Technical report on the enhancement of Millennium Cohort Study data with accelerometer-derived measures of physical activity and sedentary behaviour in seven year olds

Authors
Lucy Griffiths[1], Carly Rich[1], Marco Geraci[1], Francesco Sera[1], Mario Cortina-Borja[1], Theodora Pouliou[1], Lucinda Platt[2], Jon Johnson[2] and Carol Dezateux[1]

Affiliation
[1] MRC Centre of Epidemiology for Child Health, UCL Institute of Child Health, London, UK.
[2] Centre for Longitudinal Studies, Institute of Education, 20 Bedford Way, London, UK.

Date of production
January 2013

Contents

1 ACKNOWLEDGEMENTS

We gratefully acknowledge the contributions of the following:

- Jane Ahn, Richard Pulsford and Florence-Emilie Kinnafick [University College London Institute of Child Health (UCL ICH)] who contributed to the fieldwork, data collection and data processing
- Lisa Calderwood (Institute of Education) who contributed to survey management and fieldwork.
- Anthony Thomas and Tito Castillo (UCL ICH) who contributed to linking the survey and physical activity data and to the preparation of datasets for analysis.
- The participating Millennium Cohort Study (MCS) children and families.
- Children and teachers from Lordship Lane Primary School (London) for their participation in the calibration study.

2 FUNDING SOURCES

The Millennium Cohort Study is funded by grants to the Centre for Longitudinal Studies at the Institute of Education from the Economic and Social Research Council and a consortium of government departments. The study of accelerometer-derived measures of physical activity and their determinants was funded by the Wellcome Trust (grant title: "Determinants of physical activity in the UK Millennium Cohort Study"; grant reference 084686/Z/08/A; PI: Carol Dezateux). This work was undertaken at the MRC Centre of Epidemiology for Child Health within the Centre for Paediatric Epidemiology and Biostatistics at UCL ICH, which receives funding from the UK Medical Research Council (grant reference G0400546). The UCL Institute of Child Health receives a proportion of funding from the Department of Health's National Institute for Health Research Biomedical Research Centres funding scheme. The MCS accelerometer calibration study was funded by both the Wellcome Trust grant detailed above and the International Centre for Child Studies (PI: Lucy Griffiths).

3 INTRODUCTION

The Millennium Cohort Study (MCS) is a multidisciplinary survey of over 19,000 children born between 1 September 2000 and 31 August 2001 in England and Wales, and between 22 November 2000 and 11 January 2002 in Scotland and Northern Ireland who are followed over time.[1] A disproportionately stratified clustered sampling design was used to over-represent children living in Wales, Scotland and Northern Ireland, disadvantaged areas and areas with high proportions of ethnic minority groups. The first survey took place when the children were aged around 9 months old,[2] and subsequent surveys have taken place when the children were aged around 3 years, 5 years and 7 years old. The Age 11 survey is currently in the field and subsequent data collection is planned for ages 14 and 17. The survey collects information from parents covering a range of domains including socio-economic circumstances, parenting, child's activities and behaviour, child and parental health, neighbourhood, relationships, childcare, and child's education and schooling. Since the Age 3 survey direct anthropometric measures and cognitive assessments have also been

carried out with the cohort children. From the Age 7 survey, the cohort children have completed their own self-completion questionnaire. For further information on the MCS see: www.cls.ioe.ac.uk/mcs.

Levels and patterns of physical activity (PA) and sedentary behaviour (SB) among the MCS children at around age 7 were assessed using accelerometers issued to consenting children participating in the Age 7 survey. These measurements were obtained primarily to understand the determinants and consequences of children's PA and SB in the context of the longitudinal biological, social, psychological, behavioural and environmental information collected earlier and to be collected subsequently at MCS home visits.

4 ACCELEROMETER STUDY DEVELOPMENT

A pilot study and dress rehearsal of the accelerometer protocol were completed during April 2007 and August 2007, respectively. The reports from these pilot studies are provided as Appendix A and Appendix B. As a result of the two pilots a number of improvements were made to the protocols and the administration of the accelerometer study, including adjustments to the time sheet and to the communication materials.

5 FIELDWORK PROCEDURES

5.1 Consent

The interviewers invited all children surveyed at age 7 years to wear an accelerometer or 'activity monitor'. Parents or guardians who agreed to their child's participation were asked to provide written consent. The interviewers demonstrated how the accelerometer should be worn, its correct positioning using a 'dummy' monitor and how and when they should receive, and return, their child's activity monitor.

5.2 Accelerometer fieldwork protocol

Activity was measured using the Actigraph GT1M uni-axial accelerometer (Actigraph, Pensacola, Florida); a small (38 x 37 x 18 mm) and lightweight (27g) device. The Actigraph has been extensively validated in samples of children and has compared favourably against observational techniques,[3] heart rate telemetry,[4] indirect calorimetry,[5] and energy expenditure measured using doubly labelled water.[6] It is the most commonly used accelerometer for PA measurement in children and has been shown to be robust when used in large-scale studies in children including the Avon Longitudinal Study of Parents and Children,[7] the National Health and Nutrition Examination Survey,[8] and the European Youth Heart Study.[9]

Accelerometers were initialized using ActiLife Lifestyle Monitoring System software version 3.2.11 (Actigraph, Pensacola, Florida). The following parameters were selected to initialize all accelerometers:

- Activity (default mode): enabled (so that count data were collected)
- Sampling epoch: 15 seconds (data were collected every 15 seconds as this was the shortest possible epoch (sampling period) that was allowed given the number of days of wear required)
- Step count: enabled (step and count data were collected to create additional research opportunities)
- Flash LED: disabled (to conserve the battery life)
- Start date: two days after posting to the families (because children were asked to start wearing the monitor the day after they received it)
- Start time: 05:00 (as this was considered the earliest time that children would start wearing their monitor in the morning)
- Subject information name: Unique child ID (to identify which monitor corresponded to which cohort child)

Consenting families were sent a physical activity monitoring pack that contained the following:

1. Parent cover letter (Appendix C)
2. Information leaflet (Appendix D)
3. Programmed accelerometer (attached to an elastic belt)
4. Time sheet (Appendix E)
5. Letter for the child's class teacher to explain why the child was wearing the monitor and how it should be worn in school (Appendix F)
6. Pre-paid envelope

If requested at the home interview, families received translated versions of the parent cover letter, information leaflet and timesheet; these were available in 11 languages (Welsh, Turkish, Hindu, Punjabi, Tamil, Arabic, Kurdish, Bengali, Gujarati, Somali, and Urdu).

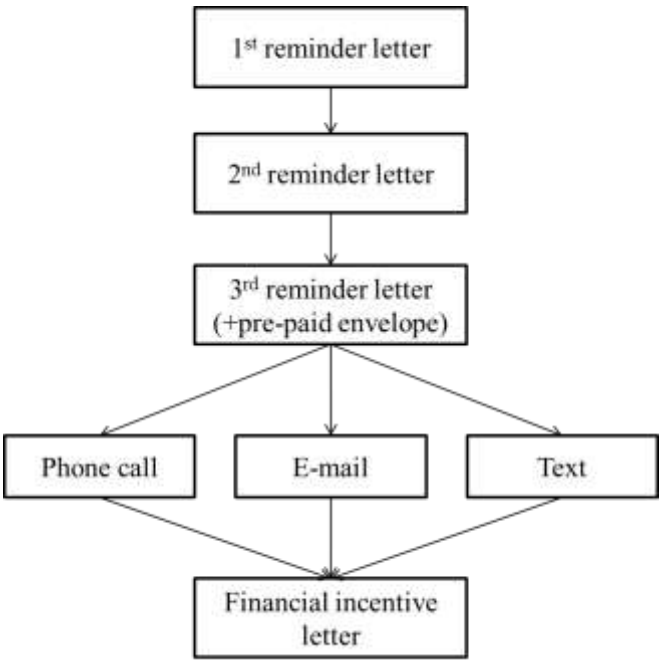
Accelerometers and corresponding documents were posted to families via Royal Mail first class delivery. They were posted in order of interview date, unless families had specifically stated at the interview that a date was not convenient. Distribution occurred between May 2008 and August 2009.

The MCS children were asked to start wearing their accelerometer the morning after they received it on their right hip for seven consecutive days during all waking hours, but to remove it during aquatic activities as the accelerometers are not waterproof. Children received either a 26" or 32" sized belt based on their waist size, which was measured at the home interview. Families were asked to complete the timesheet for all days the accelerometer was worn, to cover duration of wear and periods when not worn, as well as whether the week was a 'typical' one. Families were asked to return their accelerometer (attached to the belt) and the completed timesheet as soon as possible after the monitoring period in a pre-paid envelope (Royal Mail second class delivery).

Three postal reminder letters (Appendix G) were sent at weekly intervals to families who had not returned their accelerometer by three weeks after issue (Figure 1). An additional pre-paid envelope was provided with the third reminder letter. Further reminders were

issued by text, e-mail or phone call depending on the contact details held. A final reminder letter was sent to all families that had received three reminder letters and either a text, e-mail or phone call and still not returned their accelerometer. The final reminder letter offered the family a £10 gift voucher for the return of their accelerometer.

Figure 1: Order of reminders issued to the MCS families

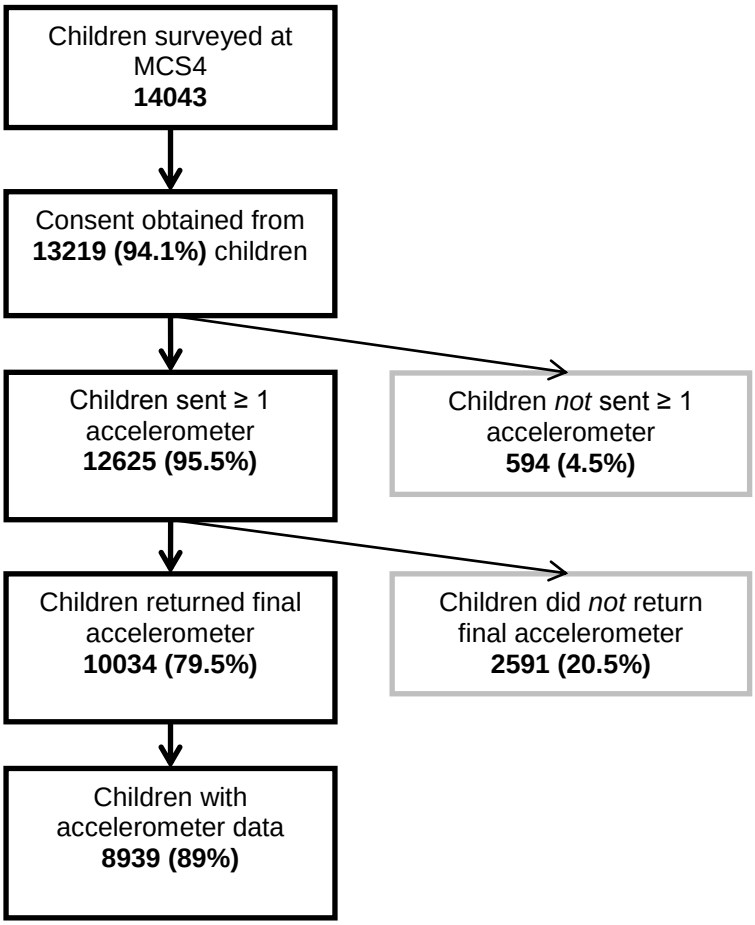


All families that returned their child's accelerometer (unless they had explicitly stated that the accelerometer had not been worn) were sent a feedback certificate pack containing a certificate (Appendix H), a set of physical activity graphs for their child (Appendix I) and a letter explaining the latter and thanking the children for their involvement in the study (Appendix J).

