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**IPEN Adolescent Accelerometer Methods Guidelines**

**Updated May 2013**

Below are the various issues, criteria, and definitions that need to be addressed and standardized to the extent possible to achieve comparability in accelerometer data across countries. The Cain et al. (JPAH, 2013) article (<http://sallis.ucsd.edu/Cain_Review.pdf>) addresses many of these issues in more detail.

**IPEN Adolescent Protocol Decisions:**

* Accelerometer model: any Actigraph model will be acceptable (7164, GT1M, GT3X, GT3X+, wGT3X+, ActiTrainer). Although there are differences between the old (7164) and new generation Actigraphs (Rothney 2008, Kozey 2010), several countries have already collected data with the 7164 devices so we’ll have to deal with this. For new countries, we recommend the GT3X+ (512MB) because of the flexibility in data processing and longer battery life. The Coordinating Center (CC) will have some to loan.

**IPEN protocol:** **any ActiGraph model will be acceptable.**

* Low frequency filter: The recommendation is to use the low frequency extension (LFE) with the new models (GT1M, GT3X, GT3X+). This will increase the sensitivity of the devices to detect movement, particularly on the low end of the intensity spectrum, and attenuate the differences found between old and new generation Actigraphs (Mathias 2012; Cain 2013). The San Diego team completed a low frequency comparison study in teens and the results are largely replicating those found in adults (Cain 2013). *Note: unfortunately the LFE makes step counts unusable!*

**IPEN protocol: with new generation Actigraphs, apply the Low Frequency Extension either during initialization (GT1M, GT3X) or during download (GT3X+)**

* Epoch length: For data collection, we recommend countries collect data with the shortest epoch possible, after considering memory and battery limitations of the devices. However, for the pooled dataset we need to match all data to the longest epoch used in any country, which is 30 seconds. PA outcomes from different epochs have been shown not to be comparable in adolescents (Edwardson 2010). Therefore, when transferring data to the CC, we will ask that data are aggregated to 30 seconds before processing. Calibration studies have used different epochs (e.g., Freedson = 60 seconds, Treuth = 30 seconds, Evenson = 15 seconds) but it has become common practice to adjust threshold values to match the epoch. If anyone knows of validity studies on epoch-adjusted cut points, please share them.

**IPEN protocol: use the shortest epoch allowable with your device’s memory and battery and convert to a 30 second epoch when sending data to the CC.**

* Non-wear time definition:there is not a clear recommendation from the literature -- one study supports a 30 minute definition (Rowlands 2009) while another recommends 90 minutes (Choi 2011). The US team recently conducted a ‘sitting study’ to determine how many consecutive 0’s are recorded during bouts of sitting in adolescents. Findings are suggesting that a 60 minute non-wear definition will be the most sensitive to detect sedentary behavior in this age group using either an old generation ActiGraph (7164) or a new generation ActiGraph (GT1M, GT3X, GT3X+) with the LFE activated. Shorter definitions (e.g., 20 minutes) will underestimate sedentary time by as much as 10%.

**IPEN protocol:** **use a 60 minute consecutive zero count non-wear definition.**

* + - Daily wear hours for compliance: The recommendation is 10 hours of wear time for weekdays and 8 hours for weekends to be considered valid wear days for compliance. IPEN Adolescent investigators and others have supported reducing required wear time on weekends (Rowlands, 2007) because typical adolescent weekend schedules may make recording 10 wearing hours difficult. For inclusion in the final dataset we may have to adjust to what is reasonable across countries or use a “70/80” rule within each country. This decision will have to be made when all data are in.

**IPEN protocol: for wearing time compliance, 10 wearing hours during weekdays and 8 wearing hours during the weekend are required.**

* Wear days for compliance**:** The recommendation is to ask participants for 7 days of wearing, including 2 weekend days. This means that there will be 8-9 days from drop off to pick up to allow for 7 full wearing days. Participants should be instructed to wear for an extra day (or more) at the end of the week if they forget to wear or don’t wear for a full day. Regular check-ins are important here so pick-ups can be rescheduled if more wearing time is needed. Enough wear days for compliance (i.e., no rewear requested) should be 5, including 1 weekend day. For inclusion in the final dataset we may have to adjust this to what is reasonable across countries. This is a decision we will have to make when all the data are in and processed.

**IPEN protocol: for wearing time compliance, 5 wearing days including 1 weekend are required. If not enough data are collected the first time, rewears should be requested for the number of days that are missing.**

* Wearing Time and School Schedule Log:Participants should be asked to complete a wearing time log noting days and times the accelerometer is put on and taken off each day. Not only will this help with data processing, it may serve as a reminder to wear the device. ‘Due dates’ may also be included to help with compliance (see <http://ipenproject.org/Adol_materials.html>). Daily school start and end times should also be reported by the participant for each wearing day. This will allow us to create in-school and out-of-school accelerometer measures. To reduce participant burden, school schedule information *could* be collected by the research team concurrent with accelerometer wearing.

