

# Millennium Cohort Study

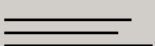
## Physical Activity: Accelerometer dataset

MCS6(2015)

USER GUIDE

March 2018, Edition 1

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# 1 Preface

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The Centre for Longitudinal Studies (CLS) is an ESRC Resource Centre based at the Institute of Education (UCL).

It provides support and facilities for those using the three internationally-renowned birth cohort studies: the National Child Development Study (1958), the 1970 British Cohort Study and the Millennium Cohort Study (2000). CLS conducts research using the birth cohort study data, with a special interest in family life and parenting, family economics, youth life course transitions and basic skills. The views expressed in this work are those of the author(s) and do not necessarily reflect the views of the Economic and Social Research Council. All errors and omissions remain those of the author(s).

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## 2 Millennium Cohort Study

The Millennium Cohort Study (MCS) is a multi-disciplinary research project following the lives of around 19,000 children born in the UK in 2000-01. It is the most recent of Britain's world-renowned national longitudinal birth cohort studies. The study has been tracking the Millennium children through their early childhood years and plans to follow them into adulthood. It collects information on the children's siblings and parents. MCS's field of inquiry covers such diverse topics as parenting; childcare; school choice; child behaviour and cognitive development; child and parental health; parent's employment and education; income and poverty; housing, neighbourhood and residential mobility; and social capital and ethnicity.

The study is core funded by the Economic and Social Research Council (ESRC) and a consortium of Government departments.

To date, there have been six surveys of the cohort: at age nine months, three, five, seven, eleven and fourteen years old.

| Sweep | Fieldwork start | Mean age of Cohort Members |
|-------|-----------------|----------------------------|
| MCS 1 | 2001            | 9 months                   |
| MCS 2 | 2004            | 3 years old                |
| MCS 3 | 2006            | 5 years old                |
| MCS 4 | 2008            | 7 years old                |
| MCS 5 | 2012            | 11 years old               |
| MCS 6 | 2015            | 14 years old               |
| MCS 7 | 2018            | 17 years old               |

Further information about the MCS is available from the CLS website <http://www.cls.ioe.ac.uk/mcs>.

For any queries please contact [help@ukdataservice.ac.uk](mailto:help@ukdataservice.ac.uk)

## 3 Introduction to the Accelerometer of MCS6

### 3.1 Background

This document accompanies the deposit of the Millennium Cohort Study's physical activity data. This data set contains physical activity variables obtained using GENEActiv Original accelerometer devices on Millennium Cohort Study (MCS) cohort members participating in the sixth (age 14) sweep. Detailed information on the Physical Activity module that included a Time Use Diary in parallel to the accelerometer can be found <sup>1</sup> and <sup>2</sup>.

Cohort members who participated in the age 14 sweep of MCS were asked to wear accelerometer devices for two specified full days: one during the week and the other at the weekend <sup>2</sup>. These two days were randomly selected at the time of the interviews. Text messages were sent to the cohort members and their parents to remind them to wear the devices on both selected days. On each of these days, the day begins at 4am and ends at 4am.

### 3.2 Sample/eligibility

The stock of accelerometer devices available to interviewers at the main stage of the fieldwork was estimated to be insufficient to cover all the cohort members in England. A random subsample of 81% of cohort members in England was drawn before fieldwork began and only these participants were asked to wear the devices. All the cohort members in Wales, Scotland and Northern Ireland were asked to take part. The resulting subsample who were eligible to take part in the activity monitoring task was 88% overall.

A total of 11,276 families took part in the Age 14 survey. Of these families, 10,337 cohort members were eligible for the activity monitor task.

- Devices not placed (1,153): Most of these cases were down to the respondent refusing to take part
- Devices not returned (2,448)
- Devices broken or returned with no data (503)

CLS received the binary files for the remaining 6,233 cohort members that had returned the devices with at least some data on them. The data was processed using R and the GGIR package (see below for more information). Of these files:

- No data was processed (1,122): This was mostly cases where the data on the device was not for the specified days
- Some data was processed (307) But less than 10 hours on either day
- One valid day (645)
- Valid days for both days (4,159)

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<sup>1</sup> Centre for Longitudinal Studies (2017) *Millennium Cohort Study Sixth Sweep (MCS6). Age 14 Survey. Activity Monitor, Time Use and Physical Measurement*

<sup>2</sup> Ipsos MORI Social Research Institute (2017) *Millennium Cohort Study Sixth Sweep (MCS6). Technical Report. February 2017, version 2. Prepared for the Centre for Longitudinal Studies, UCL Institute of Education*

## 4 Data extraction

### 4.1 R package GGIR

The data was extracted from the binary files of the devices using the GGIR package <sup>3</sup>. The main developer of this package, Vincent van Hees, extended this package to allow the variables below to be created for the Centre for Longitudinal Studies (CLS). The data in this deposit were produced by using modes 1 and 2 of the GGIR program to process each of the 6,221 files that CLS received from Ipsos Mori. The files only processed the specified days, chosen for each of the participants, and not the rest of the data stored in the binary files. Each row in the data represents one of the two specified days. An overview of the data processing pipeline can be found at <https://github.com/wadpac/millenniumcohort-acc>.

### 4.2 Mean Acceleration: Euclidean Norm Minus One (ENMO)

The metrics available in this dataset to measure physical activity calculate vector magnitude the Euclidean Norm Minus One (or ENMO). For more details about this measure, please see this article <sup>4</sup>. ENMO is a measure of mean acceleration measured in g-units (gravitational units).