6 MAIN STAGE ACCELEROMETER STUDY RESPONSE RATES

A total of 14,043 MCS children (13,681 singletons) took part in the MCS4 (Age 7) survey. Parents of 13,219 (94.1%) children (12,872 singletons) gave consent for their child to participate in the accelerometer study (Figure 2).

Figure 2: Summary of the MCS4 accelerometer study fieldwork

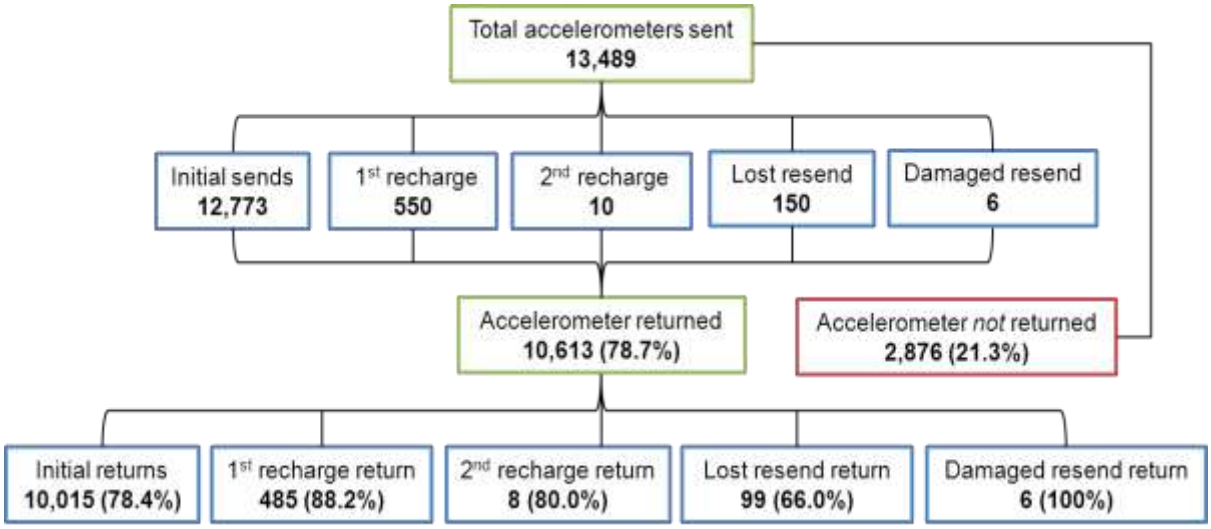


Accelerometers were sent to 12,625 (95.5%) consenting children (12,303 singletons); 29 (0.2%) children were not sent an accelerometer because one could not be sent during the requested time period, and details of the remaining 565 (4.5%) children who were not sent an accelerometer were not transmitted to the ICH fieldwork team. A total of 13,489 (Figure 3) accelerometers were sent to MCS families, of which 10,613 (78.7%) were returned; 716 extra accelerometers were sent to consenting children because the initial accelerometers were either lost (*n*=150), damaged (*n*=6), or needed recharging (*n*=550); and 148 accelerometers were sent to non-consenting children because the ICH received their details in error from the fieldwork agency. (This incident was reported to the Research Ethics Committee and any accelerometer data returned from these children were not used.)

Overall, 15,643 reminders letters were sent to the MCS families to encourage return of the accelerometers, which resulted in 2,868 accelerometers being returned. A total of 5,025 phone calls, texts, e-mails, or final incentive letters were sent which resulted in 635 accelerometers being returned.

Data were obtained from 8939 (89%) consenting children and reliable data (≥2 days lasting ≥ 10 hours per day as discussed in section 9.4) from 6675 (50%).

Figure 3: Accelerometers sent and returned by the MCS4 children (total n = 13,489)



7 SEASONAL ACCELEROMETER STUDY

7.1 Background

An additional study investigating seasonal variation in levels and patterns of PA and SB was carried out in a sample of MCS children who had participated in the main accelerometer study during winter 2008/09. Repeat accelerometer measurements were obtained from these children during each of the three subsequent seasons during a single calendar year. The seasonal accelerometer distribution periods were defined as: winter (November 2008 to January 2009) (PA1); spring (February to April 2009) (PA2); summer (May to July 2009) (PA3); and autumn (August to October 2009) (PA4). Accelerometer measurements were also sent out in an additional winter season (November 2009 to January 2010) (PA5) in order to investigate any longitudinal variation in PA and SB between winter 2008/9 and winter 2009/10.

7.2 Recruitment and Consent

All children who wore their accelerometer for at least two days in the MCS main stage accelerometer study during winter 2008/09 (PA1) were eligible and they and their parents were invited to participate in the seasonal study. Parents and children were sent a letter (Appendix K) inviting their child to wear an accelerometer on three further occasions (PA2-4) and were offered a £5 gift voucher for each season (£15 total) that their child wore and returned the accelerometer. Parents willing for their child to participate in the seasonal study were asked to sign and return a consent form (Appendix L). The additional winter period of monitoring (PA5) required an additional invitation letter for parents (Appendix M) and consent form (Appendix L).

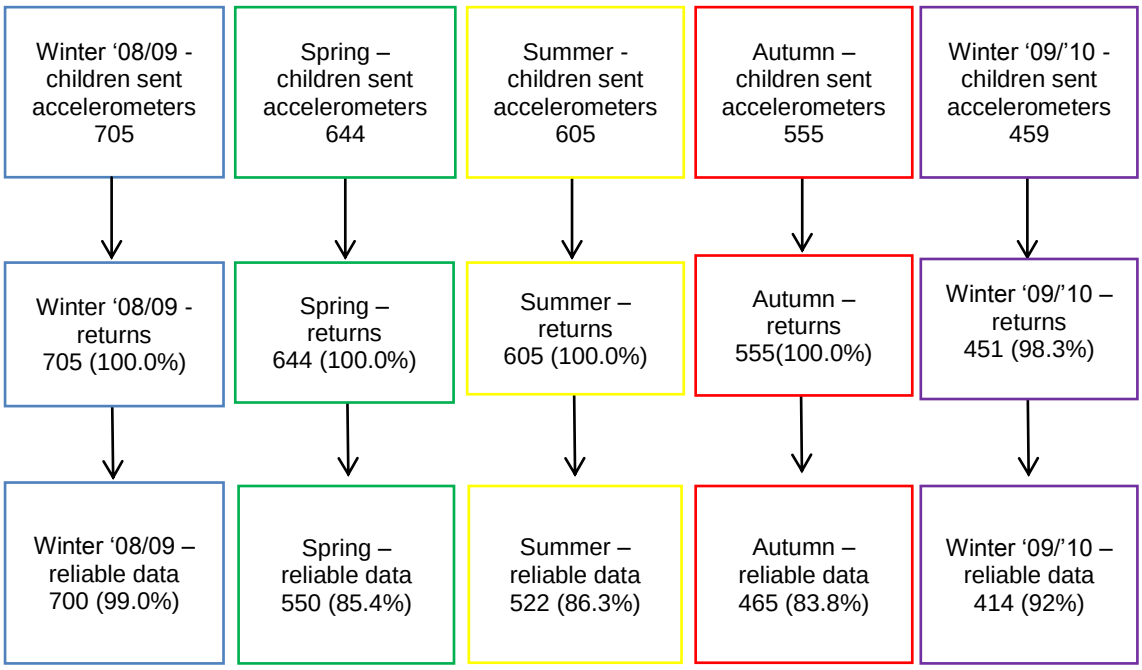
7.3 Seasonal accelerometer study fieldwork protocol

This study adopted the same fieldwork protocol as the main accelerometer study.

8 SEASONAL ACCELEROMETER STUDY RESPONSE RATES

Overall, a total of 705 out of 1,289 (55.0%) invited parents gave consent for their child to participate in the MCS4 seasonal accelerometer study. Figure 4 shows the number of children sent an accelerometer in each season, the numbers returned and those who returned reliable data. If an accelerometer was not returned, or the family opted-out of the study, they were not sent an accelerometer for the next season. Returns reach 100% at each seasonal sweep, but there were around 7 to 9 per cent of opt outs at each sweep, reducing the number issued each time.

Figure 4: Children who were sent and returned an accelerometer, and reliable data acquired in the MCS4 seasonal accelerometer study



9 ACCELEROMETER DATA PROCESSING

9.1 Accelerometer data processing software

Data were downloaded from all returned accelerometers, unless parents had explicitly stated that they had not been worn, using the ActiLife Lifestyle Monitoring System software version 3.2.1.

After consideration of the available data processing software, researchers at the ICH (led by

Dr Marco Geraci) decided to use customised processing software[10] based on algorithms written in R language.[11] This processing software was favoured over others due to the speed of cleaning, processing and deriving outcome variables for large volumes of accelerometer data files.

9.2 Accelerometer data processing

A series of cleaning and processing procedures were applied to the raw accelerometer data. The research team at ICH developed a standard operating procedure (SOP) specifying a set of processing criteria.[12] The stages of the SOP were as follows:

9.2.1 Stage one

Stage one involved basic data cleaning and metadata consistency checks.

9.2.2 Stage two

Stage two included time stamping, wear-time classification and exclusion of low and high end days. Non-wear was defined as any time period of consecutive zero-counts for a minimum of 20 minutes.[13] A substantial number of monitors were worn after the programmed start date as a consequence of the postal distribution of the accelerometers; and in many cases the accelerometer continued to record data after the child had finished wearing the monitor (during posting). As a result, low and high end days needed to be excluded from analyses. The statistical research team at the ICH created a programme using algorithms developed in the R software environment (led by Francesco Sera and Dr Mario Cortina-Borja) that detected the observational period for each accelerometer file. The start and end dates were detected based on a specified amount of daily waking time (defined as between 07:00 and 21:59) required to be different from zero counts: the threshold for the observational period was set to at least 150 minutes per day.

9.2.3 Stage three

Stage three included the removal of extreme high count values, defining sedentary behaviour, and light, moderate and vigorous activity, and the creation of summary outcome variables.

Extreme count values

Accelerometers are designed to measure plausible human activity, however, extreme high count values can occur, possibly as a result of accelerometer malfunction, or participant misuse of the accelerometer such as vigorous shaking.[14] A study was conducted using the MCS accelerometer data to propose a threshold to define extreme high count values in the Actigraph GT1M.[15] Based on the results of this study, periods of time when counts per minute were 11,715 or greater were regarded as extreme and excluded.

Defining activity intensities and sedentary behaviour

The primary outcome measure of an accelerometer is body acceleration, expressed as a count value. A ‘count’ is biologically meaningless without calibration.[16] Thresholds used to define activity intensities and sedentary behaviour are derived from studies that calibrate accelerometer counts with an objective ‘gold standard’ measure of energy expenditure such as oxygen consumption over a range of exercise intensities.

The ICH research team carried out a calibration study in seven year old children specifically to inform the thresholds to be used to define intensities of activity in the accelerometer data collected from MCS participants. This calibration study was funded by the International Centre for Child Studies and the Wellcome Trust. Previous calibration studies had used older Actigraph models or been carried out in different age groups of children, and the suggested thresholds were inconsistent.[17] Based on this new calibration study, threshold values for the MCS accelerometer counts/minute were defined as <100 for sedentary behaviour, and ≤2240, ≤3840, and ≥3841 for light, moderate and vigorous physical activity, respectively.[18] These thresholds were used to derive the physical activity summary variables.