**IPEN protocol: ask participants to complete an accelerometer wearing time log, including school start and end times.**

* Tracking: A database should be used to track researcher delivery and pick-up dates (VERY IMPORTANT), device information, data problems, compliance decisions, etc. The CC will provide an Access database for this purpose. This database will also have a data entry form for logs and a form to keep track of recruitment and data collection efforts. Using the Access database is not required; however, if you choose to use your own database, please send a copy to the CC for approval. We need to make sure the variables needed for accelerometer processing are included.

**IPEN protocol: a tracking database to record delivery and pick-up dates and other key information is required. An Access database developed at the CC is available for download.**

* Major holidays and school breaks: Adolescent activity patterns tend to be different during major holidays and school breaks (e.g., summer break). Therefore, we will NOT collect data during these times for IPEN Adolescent. Please plan your data collection to avoid these time periods.

**IPEN protocol: data should NOT be collected during major holidays and school breaks.**

* Cut points: There are a lot of options which provide very different results and it is difficult to make a recommendation at this point. One recent validation study supports Freedson age-specific (4 METs) and Evenson cut points (Trost 2011), and the 100 cpm sedentary threshold seem to be generally well supported (Ridgers 2012, Fisher 2012, Carr 2012, Trost 2011). In the US adolescent data, the relationship between MVPA and neighborhood walkability did not differ substantially between Freedson 3 METS, Freedson 4 METS, and Evenson cut points. The mean PA estimates were substantially different, but the high-low walkability differences in average minutes per day of MVPA were quite similar across the three methods. We may decide to score the data with a few different cut points, or consensus on this issue may emerge over the next few years. This seems like a good topic for discussion and input from all investigators!

**IPEN protocol: open for further discussion and investigation.**

References

Cain KL, Conway TL, Adams MA, Husak LE, Sallis JF. Comparison of older and newer generations of ActiGraph accelerometers with the normal filter and the low frequency extension. International Journal of Behavioral Nutrition and Physical Activity 2013, 10:51. DOI: 10.1186/1479-5868-10-51

Cain KL, Sallis JF, Conway TL, Van Dyck D, Calhoon L. (in press). Using Accelerometers in Youth Physical Activity Studies: A Review of Methods. *Journal of Physical Activity and Health,* 2013, 10, 437-450.

Carr LJ & Mahar MT (2012). Accuracy of Intensity and Inclinometer Output of Three Activity Monitors for Identification of Sedentary Behavior and Light-Intensity Activity. *Journal of Obesity*, Volume 2012, Article ID 460271, 9 pages, doi:10.1155/2012/460271.

Choi, L., Liu, Z., Matthews, C., Buchowski, M. Validation of Accelerometer Wear and Nonwear Time Classification Algorithm. *Med Sci Sports Exerc*.2011*:* 43 (2), 357-364.

Edwardson CL, Gorely T. Epoch Length and Its Effect on Physical Activity Intensity. *Med Sci Sports Exerc*.2010;42(5):928–934.

Fisher C, Yildirim M, Salmon J, Chinapaw MJM. (2012). Comparing Different Accelerometer Cut-Points for Sedentary Time in Children. *Pediatric Exercise Science,* 2012, 24, 220-228

Kozey SL, Staudenmayer JW, Troiano RP, Freedson PS. (2010). Comparison of the Actigraph 7164 and the Actigraph GT1M during self-paced locomotion *Med Sci Sports Exerc*. 42: 971-976.

Mathias Ried-Larsen, Brond JC, Brage S, Hansen BH, Grydeland M, Andersen LB, Moller NC (2012). Mechanical and free living comparisons of four generations of the Actigraph activity monitor. *International Journal of Behavioral Nutrition and Physical Activity, 9: 113.* doi:10.1186/1479-5868-9-113.

McClain JJ, Abraham T, Brusseau T, Tudor-Locke C. Epoch Length and Accelerometer Outputs in Children: Comparison to Direct Observation. *Med Sci Sports Exerc*. 2008; 40(12):2080-2087.

Ridgers ND, Salmon J, Ridley K, O'Connell E, Arundell L, Timperio A. (2012) Agreement between activPAL and ActiGraph for assessing children’s sedentary time. IJBNPA 9: 15.

Rothney MP, Apker G a, Song Y, Chen KY. (2008). Comparing the performance of three generations of ActiGraph accelerometers. *J Appl Physiol*.;105(4):1091-1097.

Rowlands, Esliger, Eady, & Eston (2009). Empirical Evidence to Inform Decisions Regarding Identification of Non-Wear Periods from Accelerometer Habitual Physical Activity. Children And Exercise XXV.

Rowlands AV (2007). Accelerometer assessment of physical activity in children: an update. *Pediatric Exercise Science,* 19(3), 252-266.

Trost SG, Loprinzi PD, Moore R, Pfeiffer KA. (2011) Comparison of accelerometer cut points for predicting activity intensity in youth. *Med Sci Sports Exerc*.43(7):1360-1368.