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Diabetes and Digestive
and Kidney Diseases

Comparing ActiGraph CentrePoint Insight Watch, GT9X Link, and wGT3X-BT Accelerometers to NHANES 2011-2014 GT3X+ Devices using an orbital shaker



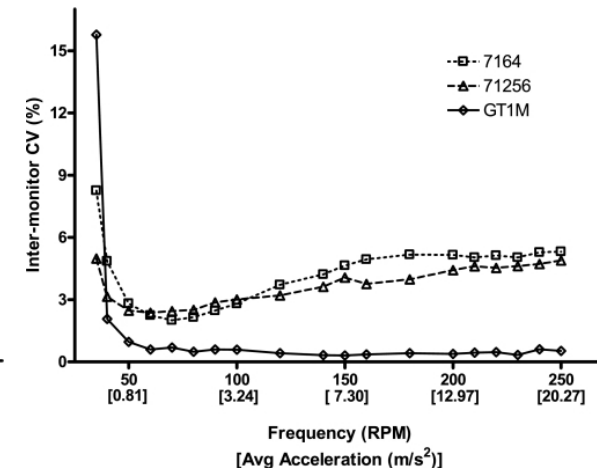
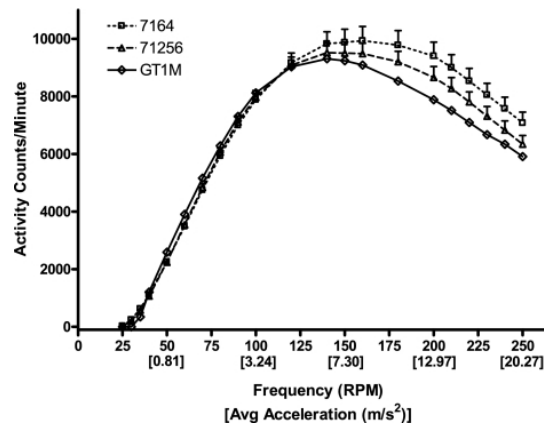
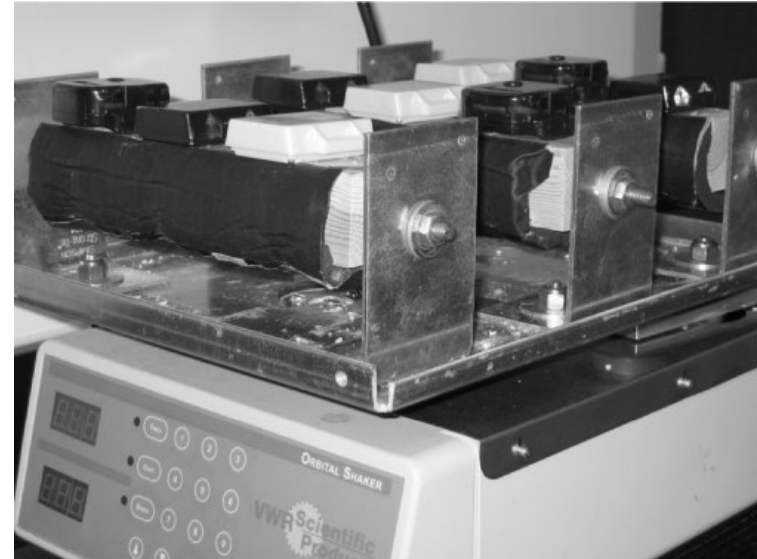
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Background & Introduction

- ActiGraph devices are among the most frequently used research-grade devices used to objectively assess physical activity, sedentary behavior, and sleep in a variety of research settings.
- Cross-study comparison
 - Inter- and intra-generational devices differences
- Orbital shaker example: Rothney et al. 2008
 - Documented inter- and intra-generational device differences
- Gap in the literature
 - Primarily legacy generations
 - Mostly counts, no raw data examination