9.3 Derived accelerometer variables

The variables that were generated by the data processing software are summarised in Table 1. With exception of the two weight variables, these variables were all created for both the main stage accelerometer study *and* for the seasonal study.

This daily dataset has a long data structure.

Table 1: Accelerometer variables

Variable name	**Variable label**	**Variable type**
MCSID	MCS Research ID	String
DCNUM00	Cohort member number	Byte
TDATE	Accelerometer stamping date (first day with at least 150 minutes of data)	String
FILEID	Dat file name	String
DUPLICATE	Dummy variable to flag files to be excluded as duplicates (1 = to be excluded)	Byte
EMPTY	Dummy variable to flag files with no data	Byte
TIME	Greenwich Mean Time/British Summer Time	String
DAYWEEK	Abbreviated weekday name	String
WKDAY	Dummy variable for weekday (1 = yes)	Byte
WEDAY	Dummy variable for weekend day (1 = yes)	Byte
MONTH	Abbreviated month name	String
SEASON	Calendar season based on solstices and equinoxes for corresponding calendar year	String
TOTTIMEDAY	Total valid time (mins) in a day given by the sum of TOTPATY0-TOTPATY3	Float
TOTTIMEDAYE	As TOTTIMEDAY, plus TOTPATY99	Float
TOTPATY0	Total time (mins) spent in sedentary behaviour	Float
TOTPATY1	Total time (mins) spent in light activity	Float
TOTPATY2	Total time (mins) spent in moderate activity	Float
TOTPATY3	Total time (mins) spent in vigorous activity	Float
TOTPATY99	Total time (mins) recorded as extreme high count values	Float
NWTIME	Non-wear time (mins)	Float

TOTCOUNT	Total sum of counts	Long
TOTSTEPS	Total sum of steps	Long
MBSTATUS	Multiple birth status	String
ISVALIDDAY	Dummy variable for valid day (at least 10 hours recording)(1 = yes)	Byte
RELIABLE	Reliable (>=2 days, >=10 hours) accelerometer data acquired (1 = yes)	Byte
DOVWT1PA*	S4:overall weight accelerometer study single country analyses	Float
DOVWT2PA*	S4:overall weight accelerometer study whole UK analyses	Float

Value labels of categorical variables are not provided as all variables are discrete, date or continuous format.
*Defined as -1 for 'non-reliable' children (see below).

9.4 Derived accelerometer variables for children with 'reliable data'

Reliable accelerometer data
Not all MCS children wore their accelerometer for the entire requested time period (seven consecutive days). As a result, criteria were defined to determine whether children had worn the accelerometer for a sufficient period to be included in analyses. A study was conducted using MCS accelerometer data to propose a minimum wear criterion.[19] Based on the results of this study, children with a wear time period of at least two days, lasting at least 10 hours per day, were considered to provide reliable data. This minimum daily wear time has also been used in other large accelerometer studies in children such as the Avon Longitudinal Study of Parents and Children, and the Child Heart Health Study in England.

For the 6675 children classified as having 'reliable data' (>=2 days, >=10 hours) summary physical activity variables have been derived. These are summarised in Table 2. These variables were created for the main stage accelerometer study and for the seasonal study.

Table 2: Summary variables

Variable name	**Variable label**	**Variable type**
MCSID	MCS Research ID	String
DCNUM00	Cohort member number	Byte
MBSTATUS	Mulitple birth status	String
N_DAYS_V	Total number of valid* days	Int
N_WEDAYS_V	Total number of valid weekend days	Int
N_WKDAYS_V	Total number of valid week days	Int
TREGTIME_V	Total time worn (mins) across all valid days	Float
TOT_NW_V	Total non-wear time across all valid days (mins)	Float
TOTCOUNT_V	Total sum of counts across all valid days	Float
MNCOUNT_V	Daily mean counts across all valid days	Float
TOTPATY99_V	Total time (mins) recorded as extreme high count values across all valid days	Float
TOTPATY0_V	Total time (mins) spent in sedentary behaviour across all valid days	Float

MNPATY0_V	Mean time (mins) spent in sedentary behaviour across all valid days	Float
TOTPATY1_V	Total time (mins) spent in light activity across all valid days	Float
MNPATY1_V	Mean time (mins) spent in light activity across all valid days	Float
TOTPATY2_V	Total time (mins) spent in moderate activity across all valid days	Float
MNPATY2_V	Mean time (mins) spent in moderate activity across all valid days	Float
TOTPATY3_V	Total time (mins) spent in vigorous activity across all valid days	Float
MNPATY3_V	Mean time (mins) spent in vigorous activity across all valid days	Float
TOTSTEPS_V	Total sum of steps across all valid days	Float
MNSTEPS_V	Daily mean steps across all valid days	Float
CPMR_V	Mean counts per minute (valid days)	Float
DOVWT1PA	S4:overall weight accelerometer study single country analyses	Float
DOVWT2PA	S4:overall weight accelerometer study whole UK analyses	Float

*Days with at least 10 hours recorded time.

Adjustment for total valid time

Total valid time (TOTTIMEDAY) is not constant across days. As a result, the total amount of counts, steps and wearing time for each child will depend on how long the accelerometer was worn. These measures should therefore be standardized. One approach is to consider relative measures (e.g., proportions). If otherwise the focus is on absolute measures of activity, a possible approach is to introduce the notion of a standard day with equal duration for all children. Here, we provide guidance on how to adjust MNPATY0_V, MNPATY1_V, MNPATY2_V, and MNPATY3_V for total valid time.

Let y_{ij} be the number of valid minutes for child *i* and day *j* with reliable data. Let also $y_{ij,k}$ be the number of valid minutes classified at intensity *k* (sedentary, light, moderate, and vigorous). We define a standard day of duration $\bar{y} = \sum_{i,j} y_{ij}/n$, where $n = \sum_i n_i$ and n_i is the number of valid days for child *i* (N_DAYS_V).

Define the weights $w_{ij} = \left(\frac{\bar{y}}{y_{ij}}\right)^{\alpha}$. The parameter α can be determined, for example, as the value such that $\text{cor}(x_{i,k}, T_i)$, $x_{i,k} = \sum_j y_{ij,k} w_{ij}$ and $T_i = \sum_j y_{ij}$, is as small as possible in magnitude. The exponent α, therefore, is calculated from within the data. The newly derived summary variables will be calculated as $x_{i,k}/n_i$ (labelled MNPATY0_W, MNPATY1_W, MNPATY2_W, MNPATY3_W). For the sake of simplicity, suppose $\alpha = 1$. In other words, $x_{i,k} = \sum_j \frac{y_{ij,k}}{y_{ij}} \bar{y} = \sum_j \pi_{ij,k} \bar{y}$ is the total number of valid minutes at intensity *k* that child *i* would spend during a standard day of duration $\bar{y}$, proportional to the observed ratio $\pi_{ij,k} = \frac{y_{ij,k}}{y_{ij}}$.

The Stata syntax to adjust for total valid time is provided (Appendix Q), with parameters $\bar{y}$ and α specific to the main stage accelerometer study only.

9.5 Study response variables

Derived study response variables for the main stage accelerometer study and for the

seasonal accelerometer study are shown in Table 3.

Table 3: Study response variables

Variable name	Variable label	Variable type	Value labels of categorical variables
MCSID	MCS Research ID	String	
DCNUM00	Cohort member number	Byte	
CONSENT	MCS4 Accelerometer study consent	Double	No Yes
SENT	MCS4 Accelerometer sent	Double	No Yes Yes, but sent in error
RETURNED	MCS4 Accelerometer returned	Double	No Yes Yes, but sent in error
RELIABLE	Reliable* accelerometer data acquired	Byte	No Yes
TSHEET	Timesheet received	Double	Not applicable No Yes

*>=2 days, >=10 hours.

9.6 Adjustment for non-response and non-compliance

The issue of missing data due to unit non-response and non-compliance to the study protocol was addressed.[20] Probability weights at the child-level were predicted using a binomial logistic regression model. The predictors in the model included all variables used by Plewis[21] to generate family-specific non-response weights for the first and second waves of the MCS. In addition, child-level predictors (sex and obesity status) were included in our model. The estimation accounted for the MCS survey-design features. Correlation among siblings from multiple births was accounted for by using a robust variance estimator.[22] Since predictors were incomplete for a number of children, multiple imputation was used by chained equations to obtain complete datasets. Finally, predicted inverse probabilities were multiplied by the MCS4 non-response adjusted sampling weights to give overall weights. These were rescaled to the number of families interviewed in the fourth sweep. Weights were produced for country-specific as well as for UK-wide analyses.

NOTE: These weights have been derived for use with the main accelerometer data collection dataset. They are not appropriate for use with the seasonal data.

10 ETHICS

Research ethics approval for the MCS4 main stage and seasonal accelerometer studies was granted by the Northern and Yorkshire Research Ethics Committee (REC number: 07/MRE03/32) and the UCL Research Ethics Committee (REC number: 1325/ 002)

respectively. The MCS accelerometer calibration study was approved by the University College London Research Ethics Committee (REC number: 1325/001).

11 ACTIVITY LEVELS

Median and interquartile ranges of time spent in sedentary, light, moderate and vigorous physical activity of the 6497 singletons who participated in the main stage accelerometer study are provided below (Table 4).

Table 4: Weighted summary statistics* (median, interquartile range) for sedentary behaviour and different intensities of activity for the 6497 singleton cohort members with reliable data

	Sedentary (hours/day)	**Light (min/day)**	**Moderate (min/day)**	**Vigorous (min/day)**
All children	6.4 5.8, 7.1	280 253.2, 308.2	41.8 33.5, 51.3	17.9 12.5, 25.6

*Using summary measures based on valid days

12 RAW ACCELEROMETER DAT FILES

All individual raw accelerometer files (".dat" files (ASCII)) from the main accelerometer study and the seasonal study have also been prepared for deposit with the UK Data Service. These data will be made available through the UKDS under appropriate access conditions for researchers wishing to analyse the raw files directly.

13 SUPPLEMENTARY DATA COLLECTED

Parents or guardians of children participating in the main accelerometer study and the seasonal study were asked to complete additional documentation as outlined in Table 5 and described below in sections 13.1 to 13.3.

Table 5: Additional information collected in the MCS4 accelerometer studies

PA1	Winter 2008-9	Timesheets
PA2	Spring 2009	Timesheets; Additional timesheet questions; Physical activity questions
PA3	Summer 2009	Timesheets; Additional timesheet questions; Physical activity questions
PA4	Autumn 2009	Timesheets; Additional timesheet questions; Physical activity questions; Pediatric Quality of Life Inventory
PA5	Winter 2009-10	Timesheets; Additional timesheet questions

13.1 Physical activity timesheet data

For the main and seasonal accelerometer study, parents were asked to complete a physical activity timesheet for the week during which their child wore the activity monitor (Appendix E). This enabled them to record:

1. Dates that the monitor was worn
2. Times that the monitor was put on in the morning and taken off at night
3. Any periods spent swimming or cycling
4. Any other periods when the monitor was not worn
5. Whether the week the monitor was worn was a typical week in terms of their child's activity levels

This additional information is helpful as limitations of the Actigraph uniaxial accelerometer used in the MCS include inability to accurately capture activities that include vertical movement of the trunk, like cycling, as well as inability to record aquatic activities, such as swimming as the accelerometers are not waterproof. This supplementary timesheet information can therefore be used in conjunction with the objective measurements to obtain a more complete picture of activity levels. These data have not been used in the processing stages of the accelerometer data.