### 4.3 Valid hours

GGIR inferred 'valid hours' from the standard deviation and value range of each axis. We classified particular time windows (in moving increments of 15 minutes) as non-valid if the standard deviation of the raw signal from at least two of the three axes was less than 13mg and the value range was less than 50mg. For further details on this procedure, please see this article [#f4]. This data set includes all days with 10 or more valid hours.

| Variable name          | Variable label  |
|------------------------|---|
| FCACC_N_valid_hrs      | Number of hours of valid data (min 10)  |
| FCACC_mean_acc_24h     | Mean acceleration (ENMO - Euclidean Norm Minus One) for the day (24 hours)                              |
| FCACC_mean_acc_1am_6am | Mean acceleration (ENMO - Euclidean Norm Minus One) for the period between 1am and 6am (sleeping hours) |

### 4.4 Most/Least active 5-hour blocs (L5 and M5)

The GGIR package calculates the most active and the least active 5-hour blocks for each day. The hour that these blocks begin is available in the data, as well as the mean acceleration

<sup>3</sup> Vincent van Hees, Zhou Fang, Jing Hua Zhao, Joe Heywood, Evgeny Mirkes, Severine Sabia, Jairo H Migueles (2018) *R package GGIR - Raw Accelerometer Data Analysis* <https://cran.r-project.org/web/packages/GGIR/index.html>

<sup>4</sup> Vincent T. van Hees, Lukas Gorzelniak, Emmanuel Carlos Dean Leon, Martin Eder, Marcelo Pias, Salman Taherian, Ulf Ekelund, Frida Renstrom, Paul W. Franks, Alexander Horsch, Soren Brage (2013) *Separating Movement and Gravity Components in an Acceleration Signal and Implications for the Assessment of Human Daily Physical Activity* PLoS ONE 8(4):e61691. <https://doi.org/10.371/journal.pone.0061691>

(Euclidean Norm Minus One or ENMO) values for these blocks.

| Variable name            | Variable label   |
|--------------------------|--|
| FCACC_M5_hour_start      | Hour of day that most active 5-hour block begins                 |
| FCACC_M5_mean_acc_mg_24h | Mean acceleration in mg for most active 5-hour block of the day  |
| FCACC_L5_hour_start      | Hour of day that least active 5-hour block begins                |
| FCACC_L5_mean_acc_mg_24h | Mean acceleration in mg for least active 5-hour block of the day |

## 4.5 Moderate to Vigorous Physical Activity

GGIR also calculates the mean time spent in moderate-to-vigorous physical activity (MVPA). The time spent in MVPA is calculated as the time spent with acceleration (calculated as ENMO as described above) with a value above 100mg (ENMO). These epochs can be based on epochs of five seconds, one minute or five minutes. See this article <sup>5</sup> for more information on MVPA. These variables contain the total number of minutes that the accelerometer recorded the Cohort Member in an activity with mean acceleration (ENMO) higher than 100mg for at least five seconds, one minute or five minutes within that day.

| Variable name                   | Variable label  |
|---------------------------------|---|
| FCACC_MVPA_mean_acc_e5sec_100mg | Total minutes in MVPA: 5sec epochs where ENMO > 100mg |
| FCACC_MVPA_mean_acc_e1min_100mg | Total minutes in MVPA: 1min epochs where ENMO > 100mg |
| FCACC_MVPA_mean_acc_e5min_100mg | Total minutes in MVPA: 5min epochs where ENMO > 100mg |

## 4.6 Bouts of 80% moderate-to-vigorous activity

The final set of variables give information on the time spent in bouts where the cohort member has spent over 80% of the time in the moderate-to-vigorous level of activity for at least the duration as indicated (as defined above).

| Variable name                   | Variable label  |
|---------------------------------|---|
| FCACC_MVPA_E5S_B1M80_T100_ENMO  | Mins in mod/vig: 5sec epoch, 80% bout criteria 100 ENMO 1min  |
| FCACC_MVPA_E5S_B5M80_T100_ENMO  | Mins in mod/vig: 5sec epoch, 80% bout criteria 100 ENMO 5min  |
| FCACC_MVPA_E5S_B10M80_T100_ENMO | Mins in mod/vig: 5sec epoch, 80% bout criteria 100 ENMO 10min |

<sup>5</sup> da Silva IC, VT van Hees, VV Ramires, AG Knuth, RM Bielemann, S Brage, PC Hallal (2014) *Physical activity levels in three Brazilian birth cohorts as assessed with raw triaxial wrist accelerometry* International Journal of Epidemiology. 43(6): 1959-68 <https://www.ncbi.nlm.nih.gov/pubmed/25361583>

## 5 Further information

Further information on MCS is available from the CLS website (<http://www.cls.ioe.ac.uk/mcs>). CLS can also be contacted at the following email address: [clsfeedback@ioe.ac.uk](mailto:clsfeedback@ioe.ac.uk)

The author would like to thank Vincent van Hees for his help on documenting the data.

### 5.1 Acknowledgement

For this report, the author(s) used *SPHINX - Python Documentation Generator* by Georg Brandl and the Sphinx team, version 1.3.1 <http://sphinx-doc.org> and in addition to the packages embedded by Sphinx, the report utilised the following LaTeX packages:

*graphicx*, *afterpage* and *color* by David Carlisle and the LaTeX Team  
<http://www.ctan.org/pkg/graphicx> , <http://www.ctan.org/pkg/afterpage> ,  
<http://www.ctan.org/pkg/color>

*tcolorbox* by Thomas F. Sturm <http://www.ctan.org/pkg/tcolorbox>

*xcolor* by Uwe Kern <http://www.ctan.org/pkg/xcolor>

*sectsty* by Rowland McDonnell <http://www.ctan.org/pkg/sectsty>

*geometry* by Hideo Umeki <http://www.ctan.org/pkg/geometry>

*tikz* by Till Tantau and Christian Feuers?nger <http://www.ctan.org/pkg/pgf>

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