Study Objective

- The purpose of this study was to examine the inter- and intra-generational comparability of five generations of ActiGraph devices, across a broad frequency range using a mechanical shaker.
- We will compare the five ActiGraph generations to a NIST-certified criterion measure of acceleration (Lord Microstrain 3DM) and the wGT3X-BT, GT9X, and CPIW to GT3X+ devices used in the 2011-2014 NHANES cycles



GT3X+

Est. 2009



wGT3X-BT

Est. 2013



GT9X Link

Est. 2014



CentrePoint
Insight Watch

Est. 2017



CentrePoint
Insight Watch 2.0

Est. 2021



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Methods: Shaker



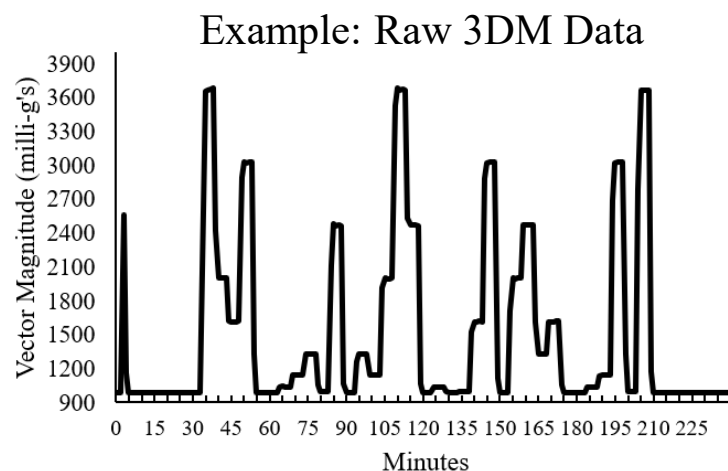
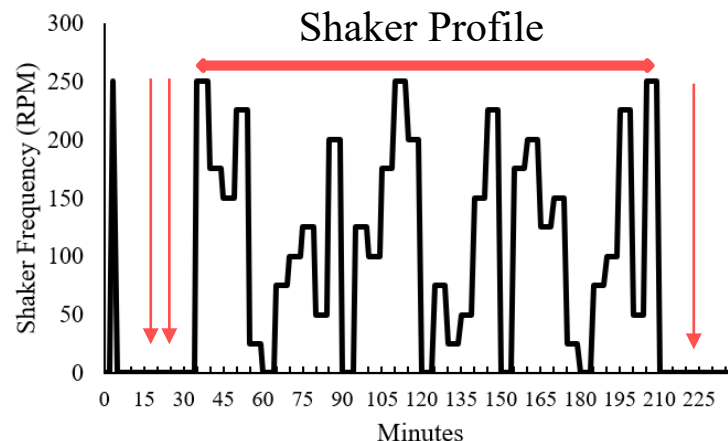
Methods: Shaker Protocol

Shaker Test Profile

- 0-250 RPM in 25 RPM increments
- ~0-3.7 g's
 - 11 total frequencies including zero
 - 5 minutes at each frequency
 - Middle 3 minutes used for analyses
- Four Total Runs
 - 30 and 80 Hz sampling frequencies (32 and 64 Hz CPIW)
 - XY and XZ orientation
 - **Mean from four runs presented here as overall summary**