Processing of the data from the timesheets was undertaken by Abacus Data Entry Ltd. during July / August 2012. This involved scanning of the documentation to PDF format and indexing each document (timesheets and data described below in section 13.1) and extraction of the data. All documentation was then returned to the MCS data management team at the Centre for Longitudinal Studies, along with the data for checking.

Table 6 displays the data collected using the timesheets. These variables were all created for the main stage accelerometer study and for the seasonal accelerometer study.

Table 6: Timesheet data

Variable name	**Variable label**	**Variable type**
MCSID	MCS Research ID	String
DCNUM00	Cohort Member Number	Double
D1_DATE	Day 1 (date for day 1 of wear)	Long
D2_DATE	Day 2 (date for day 2 of wear)	Long
D3_DATE	Day 3 (date for day 3 of wear)	Long
D4_DATE	Day 4 (date for day 4 of wear)	Long
D5_DATE	Day 5 (date for day 5 of wear)	Long
D6_DATE	Day 6 (date for day 6 of wear)	Long
D7_DATE	Day 7 (date for day 7 of wear)	Long
D1_AM	Monitor put on in morning Day 1 (time: 24 hour clock)	Double

D2_AM	Monitor put on in morning Day 2 (time: 24 hour clock)	Double
D3_AM	Monitor put on in morning Day 3 (time: 24 hour clock)	Double
D4_AM	Monitor put on in morning Day 4 (time: 24 hour clock)	Double
D5_AM	Monitor put on in morning Day 5 (time: 24 hour clock)	Double
D6_AM	Monitor put on in morning Day 6 (time: 24 hour clock)	Double
D7_AM	Monitor put on in morning Day 7 (time: 24 hour clock)	Double
D1_PM	Monitor taken off in evening Day 1 (time: 24 hour clock)	Double
D2_PM	Monitor taken off in evening Day 2 (time: 24 hour clock)	Double
D3_PM	Monitor taken off in evening Day 3 (time: 24 hour clock)	Double
D4_PM	Monitor taken off in evening Day 4 (time: 24 hour clock)	Double
D5_PM	Monitor taken off in evening Day 5 (time: 24 hour clock)	Double
D6_PM	Monitor taken off in evening Day 6 (time: 24 hour clock)	Double
D7_PM	Monitor taken off in evening Day 7 (time: 24 hour clock)	Double
D1_SWIM	Minutes spent swimming Day 1	Double
D2_SWIM	Minutes spent swimming Day 2	Double
D3_SWIM	Minutes spent swimming Day 3	Double
D4_SWIM	Minutes spent swimming Day 4	Double
D5_SWIM	Minutes spent swimming Day 5	Double
D6_SWIM	Minutes spent swimming Day 6	Double
D7_SWIM	Minutes spent swimming Day 7	Double
D1_CYCLE	Minutes spent cycling Day 1	Double
D2_CYCLE	Minutes spent cycling Day 2	Double
D3_CYCLE	Minutes spent cycling Day 3	Double
D4_CYCLE	Minutes spent cycling Day 4	Double
D5_CYCLE	Minutes spent cycling Day 5	Double
D6_CYCLE	Minutes spent cycling Day 6	Double
D7_CYCLE	Minutes spent cycling Day 7	Double
D1_ADD	Minutes not worn Day 1 (any other periods they did not wear the monitor on Day 1)	Double
D2_ADD	Minutes not worn Day 2	Double
D3_ADD	Minutes not worn Day 3	Double
D4_ADD	Minutes not worn Day 4	Double
D5_ADD	Minutes not worn Day 5	Double

D6_ADD	Minutes not worn Day 6	Double
D7_ADD	Minutes not worn Day 7	Double
WEEK_TYP	Typical week for cohort member	Double

The timesheets for the seasonal accelerometer study (PA2 – 5) also collected the additional information in Table 7 (Appendix N).

Table 7: Additional timesheet questions in the seasonal accelerometer study

Variable name	**Variable label**	**Variable type**
s_wkday	Monitor worn during week in school or holiday?	Double
s_both_1	Worn both school and holiday Day 1	Double
s_both_2	Worn both school and holiday Day 2	Double
s_both_3	Worn both school and holiday Day 3	Double
s_both_4	Worn both school and holiday Day 4	Double
s_both_5	Worn both school and holiday Day 5	Double
s_both_6	Worn both school and holiday Day 6	Double
s_both_7	Worn both school and holiday Day 7	Double
sweather	Description of weather during period monitor worn	Double

13.2 Physical activity questions

Within PA2 – PA4, parents were given a short additional questionnaire (Appendix O) that asked them about their perception of their child's activity level during the week, and where the child's physical activities typically took place. The information collected is displayed in Table 8.

Table 8: Additional seasonal information

Variable name	**Variable label**	**Variable type**
Mcsid	MCS Research ID	String
dcnum00	Cohort member number	Double
Collect	Seasonal Data Collection	Double
s_qact	Number of days cohort child is moderately to vigorously active for ≥ 60 minutes day	Double
s_qinout	Location of activity	Double

13.3 Pediatric Quality of Life Inventory

The Pediatric Quality of Life Inventory (parent proxy-report) was used at PA4 (Appendix P). This inventory measures the core dimensions of health as well as role (school) functioning, in healthy children and adolescents and those with acute and chronic health conditions. It contains 23 items (Table 9), and for each measures the extent to which the frequency with which the particular domain of function is a problem. Further information on the Pediatric Quality of Life Inventory, including scoring instructions, can be found on the following website: http://www.pedsql.org/

Table 9: Pediatric Quality of Life Inventory items

Variable name	**Variable label**	**Variable type**
MCSID	MCS Research ID	String
dcnum00	Cohort member number	Double
Collect	Seasonal Data Collection	Double
qolphys1	Walking more than one block	Double
qolphys2	Running	Double
qolphys3	Participating in sports activity or exercise	Double
qolphys4	Lifting something heavy	Double
qolphys5	Taking a bath or shower by themselves	Double
qolphys6	Doing chores around the house	Double
qolphys7	Having hurts or aches	Double
qolphys8	Low energy level	Double
qolemot1	Feeling afraid or scared	Double
qolemot2	Feeling sad or blue	Double
qolemot3	Feeling angry	Double
qolemot4	Trouble sleeping	Double
qolemot5	Worrying about what will happen to him or her	Double
qolsoc_1	Getting along with other children	Double
qolsoc_2	Other kids not wanting to be his or her friend	Double
qolsoc_3	Getting teased by other children	Double
qolsoc_4	Not able to do things that other children of same age can do	Double
qolsoc_5	Keeping up when playing with other children	Double
qolsch_1	Paying attention in class	Double
qolsch_2	Forgetting things	Double
qolsch_3	Keeping up with school work	Double
qolsch_4	Missing school because of not feeling well	Double
qolsch_5	Missing school to go to the doctors or hospital	Double
Qolrel	Relationship to your child	Double

14 CONTACT

Centre for Longitudinal Studies User Support: clsfeedback@ioe.ac.uk

15 HOW TO ACKNOWLEDGE THIS DATA RESOURCE

Authors of publications or reports using these data are required to insert the following acknowledgement:

"The authors acknowledge: the Centre for Longitudinal Studies, Institute of Education for the use of these data; the UK Data Service for making them available; the MRC Centre of Epidemiology for Child Health (Grant reference G0400546), Institute of Child Health, University College London for creating the accelerometer data resource which was funded by the Wellcome Trust (grant reference 084686/Z/08/A). The institutions and funders acknowledged bear no responsibility for the analysis or interpretation of these data."

16 REFERENCE LIST

1. Smith K, Joshi H. The Millennium Cohort Study. *Popul.Trends* 2002(107):30-34.
2. Plewis I, Ketende S. Millennium Cohort Study: technical report on response, first edition. London: Institute of Education, University of London, 2006.
3. Fairweather SC, Reilly J, Stanley G, Arthur W, James YP. Using the Computer Science and Applications (CSA) Activity Monitor in Preschool Children. *Pediatr.Exerc.Sci*. 1999;11(4):413-20.
4. Janz KF. Validation of the CSA accelerometer for assessing children's physical activity. *Med.Sci.Sports Exerc.* 1994;26(3):369-75.
5. Trost SG, Way R, Okely AD. Predictive validity of three ActiGraph energy expenditure equations for children. *Med.Sci.Sports Exerc.* 2006;38(2):380-87.
6. Plasqui G, Westerterp KR. Physical activity assessment with accelerometers: an evaluation against doubly labeled water. *Obesity.(Silver.Spring)* 2007;15(10):2371-79.
7. Riddoch CJ, Mattocks C, Deere K, Saunders J, Kirkby J, Tilling K, et al. Objective measurement of levels and patterns of physical activity. *Arch.Dis.Child* 2007;92(11):963-69.
8. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med.Sci.Sports Exerc.* 2008;40(1):181-88.
9. Riddoch CJ, Bo AL, Wedderkopp N, Harro M, Klasson-Heggebo L, Sardinha LB, et al. <Physical activity levels and patterns of 9- and 15-yr-old European children. *Med.Sci.Sports Exerc.* 2004;36(1):86-92.
10. Geraci M. pawacc: Physical activity with accelerometers. R package version 1.0, 2012. Available from: http://r-forge.r-project.org/projects/pawacc/.
11. R Core Development Team. [internet] R: A language and environment for statistical computing website. Vienna, Austria: R Foundation for Statistical Computing, 2010. Available from: http://www.R-project.org/.
12. Geraci M, Rich C, Sera F, Cortina-Borja M, Griffiths LJ, and Dezateux C. Technical report on accelerometry data processing in the Millennium Cohort Study. London: Institute of Child Health, University College London, 2012. Available from: http:// http://discovery.ucl.ac.uk/1361699/.
13. Owen CG, Nightingale CM, Rudnicka AR, Cook DG, Ekelund U, Whincup PH. Ethnic and gender differences in physical activity levels among 9-10-year-old children of white

European, South Asian and African-Caribbean origin: the Child Heart Health Study in England (CHASE Study). *Int.J.Epidemiol.* 2009;38(4):1082-93.
14. Colley R, Gorber SC, Tremblay MS. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. *Health Rep.* 2010;21(1):63-69.
15. Rich C, Geraci M, Griffiths L, Sera F, Dezateux C, Cortina-Borja M. Quality Control Methods in Accelerometer Data Processing: Identifying Extreme Counts. Under review.
16. Rothney MP, Schaefer EV, Neumann MM, Choi L, Chen KY. Validity of physical activity intensity predictions by ActiGraph, Actical, and RT3 accelerometers. *Obesity.(Silver.Spring)* 2008;16(8):1946-52.
17. Evenson KR, Catellier DJ, Gill K, Ondrak KS, McMurray RG. Calibration of two objective measures of physical activity for children. *J.Sports Sci.* 2008;26(14):1557-65.
18. Pulsford RM, Cortina-Borja M, Rich C, Kinnafick FE, Dezateux C, Griffiths LJ. Actigraph accelerometer-defined boundaries for sedentary behaviour and physical activity intensities in 7 year old children. *PLoS One* 2011;6(8):e21822.
19. Rich C, Geraci M, Griffiths L, Sera F, Dezateux C, Cortina-Borja M. Quality Control Methods in Accelerometer Data Processing: Defining Miniumum Wear Time. In preparation.
20. Geraci M, Sera F, Griffiths L, Cortina-Borja M, Rich C, Dezateux C. Missing data in accelerometry-based surveys on physical activity: Adjusting for non-response and non-compliance in the Millennium Cohort Study. Under review.
21. Plewis I. Non-Response in a Birth Cohort Study: The Case of the Millennium Cohort Study. *International Journal of Social Research Methodology* 2007;10(5):325-34.
22. Williams RL. A note on robust variance estimation for cluster-correlated data. *Biometrics* 2000;56(2):645-6.

