Published 2016 Dec 8. doi:10.1186/s12877-016-0380-5

R code for accelerometer processing and visualizations
for this presentation are available on GitHub at:

<https://github.com/bhelsel/APHA21PA3190>