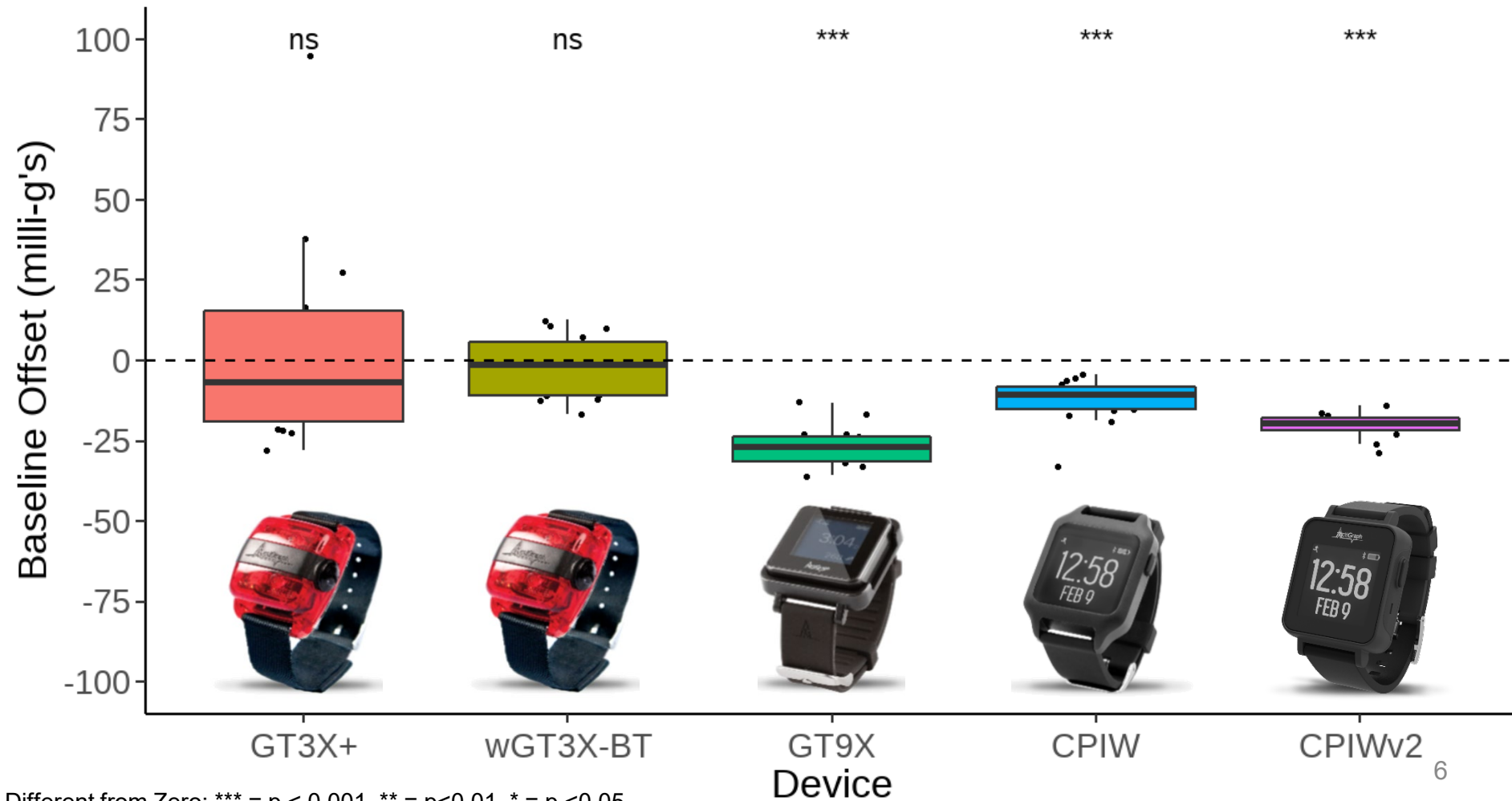
Components to Characterize

- n = 15 of each device type (n = 11 for CPIWv2)
- Baseline Offset
 - Difference from 1 g vector magnitude at rest
- Signal Drift
 - Change in the baseline sensor signal over time.
 - Baseline at beginning minus baseline at end
- Dynamic Response
 - The change in the sensor signal during applied accelerations above the force of gravity