17 APPENDICES

Appendix A: Pilot study report

Institute of Child Health
University College London

Pilot Report of the MCS4 Age 7 Physical Activity Monitor Mailing

Carly Rich, Carol Dezateux, Lisa Calderwood

June 2007

Contents

1. Introduction

As part of the pilot of the Millennium Cohort Study Fourth Sweep (MCS4) researchers at the Institute of Child health (ICH), University College London, took direct measurements of the children's physical activity using an Actigraph activity monitor. All children interviewed for MCS4 were invited to take part in wearing an activity monitor, and all parents/ guardians were asked for written consent.

Soon after the interviews, participant details were given securely to ICH, and the activity monitors were posted out to the families. Children were instructed to wear the activity monitor at all times for seven consecutive days, except for when sleeping, bathing, showering, swimming, or participating in vigorous activities. The parents/ guardians were also sent a timesheet, and asked to record any periods when their child did not wear the activity monitor. After the seven days, the parents/ guardians were asked to post the monitor and timesheet back to ICH. The data were then downloaded using ActiLife Software, and a feedback certificate with a summary of their child's activity was sent to the family.

2. Timetable

The time below shows a record of the dates that the physical activity project occurred:

	Start	End
Sample Details to ICH	20/04/2007	N/A
Activity monitors sent	24/04/2007	15/05/2007
Activity monitors returned	04/05/2007	15/06/2007
Feedback certificates sent	25/05/2007	01/06/2007

3. Sample

A total of 38 parents/ guardians and their children were interviewed at MCS4 Pilot 1 (March/ April 2007). 26 of these took part in the first pilot from the age 5 survey, and the remaining 12 were newly recruited from the general population.

All children were invited to take part in wearing an activity monitor, of which 31 out of 38 (79%) children agreed and their parents/guardians gave written consent.

After mailing out the activity monitors the number of children who continued to take part was 29. Two families decided that they did not want their children to take part at all and returned their unopened activity monitor pack, but did not explain why.

4. Fieldwork

At the interviews the families were shown a 'dummy' activity monitor, which was generally well received by both parents and children. Written consent was obtained

from all parents who agreed for their children to participate in the activity monitoring. The majority of the children and parents/ guardians were excited about receiving the monitors and some of the children mentioned they felt quite special that they were being asked to do the task.

The parents/ guardians who did refuse for their children to wear the activity monitor were mainly concerned about their child being singled out from the rest of their peers and being a potential target for bullying. The children refused to elaborate on why they did not want to wear the monitor, even when probed by the interviewer.

The parents/ guardians that gave consent to their child wearing an activity monitor were given the following documents to read prior to being sent their activity monitor pilot mailing:

1. information leaflet
2. timesheet for parent and child to complete
3. letter for the child's class teacher

Interviewers mentioned that they face time constraints when in an interview situation and felt that some parents/guardians had started to 'switch off' when it came to explaining the monitor, especially with the amount of information provided for this section.

5. Content

5.1 Activity monitor mailing

Once participant details were given securely to ICH activity monitor packs were sent. These comprised of 7 enclosures:

1. parent cover letter
2. information leaflet
3. physical activity monitor and belt
4. timesheet for parent and child to complete
5. letter for the child's class teacher
6. feedback questionnaire for parent and child to tell us their views
7. pre-paid 1st class envelope (padded) for posting back the monitor and completed documents

5.2 Returned enclosures

The parents/ guardians were asked to return the following enclosures in the pre – paid envelope as soon as possible after the seven day monitoring period:

1. physical activity monitor and belt
2. timesheet
3. feedback questionnaire

5.3 Feedback certificate mailing

Upon receiving the returned enclosures at ICH parents/guardians were sent feedback certificates for their children that summarised their activity levels. The feedback certificate mailing comprised of the following enclosures:

1. Feedback certificate showing a graph summarising the child's activity levels
2. Information sheet to explain the graph on the feedback certificate
3. Feedback questionnaire for the parent and child to tell us their views on the feedback certificate
4. pre-paid 1st class envelope for posting back the completed feedback questionnaire

6. Findings from Pilot Mailing (Activity monitor mailing)

Activity monitor related mailing and returns have been securely logged in detail at ICH. The data is stored in password protected files so that named children cannot be matched to descriptive data. The data from the feedback questionnaires has also been securely entered onto a spreadsheet.

6.1 Sent documents

Parents/ guardians were told that their child's activity monitor would be posted to them 2-4 weeks after the interview, unless they requested a later start date, for example, if they were going on holiday.

- *How many children have been sent their activity monitors?*

All those that gave consent at the interview have been sent their activity monitors.

- *How long after the interview date were the activity monitors sent?*

The activity monitor sample details were received at ICH on 28/03/07 (23 days after the first interview and 10 days after the last interview).

The table below shows how many days after the interviews took place the monitors (n=31) were sent.

Interval from interview by NatCen to sending at ICH (days)	No. of monitors	Percentage (%)
16	1	3
17	2	6
18	0	0
19	0	0
20	0	0
21	1	3
22	6	18
23	3	9
24	2	6
25	6	18
26	3	9

27	2	6
28 (4 weeks after interview)	1	3
28+	4	12
Total	*31*	*100*

- *What were the reasons for sending the 4 monitors later than 4 weeks after the interview ?*

1. *Requested at the interview to be sent later (on holiday).*
2. *Rang ICH after receiving the monitor requesting that the monitor be sent back at a later date (booked holiday since interviews).*
3. *Rang ICH after receiving the monitor explaining that they had lost all monitor documents. As a result monitor was returned and reprogrammed then sent at a later date with new documents.*
4. *Delay in receiving contact details of family from NatCen.*

6.2 Returned documents

6.2.1 Activity monitor

Parents/ guardians were asked to return the activity monitors and belts as soon as possible after the seven day monitoring period. If the monitors were not returned within 21 days of being sent, a reminder letter was sent. Subsequent reminders were sent 28 days and 35 days after sending the activity monitors.

- *How many parents/ guardians have returned the physical activity monitors*?

At present, 26 out of 31 (84%) activity monitors have been returned. All of these were attached to a belt.

- *How many parents/ guardians have received reminder letters*?

At present, 5 families have been sent all 3 reminder letters, of which one has returned their monitor. The 4 families that haven't returned their monitors have also received numerous telephone calls. We are awaiting two monitors whose parents/ guardians promised to return the monitor, but the other two parents/ guardians were not available so answering phone messages were left. One family returned their monitor after receiving their first reminder letter. The remaining one activity monitor to be returned to ICH is not due back yet. This was sent at a later date to the other monitors because the family details were received at a later date by ICH.

- *How long did it take the parents/ guardians to return the activity monitors*?

The table below shows how many days it took for the monitors (n = 24) to be returned. The table does not include the 2 monitors that were not worn.

Interval from sending at ICH to receiving back at ICH (days)	**No. of monitors**	**Percentage (%)**

10	2	8
11	0	0
12	2	8
13	7	29
14	5	21
15	2	8
16	0	0
17	0	0
18	3	13
19	1	4
20	0	0
21 – 27	1	4
> 28	1	4
Total	*24*	*100%*

- *Were there any damage to the activity monitors?*

There was no functional damage to the activity monitors. In two activity monitors the USB port protector was missing. None of the belts have been damaged. Some belts have started to fray where Velcro had been attached to the belt

6.2.2 Timesheets

Parents/ guardians were sent a timesheet (Appendix 1) and asked to write the dates that the monitor was worn, the time the monitor was put on in the morning and taken off at night, any periods spent swimming or cycling, and any other periods when the monitor was not worn. They were also asked whether the week was typical for their child in terms of their usual activity. They were asked to return the completed timesheet with the activity monitor as soon as possible after the seven day monitoring period. A copy of the timesheet was also given to the parents/ guardians at the interview, but they were asked to complete the timesheet sent to them, as this contained a reference number for office use.

- *How many parents/ guardians returned the timesheets?*

A completed timesheet was returned for all of the children that wore the activity monitor.

- *Did the parents/ guardians complete the correct timesheets?*

Two parents/ guardians filled in the timesheet given to them at the interview. Although the timesheets had no identification, the timesheet and activity monitor were sent together, and as a consequence could easily be matched.

- *Were the timesheets completed correctly ?*

Nearly all parents/ guardians completed the timesheet correctly. One timesheet did not have the dates that the monitor was worn, but instead the days of the week. Also, most families only wrote in a yes when asked if their child took the activity monitor off at all during the day, but did not write in no if they didn't. One parent/ guardian did not fill this in at all.

- *Did the children start wearing their monitor two days after it was mailed out?*

All monitors were programmed to turn on automatically at 5am two days after they had been posted out. When the monitors are turned on, a flashing light is visible. Parents/guardians were told that their child should start wearing the activity monitor the morning after it had been received. Parents/ guardians were also informed that if the monitor had been delayed in the post, they may find that the monitor is already flashing when they receive it. However, their child should still start to wear it the following morning after it had been received, and continue to wear it every day for 7 days (the monitor should remain on for at least seven days).

The table below shows how many days after sending the monitors children started to wear them (n=22). The table does not include the 2 monitors that were not worn or the 2 monitors that had no valid data (see section 6.3 Data quality).

Interval from sending by ICH to children wearing (days)	No. of children	Percentage (%)
2	16	73
3	3	14
4	3	14
Total	*22*	*100*

6.2.3 Feedback questionnaires

Parents/guardians were asked to complete and return the feedback questionnaire in the pre-paid envelope with the activity monitor and completed timesheet.

How many parents/ guardians returned the feedback questionnaire?
At present, 19 feedback questionnaires out of 26 returned activity monitors have been received.

There was no identifier printed on the questionnaire so if it was returned separately from other documents it was difficult to know which child it related. However, it was possible to match all questionnaires to a family.

6.2.4 Other comments

One parent/ guardian misplaced the activity monitor mailing documents, and phoned to request a second set of documents. They were asked to return their monitor, which was then programmed to start at a later date, and sent at a later date with new documents.

The parents/ guardians of two children who were sent monitors, rang to ask if they could receive their activity monitors at a later date because they were on holiday through the programmed time. They had not booked their holidays at the time of the interview. The monitors were both sent back, and programmed and sent at a later, more convenient start date.

Two children encountered problems with the flashing of their activity monitors. Both parents/ guardians rang to say that their children's monitors were not flashing when supposed to. They were asked to continue wearing the monitors as requested. One monitor did not flash because 'flash mode' was not enabled, but still recorded valid data. The other monitor was programmed incorrectly, and consequently did not record any valid data.

6.3 Evidence from the feedback questionnaires

Responses from 19 feedback questionnaires have been logged, and the answers are shown below.

Q1. On the whole, how did you feel about your child being asked to wear an activity monitor for a week? Do you feel that you understood why and how the activity monitor was worn? Was there anything else you would have liked to have known?