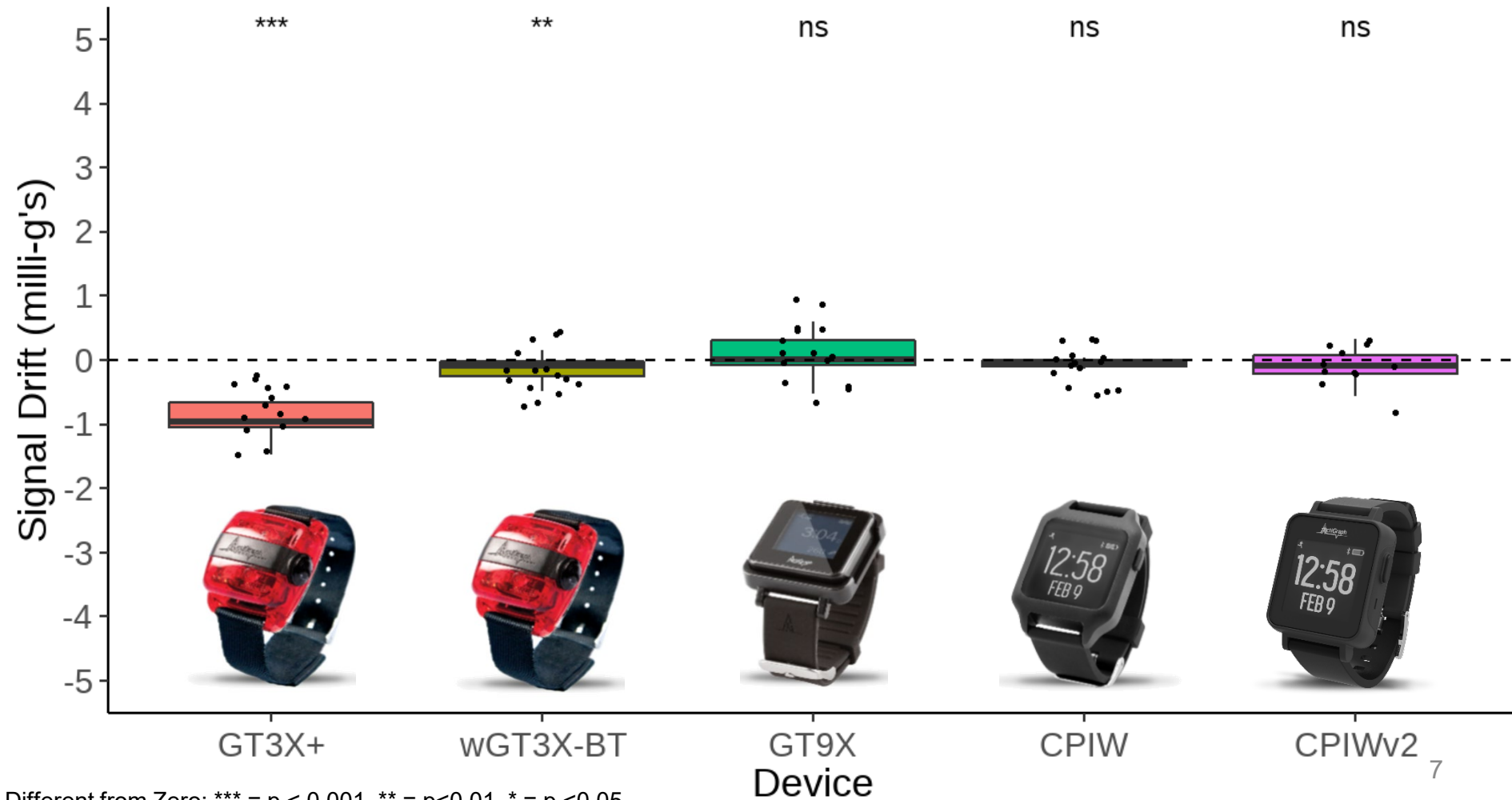
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There are measurable inter-and intra-generational differences in baseline offset (bias from 1g)