- I think the results will be interesting and all explained well.
- No problems.
- I had no problems with child wearing the monitor. In fact he really enjoyed it.
-would be interesting to know more about how the monitor works.
- My child was happy to take part with this task. She understood why she needed to wear the monitor.
- I felt happy for my child to wear the activity monitor. I did understand why/how this was worn. I was quite happy with all the information provided.
- Fine.
- Felt fine. It was easy to put on and she forgot she was wearing it after a while.
- Yes
- Child was very happy to wear the monitor.
- Full information was provided.
- I was very happy for my child to wear his activity monitor (and so was he!) I did understand why and how the monitor was worn and I had no further concerns or questions about the use of the monitor.
- Time consuming - difficult to remember. Not sure parents would bother to accurately record/wear belt use. Glad it's over!
- I was perfectly happy for my son to wear the monitor and I felt everything was explained clearly.

Q2. Overall, how easy or difficult did you find it to understand the letter, information leaflet and teacher letter?

Very easy	11	58%
Easy	8	42%
Difficult	0	0%
Very difficult	0	0%
Total	*19*	*100%*

Q3. Overall, how easy or difficult did you find it to understand and complete the timesheet?

Very easy	14	74%
Easy	3	16%

Difficult	2	11%
Very difficult	0	0%
Total	*19*	*100%*

Q4. Overall, how confident or unconfident are you that the information on the timesheet is accurate?

Very confident	6	32%
Confident	11	58%
Unconfident	2	11%
Very unconfident	0	0%
Total	*19*	*100%*

Q5. Was your child able to provide the information needed to fill out the timesheet on days when they were at school?

Always	15	79%
Sometimes	1	5%
A little	3	16%
Not at all	0	0%
Total	*19*	*100%*

Q6. Which of these statements best describes your child's activity during the monitoring week?

My child was much more active than usual	0	0%
My child was a little more active than usual	2	11%
My child was as active as usual	15	79%
My child was a little less active than usual	2	11%
My child was a lot less active than usual	0	0%
Total	*19*	*100%*

Q7. If your child was more or less active than usual, was this change in activity mainly because their activity was being monitored?

Yes	1	20%
No	4	80%
Don't know	0	0%
Total	*5*	*100%*

Q8. In relation to your child's teacher, which of these statements describes their opinion on your child wearing the monitor at school?

-He/ she did allow my child to wear the monitor

Yes	18	95%
No	0	0%
Don't know	1	5%
Total	*19*	*100%*

-He/ she did inform me if my child took the monitor off during the school day

Yes	7	37%
No	8	42%
Don't know	2	11%
Total	*19*	*100%*

Q9. Do you have any other comments on the letter, leaflet, time sheet, teacher information letter or teacher involvement?

- I didn't feel that I could ask the teacher everyday how long monitor was on and off. I have had to rely on my daughters information.
- Timesheet needs to allow for other pedalled activity (my child has a pedal go-cart and what about scootering?).
- My daughter's teacher was pleased to help in any way and encouraged her. My daughter talked about it in class.
- Everything was clearly explained and easy to understand.
- Could all the pieces of paper come in a folder with a clear summary of what to give to whom and when printed on front.
- It was quite fun, he quite enjoyed being a bit different for the week. There were so many bits of paper especially with it happening at the same time as the teacher questionnaire. As you can see I forgot to fill in this form - which would have been better to send with the activity monitor, rather than beforehand. I also failed to give one form to the school until they asked for it.

Q10. In relation to returning the activity monitor, were you confused about when and how you were supposed to return it?

Very confused	0	0%
A little confused	0	0%
Not confused at all	18	100%
Total	*18*	*100%*

Q11. Were you confused about when you had to start wearing the activity monitor?

Very confused	0	0%

A little confused	6	32%
Not confused at all	13	68%
Total	*19*	*100%*

Q12. Did your child wear his/ her activity monitor at all the required times?

Yes	14	74%
No	5	26%
I am not sure	0	0%
Total	*19*	*100%*

Q13. Did your child find the activity monitor comfortable or uncomfortable to wear?

Very comfortable	2	11%
Quite comfortable	13	68%
Quite uncomfortable	4	21%
Very uncomfortable	0	0%
Total	*19*	*100%*

Q14. Did your child find the activity monitor belt too big or too small to wear?

Too big	3	16%
Too small	0	0%
The right size	16	84%
Total	*19*	*100%*

Q15. Was your child able to put the belt on, and take if off on their own?

Yes	18	95%
No	1	5%
Total	*19*	*100%*

Q16. Do you have any other comments regarding the comfort, ease and convenience of wearing the activity monitor?

- The belt would slip around occasionally so whether it recorded properly I don't know.
- At first it was a great novelty then a burden- she hated wearing it because it got in the way, and was uncomfortable. Remembering to put it back on after getting changed as she's always changing her clothes.
- He did get fed up wearing it. I decided to let him not wear it after his evening wash/ bath. Approximately

1.5hr prior to his bedtime.
- My child found the monitor quite uncomfortable and regularly complained of a belly ache.
- My child was a little uneasy about having to wear the monitor at school at first but was fine by the end.
- My child didn't adjust the belt or undo it. She just pulled it up from her feet to her waist. This may stretch the belt over time.
- It wasn't particularly comfortable wearing it all day, and difficult to avoid him fiddling with the belt.
- It was fine.
- The little black plastic plug at the side of the monitor kept coming out. It was not sitting comfortably. I had to twist the strap to tighten it to fit properly on my daughter.
- My child had no complaints about wearing the monitor- he was happy to put it on himself and it did not bother him during the day (I think he forgot he was wearing it!)

6.4 Data quality

The table below shows the number of valid days (wearing the monitor for a minimum of 600 minutes per day) of data for the children (n=24) that wore the activity monitor.

No. of valid days	No. of monitors	Percentage (%)
7	10	42
6	4	17
5	2	8
4	5	21
3	0	0
2	0	0
1	1	4
0	2	8
Total	*24*	*100%*

Apart from 3 activity monitors the data obtained is promising. The table shows that all of the other activity monitors had at least four valid days of data, including ten children that had seven valid days of data.

These results are backed up by the feedback questionnaire which also revealed that nearly all children wore the monitor at all the required times.

One parent/ guardian decided that they did not want their child to take part in wearing the monitor after one day, because their child complained that the belt was too tight. This is the monitor that only had one valid day of data. One monitor had no valid days because of a programming mistake, which should not occur in the main stage. The only other monitor that had no valid days was because the child did not wear the monitor for a long enough period of time each day.

The results from the feedback questionnaire also showed that nearly all children were as active as usual whilst wearing the activity monitor, consequently maintaining their normal daily activities. There were only 5 children that slightly changed their activity levels, and only 1 child did this because their activity was being monitored.

7. Findings from Pilot Mailing (Feedback Certificate mailing)

7.1 Sent documents

Parents/ guardians were told that their child would receive a certificate summarising their activity levels 4-6 weeks after sending back the activity monitor.

The feedback certificates are produced by downloading and saving the activity data from the monitors using ActiLife software. This data is then processed by a macro that was used in the ALSPAC study, which produces a certificate with a personalised graph summarising the child's first day of activity.

- *How many children have been sent their feedback certificates?*

At present, 24 out of 24 children that wore and returned their activity monitors have been sent their feedback certificates.

- *How long after the activity monitor return date were the feedback certificates sent?*

The table below shows how many days after the activity monitors were returned (n=24) the feedback certificates were sent

Interval between receiving monitor back at ICH to sending feedback certificate (days)	No. of monitors	Percentage (%)
≤14	5	21
15 - 21	18	75
22 – 28 (4 weeks)	1	4
29 – 35 (5 weeks)	0	0
36 – 42 (6 weeks)	0	0
> 42	0	0
Total	24	100%

- *Were there any complications sending the feedback certificates ?*

One unanticipated problem was that there were 3 monitors that did not have enough valid data (discussed in data quality) to run the macro and produce personalized feedback certificates. These children were still sent feedback certificates, however, the graphs showed a typical child's activity levels, rather than their own. An information sheet was sent that apologised for their child not having a personalized graph and explained what the graph on their child's certificate did show.

7.2 Returned documents – feedback questionnaire

Parents/guardians were asked to complete and return the feedback questionnaire on the feedback certificate in the pre-paid envelope supplied.

How many parents/ guardians returned the feedback questionnaire?
At present, 12 feedback questionnaires out of 24 sent feedback certificates have been received.

7.3 Evidence from the feedback questionnaires

Responses from 12 feedback questionnaires have been logged, and the answers are shown below.

Q1. Did you find the feedback certificate useful?

Very useful	3	25
Quite useful	5	42
Quite useless	4	33
Very useless	0	0
Total	*12*	*100%*

Q2. Did your child find the feedback certificate useful?

Very useful	2	17
Quite useful	8	67
Quite useless	2	17
Very useless	0	0
Total	*12*	*100%*

Q3. Do you or your child have any other comments on the feedback certificate?

- It would have been useful if we'd had feedback about whether the amount of exercise was very good/ sufficient/ not enough. The sheet explaining the graph and giving ideas what to look for was useful. He really wanted to know what day it was he was looking at. It would have been even more interesting to see a print out for every day so that you could make comparisons. Or even just your most active day & your most inactive day.
- She really enjoyed understanding why the activity monitor was used and to see how active she is.
- The certificate helps in keeping my son committed to the research. It would have been useful to show my son what the normal activity levels are and how he compares.
- Does it mean she is an active child? Does it reach/ exceed your expectations? How does it compare? Will you produce some local/ national results?
- I think 'interesting' is more appropriate that useful, i.e. what use does the certificate have?
- It was interesting to see the active and the quiet periods.
- It would be nice to have more days so that we can see how active our child instead of just one day.
- It would have been nice to know which day if possible or perhaps a summary of the week.
- I would have preferred it to say how my sons activity compared to the average they would expect as I know what sports he plays and when he has PE so the graph showed what's expected. What I wanted to know was is he active enough?!
- It would have been good to know which day it was. What the average of the group was, so I could compare my child against an average. She liked the fact that it was a 'certificate'.
- He like to look at the activity levels and try to work out what he was doing at those times.
- She felt very pleased to receive the certificate!

There were no identifier's printed on the questionnaires, so when they were returned it was not possible to know which family they had been returned by.

8. Conclusions and Recommendations for Dress Rehearsal

8.1 Timetable

It is anticipated that the main stages of the activity monitor dress rehearsal will be as follows:

	Start	End
Sample Details to ICH	Late 07/2007	08/2007
Activity monitors sent	08/2007	09/2007
Activity monitors returned	+10 days	+ 21 days
Feedback certificates sent	?	?

8.2 Sample

An estimated 100 families taking part in the MCS4 dress rehearsal interviews will be invited to take part in the physical activity monitoring dress rehearsal. These families will be different to those who took part in the pilot.

8.3 Acceptability

In general, the findings from the pilot study show a reasonable degree of acceptability from parents and children in relation to the wearing of the physical activity monitor for the purposes of measuring activity levels (please see diagram 1).

At the interview most parents/ guardians (82%) agreed and gave consent for their children to take part in wearing the activity monitor. Nearly all (94%) children that were sent activity monitors packs took part in wearing the monitor.

There were many positive comments regarding the activity monitors, with most children being pleased and excited about wearing them. The parents/ guardians who did refuse for their children to wear the activity monitor were mainly concerned about their child being singled out from the rest of their peers and being a potential target for bullying.

In order to increase acceptability at the interview stage it is recommended that the number of documents and the amount of information that parent/ guardians receive

is reduced. It is suggested that the only document they receive is the information leaflet. It is also recommended that the interviewers are given a summary sheet (similar to that sent to the parents/guardians on the back of the timesheet) to help them explain the essentials, and that if any further information is required from the parents/ guardians they should ring ICH. This will hopefully help to save time and maintain the parents/ guardians interest.

It would also be helpful if interviewers could reassure the children and parents/guardians that there were no children being singled out at school, or being bullied as a result of wearing the activity monitor in the pilot study. In fact, most children really enjoyed wearing them. It is also suggested that parents/guardians and/or the children are given the option to be able to change their mind if they decline to take part in the activity monitoring at the interview, but at a later stage (possibly after reading through the information leaflet) decide that they do wish to take part.

8.4 Feasibility

In general, the findings from the pilot study show that direct collection of children's physical activity levels using Actigraph physical activity monitors in cohort members is feasible. In particular, that posting physical activity monitors to subjects can be a reliable and efficient way of obtaining valid data on children's activity levels.

This is represented by all but three monitors having at least four valid days of data, including ten children that had seven valid days of data. Also, nearly all the children maintained their normal daily activity levels, and only one of the children changed their activity level because they were wearing the monitor. Furthermore, monitors are being returned at an acceptable time, with only four monitors awaiting late return.

8.5 Changes to documents

Initial feedback from the interviews on the documents provided to parents explaining the activity monitor was positive, especially with regards to content and reasons for this aspect of the study.

8.5.1 Parent cover letter

In general, the parent cover letter was well received and all parents/ guardians said that they found the letter 'very easy' or 'easy' to understand.

The only suggested change that should be made for the dress rehearsal will be that the line 'Please use the timesheet enclosed, rather than the one given to you by the interviewer, as it contains a reference number for office use' will be taken out. This is because it is recommend that timesheets are not given at the interview stage to ensure that timesheets without identification are not filled out.

8.5.2 Information leaflet

The information leaflet was also positively received and nearly all parents/ guardians found it 'easy' or 'very easy' to understand.

In addition, all parents/ guardians were 'not confused at all' about when and how they were supposed to return the monitor. Furthermore, they were 'not confused at all' about when they had to start wearing the monitor, suggesting that the information sheet served its purpose. However, there were three parents/ guardians who said they were a 'little confused' as to when they should start wearing the monitor.

It is suggested that the section entitled 'When should my child wear the activity monitor?' should be reviewed and amended so that the start date is made clearer.

8.5.3 Physical activity monitor and belt

Belt

Overall, feedback from the initial interviews regarding fitting the monitor to the child was positive. In all cases but one the belt was of an adequate size (for the one exception, the child was rather thin and the belt was too big). One larger child was concerned prior to the fitting that the belt would be too small. However, this did not prove to be the case at the interview.

Information received from the feedback questionnaire was conflicting regarding the comfort, size and ease of wearing the activity monitor. Most children did find the activity monitor 'quite comfortable' to wear and 'the right size'. Furthermore, nearly all parents/ guardians stated that their child was able to put the belt on and take it off on their own. There were also several comments mentioning how happy their child was to wear the monitor, and that they had encountered no problems.

One child refused to take part after wearing the monitor for one day because he felt that the belt was much too tight. In addition, the feedback questionnaire revealed that the activity monitor belt was 'too big' to wear for three children. However, two of these children still thought that the belt was 'quite comfortable to wear'. Furthermore, three children also felt that the activity monitor was 'quite uncomfortable' to wear. In one of these children the belt was too big. The other two families emphasized in writing how uncomfortable the belt was, but did not explain why. Two families also commented that the belt would move around frequently.

To help make the belts more comfortable to wear, and resolve any problems with the sizes of the belts there are two alternative recommendations. The first recommendation is that that the upper size limit of 70 cm waist circumference for the belts is raised. There were two pilot children in the waist category 66- 70 cm, as against four in the 61- 65 cm category. It has been suggested that the upper limit for the belts is raised to 72 cm, even though both 70 cm and 72 cm are above the 99.9th centile in age-matched growth charts. Alternatively, a variety of sized belts

could be manufactured (possibly three different sizes). Waists sizes will then determine which sized belt will be sent to the family for their child.

Activity Monitor

An additional unanticipated issue with the activity monitor was regarding the USB port protectors. In two of the returned monitors the USB port protectors were missing. One parent/ guardian also commented that the USB protector kept coming out. This is of particular concern because the protectors are needed in order to prevent any damage to data collection and download. It is recommended that for the dress rehearsal the protectors are taped down to prevent this problem occurring. In addition, it is recommended that it is established whether spare protectors can be purchased, and if so, this should be done.

Another problem that occurred with the activity monitors was regarding the personalised stickers that were put on the back of the monitors. Each monitor had the child's first name, an ID number and a number to call if the monitor was found by anyone. Some families had tried to remover the stickers, presumably because they have their child's name on them. However, they are not removed easily, and as a consequence this would not be feasible to apply and remove stickers for each different child that uses the monitor. It is therefore suggested that the child' name is not put on the monitor, just a unique monitor number and a return telephone number. This would mean that the stickers would not need to be removed for different children. It is also recommended that parents are asked in the documents not to remove the sticker on the back of the monitor.

8.5.4 Timesheet and summary

Feedback regarding the timesheet from the initial interviews was positive, with parents understanding the importance of accurately recording the activities of the child. One or two parents did comment that the timesheet should be more child-friendly, therefore enabling the cohort children to fill it out themselves. Although interviewers expressed doubts over whether parents would remember to fill the sheets in, all families returned their completed timesheets and nearly all families correctly filled in the timesheets.

Findings from the feedback questionnaire found that nearly all parents/ guardians found the timesheet 'very easy' or 'easy' to understand and complete, although one family did say that it was 'difficult' to understand and complete. Also, nearly all were either 'very confident' or 'confident' that the information on the timesheet was accurate. Furthermore, nearly all parents/ guardians felt that their child was able to provide the information needed to fill out the timesheet on days when they were at school.

Only two parents/ guardians felt that the information on the timesheet was 'inaccurate', and two stated that their child could provide only 'a little' information to fill out the timesheet on days when they were at school. One comment made by one family was that the timesheet needed to allow for other pedalled activities such a go-carts and scooters, that would not be measured accurately as activity by the activity monitors.

Recommendations for changes to the timesheet would be to make the timesheet more appealing to children with the use of colours and pictures. An extra row should be added to take into account how many minutes children spent doing other activities in which the monitor was taken off (allowing for vigorous activities). In addition, the time spent on other pedalled activities (e.g. go-carts and scooters) should be included into the minutes spent cycling.

The completion of whether the child took the activity monitor off during the day (yes or no answer) and then the corresponding 'for how many minutes' were not filled in very successfully. To avoid any confusion this will therefore be replaced with a single question asking how many minutes their child forget to wear the activity monitor during the day.

The pilot timesheets did not have any identification on them, and therefore if returned to ICH separately to the activity monitor may have caused problems. As a result of this an identification label was stuck on the timesheet. This information should be added onto the timesheet before printing so that no label is needed. Finally, timesheets should not be given out at the interview stage to ensure that families do not fill in timesheets without identification information.

8.5.5 Letter for child's class teacher.

In general, the letter for child's class teacher was well received and most parents/ guardians said they found it 'easy' or 'very easy' to understand.

At the interviews there was some concern over the burden caused by the child wearing the activity monitor would put on the child's teacher. However, the feedback questionnaire revealed that all of the teachers of participating children did allow them to wear the monitor. One family even commented how their child's teacher was pleased to help in any way and encouraged their child.

Information relating to whether the children's teachers' informed parents if children took the monitors off during the school day was inconclusive. This is to be expected as we did not ask the parents to ask their children's teacher to do this. Half of all families said that their child's teacher did not inform them if their child took the monitor off during the school day, and nearly half said that their child's teacher did inform them when their child took the monitor off during the school day. One family commented that they didn't feel that they could ask the teacher everyday how long the monitor was put on and taken off, and that they had to rely on their child's information. This is not concerning, as reported previously, nearly all families felt that their child was able to provide the information needed to fill out the timesheet on

days when they were at school. As a result no recommended changes to the letter for the child's class teacher are to be made for the dress rehearsal. Question 8 in the feedback questionnaire which asks whether the child's teacher informed the parents if their child took the monitor off during the school day should be removed as we have not asked teachers to do this in the teacher letter.

8.5.6 Feedback questionnaire (activity monitor mailing)

We have received no negative comments regarding the feedback questionnaire. As a result it is recommended that this will still be sent for the dress rehearsal in order to obtain further information for the main stage. Recommended changes are the deletion of question 8 (as previously discussed) and also two grammatical changes. In addition, an identifier (presumably the child's name) should be added to the feedback questionnaire, so that each questionnaire can be matched with a child if the monitor and questionnaire are returned separately.

8.5.7 Feedback certificate

There were mixed responses from the feedback questionnaire regarding the feedback certificate.

Three parents found the feedback certificate 'very useful', and five parents found it 'quite useful'. In contrast, four parents found the feedback certificate 'quite useless'. Two out of twelve children also found the feedback certificate 'quite useless'.

There were comments that the certificate was 'interesting' rather than 'useful'. Parents also commented that their children really liked the idea of receiving a certificate. In addition, parents felt that it was a good idea to have a sheet explaining the graph as their children liked to look at the graph and work out what they were doing at certain times of the day. One parent felt that the certificate helped keep their child committed to the research.

Half of all parents that returned feedback forms said that they would like to know how their child's activity level compared to the 'normal' level, and whether their child was active enough. Parents also suggested that it would have been useful to have a summary of their child's activity throughout the week, in addition to having an individual day. One parent also said that it would have been useful to know which day the graph showed.

It is recommended that children will continue to receive a feedback certificate. However, the format of this certificate will be revised. It is recommended that the following changes are considered:

1. Getting the certificate templates designed professionally.
2. Showing a line corresponding to the lower threshold of moderate intensity (as established by ALSPAC at 3600 accelerometer counts/min) on the activity graphs so that parents can see how often their child takes part in moderate activity, and therefore whether their child participates in the recommended

government guidelines of at least 60 minutes of moderate physical activity a day.
3. Producing a graph that summarizes the child's activity throughout the week, in addition to the graph summarising one day of activity.
4. Informing parents which day/date the activity graph represents (on the single day graph).

All feedback certificates were sent within four weeks of the activity monitors being returned. It is recommended that all documents inform parents that they will receive their child's feedback certificate within four weeks of returning the activity monitor instead of 4-6 weeks. This will enable a quicker turnover rate.

8.5.8 Information sheet for feedback certificate

The feedback questionnaire did not ask any specific questions about the information sheet. However, one parent did comment that the sheet was very useful in order for their child to understand the graph.

As a result, it is therefore recommended that families still receive information explaining the graphs. However, the appearance of the information sheet was not very professional. It is suggested that a cover letter is sent which incorporates the explanation of the graph. This should be similar to the text sent in the pilot. If a 'moderate activity level' line is added to the graph, this should also be explained in the cover letter.

8.5.9 Feedback questionnaire (feedback certificate mailing)

We have received no negative comments regarding the feedback questionnaire for the feedback certificate mailing. However, the questionnaire was very basic. In addition, there were comments regarding the wording of the first and second questions (i.e. that the certificates weren't useful, but interesting).

As a result, it is recommended that the feedback questionnaire on the feedback certificate is reviewed so that more appropriate and informative questions are asked to the families. Also, as with the feedback questionnaire for the activity monitor mailing an identifier should be added to the feedback certificate mailing questionnaire.