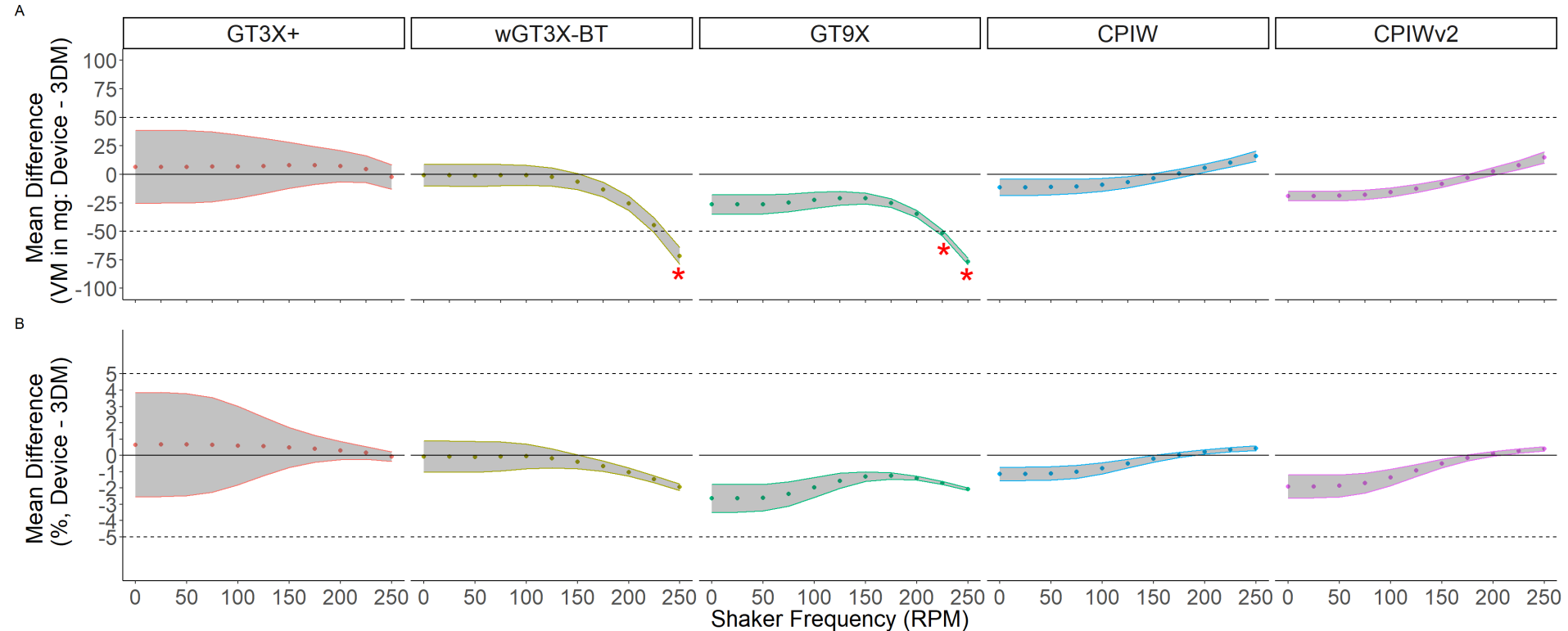


Inter-and intra-generational signal drift is negligible

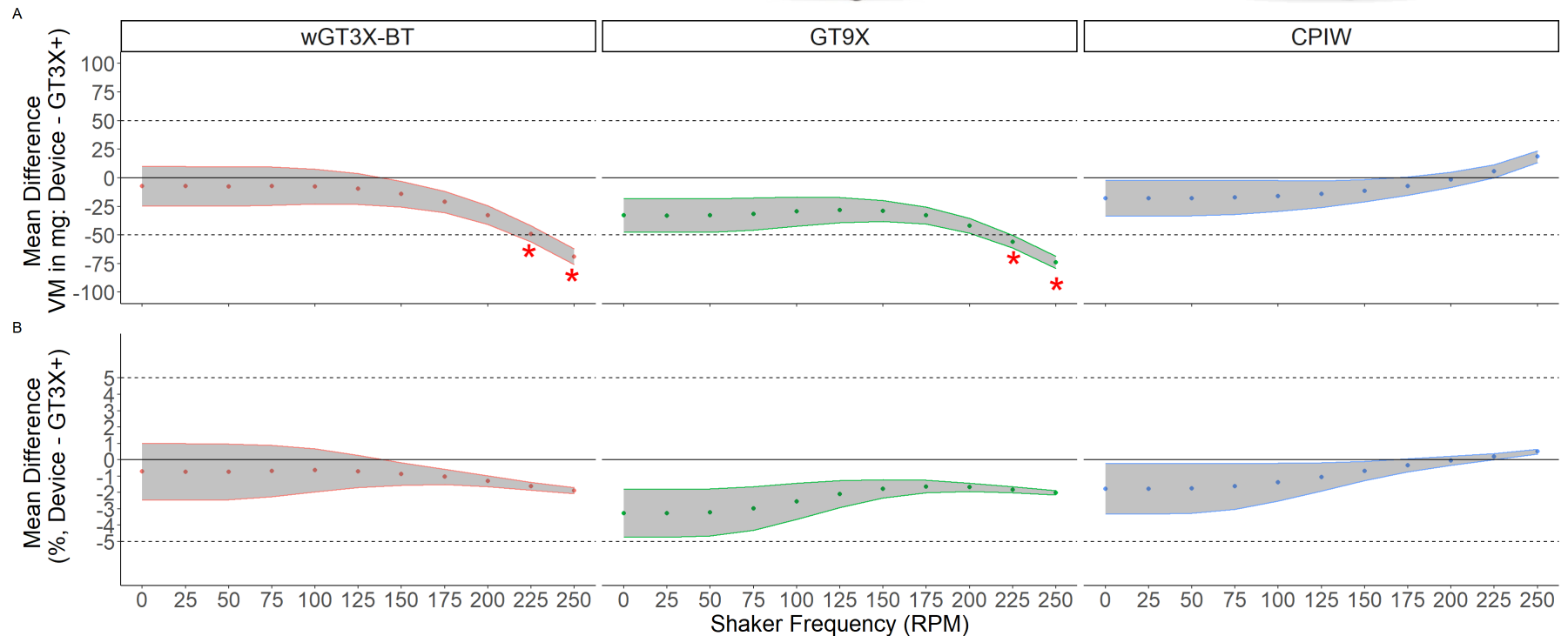
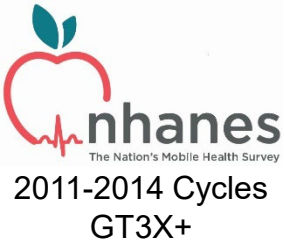
Drift = baseline signal at start minus baseline signal at the end



There are measurable inter-and intra-generational differences in the dynamic response compared to a criterion accelerometer



Current Device Statistical Equivalence as a Percent Difference from the GT3X+ NHANES Devices



Discussion

Strengths

- Inclusion of a NIST-certified criterion accelerometer
- Inclusion of devices used in NHANES
- Reproducible protocol

Limitations

- Small n of devices tested
- Short duration for signal drift evaluation



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Summary and Conclusions

- All generations of ActiGraph accelerometers were within 5% of the criterion NIST-certified 3DM accelerometer.
- At the highest frequencies, the wGT3X-BT and GT9X were significantly lower (> 50 milli-g's) compared to the criterion 3DM.
- Similar to the comparison to the 3DM, all current generation devices were within 5% of the NHANES GT3X+ devices and the wGT3X-BT and GT9X were >50 milli-g's different at the highest frequencies (>200 RPM, ~ 3 g's)



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Thank You!

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Recalibration Procedure Example