8.5.10 Envelopes

Activity monitor mailing envelope

The physical activity monitor pack was sent out in an A4 windowed envelope. In order to prevent loss of activity monitors 'return to sender' labels were printed and placed on the front of the envelope. It is recommended for aesthetic reasons and to save time that in the main stage the envelopes are pre-printed with 'return to sender' information.

The dress rehearsal activity monitor mailing will be the same as the pilot mailing, with the same enclosures. The contents of this is quite bulky. In the pilot study this made it hard for the mailing envelopes to remain closed. In some, sellotape was used to secure this. It is recommended that for the dress rehearsal all envelopes are closed this way to prevent any loss of monitors in the posting process. Alternatively, if correctly sized 'peel and seal' window envelopes can be purchased these should be used.

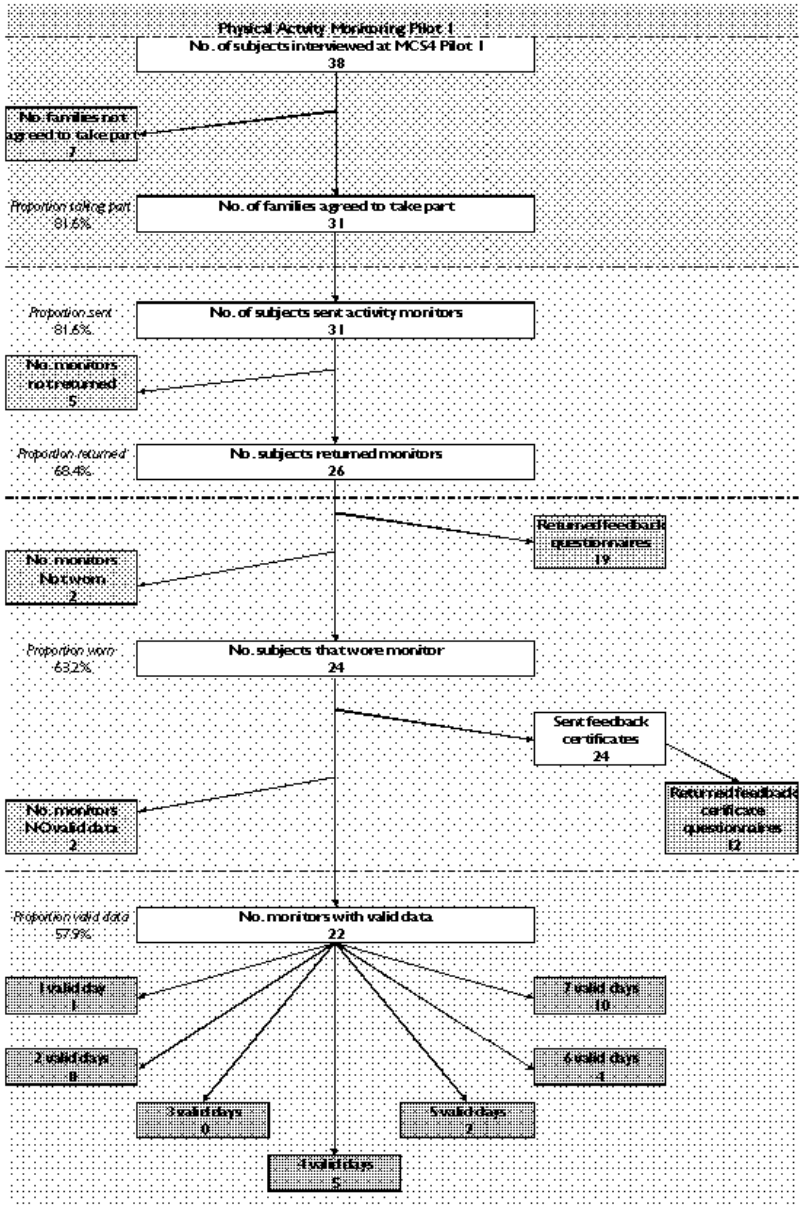
Pre-paid envelope for returning activity monitor to ICH

All families returned the activity monitor and belt in the correct pre-paid envelope. The padded material suitably protected the activity monitors, and the size was suitable for returning all documents in addition to the activity monitors. This should therefore remain the same for the dress rehearsal.

Feedback certificate mailing envelope

The feedback certificate mailing was sent out in an A4 envelope. There were no reported problems with this and as a result this will remain the same for the main stage.

Diagram 1


Physical Activity Monitoring Pilot 1
No. of subjects interviewed at MCS4 Pilot 1
38
No. families not agreed to take part
7
Proportion taking part
81.6%
No. of families agreed to take part
31
Proportion sent
81.6%
No. of subjects sent activity monitors
31
No. monitors not returned
5
Proportion returned
68.4%
No. subjects returned monitors
26
Returned feedback questionnaires
19
No. monitors Not worn
2
Proportion worn
63.2%
No. subjects that wore monitor
24
Sent feedback certificates
24
Returned feedback certificate questionnaires
12
No. monitors NO valid data
2
Proportion valid data
57.9%
No. monitors with valid data
22
1 valid day
1
2 valid days
8
3 valid days
0
4 valid days
5
5 valid days
2
6 valid days
1
7 valid days
10

Appendix 1

Child of the New Century
Age 7 Survey Pilot
Activity Monitor

NatCen
National Centre for Social Research

Summary of key points

Your child should wear the monitor....

- Every day for 7 consecutive days starting day after received
- At all times from first thing in the morning to last thing at night - except when swimming, in shower or bath or playing extremely vigorous sports
- On a belt around the waist
- On top of indoor clothing (or against skin if preferred)
- Above right hip
- Tightly but comfortably against body (not 'flopping around')

You should record on the timesheet (on the back of this form)....

- Dates that the monitor was worn
- Time monitor was put on in the morning and taken off at night
- Any periods spent swimming or cycling (the monitor should still be worn during cycling)
- Any other periods when monitor not worn
- Whether typical week or not

You should also....

- Give the letter about the activity monitor to your child's class teacher
- Return the activity monitor, belt and completed timesheet **as soon as possible** after the 7 day period in the envelope provided

We will....

- Send you a summary of your child's activity 4-6 weeks after the monitor is sent back
- Treat the information recorded on the timesheet in strict confidence in accordance with the Data Protection Act
- Answer any questions you may have. If you have any other questions or any problems with the monitor or timesheet, please call Carly Rich from the Institute of Child Health on 020 7905 2691

Timesheet	Example	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Date	*10/05/07*							
Time put on in morning	*7.45*	:	:	:	:	:	:	:
Time taken off at night	*8.30*	:	:	:	:	:	:	:
How many minutes spent swimming	*0*							
How many minutes spent cycling	*65*							
Did your child take the activity monitor off at all during the day (before they went to bed)?	*Yes*							
If yes: how many minutes did they take it off for?	*15*							

Was this week typical for your child in terms of their usual activity? Yes/ No

IF NO: why not? (e.g. sprained ankle on day 3).....

Appendix B: Dress rehearsal report

Institute of Child Health
University College London

Dress Rehearsal Report of the MCS4 Age 7 Physical Activity Monitor Mailing

Carly Rich, Carol Dezateux, Lisa Calderwood, Lucy Griffiths

October 2007

Executive Summary

- Activity monitoring was piloted in 102 children participating in the MCS4 dress rehearsal.
- the calendar period of the dress rehearsal meant that the period of issue was over the school holidays
- at home interviews 89 / 102 (87%) agreed to take part
- 82 families (91%) were sent monitors within 28 days of the interview. The reasons for sending 8 monitors later than 28 days after the interview were; 5 families had requested a later start date, 2 monitors went missing in the post, and 1 family forgot to start wearing the monitor when first sent
- 74 out of 89 monitors were returned, 58 (78%) within 4 weeks but return was delayed due to the recent postal strike
- all returned monitors and belts were undamaged although USB cover was missing in 6 monitors
- 18 monitors were not worn, largely because the child or family had subsequently changed their mind about taking part
- 56 families returned monitors that had been worn for at least one day
- 62% of these returned the monitor without a reminder, 6 with one reminder, 7 with two reminders, and 5 with three reminders, leaving 15 not returned at all
- valid data (at least 600 minutes per day) was available for at least 4 days (including 2 weekend days) in 38 (69%) of children
- all 56 with data returned completed timesheets
- 46 families completed an evaluation form and analysis of the evaluation forms demonstrated high acceptability from parents and children in relation to the wearing of the physical activity monitor for the purposes of measuring activity levels. There were some minor concerns from parents about attracting attention at school and also some recommendations to not take measurements at the start of the school year

Contents

1. Introduction

As part of the pilot of the Millennium Cohort Study Fourth Sweep (MCS4) researchers at the Institute of Child health (ICH), University College London, took direct measurements of the children's physical activity using an Actigraph activity monitor. All children interviewed for MCS4 dress rehearsal were invited to take part in wearing an activity monitor, and all parents/ guardians were asked for written consent.

Soon after the interviews, participant details were given securely to ICH, and the activity monitors were posted out to the families. Children were instructed to wear the activity monitor at all times for seven consecutive days, except for when sleeping, bathing, showering, swimming, or participating in vigorous activities. The parents/ guardians were also sent a timesheet, and asked to record any periods when their child did not wear the activity monitor. After the seven days, the parents/ guardians were asked to post the monitor and timesheet back to ICH. The data were then downloaded using ActiLife Software, and a feedback certificate with a summary of their child's activity was sent to the family.

2. Timetable

The table below records the relevant dates for the physical activity project:

	Start	End
Interviews	20/07/2007	14/08/2007
Sample Details to ICH	26/07/2007	22/08/2007
Activity monitors sent	28/07/2007	28/08/2007
Activity monitors returned	20/08/2007	16/10/2007
Feedback certificates sent	31/08/2007	08/11/2007

3. Sample

A total of 102 parents/ guardians and their children were interviewed at MCS4 Dress Rehearsal (July/ August 2007).

All children were invited to take part in the activity monitor study, and 89 out of 102 (87%) children agreed and their parents/guardians gave written consent.

4. Fieldwork

Prior to fieldwork the parents/ guardians were sent a short information leaflet explaining when, how, and why the activity monitors were to be worn.

At the interviews the families were shown a 'dummy' activity monitor, which was generally well received by both parents and children. The families were also shown two different sized belts to which the activity monitor could be

attached. The majority of the children and parents/ guardians were excited about receiving the monitors and some of the children mentioned they felt quite special at being asked to take part. The parents were particularly interested in the feedback that they would receive.

The parents/ guardians who declined to take part mentioned being concerned about their child being singled out from the rest of their peers and being a potential target for bullying. The children chose not to elaborate on why they did not want to wear the monitor, even when probed by the interviewer.

5. Content

5.1 Activity monitor mailing

Once participant details were given securely to ICH activity monitor packs were sent. These comprised of 7 enclosures:

1. parent cover letter (Appendix 1)
2. information leaflet (Appendix 2)
3. physical activity monitor and belt
4. timesheet for parent and child to complete (Appendix 3)
5. letter for the child's class teacher (Appendix 4)
6. feedback questionnaire for parent and child to tell us their views
7. pre-paid 1st class envelope (padded) for posting back the monitor and completed documents

5.2 Returned enclosures

The parents/ guardians were asked to return the following enclosures in the pre –paid envelope as soon as possible after the seven day monitoring period:

1. physical activity monitor and belt
2. timesheet
3. feedback questionnaire

6. Findings from Dress Rehearsal Mailing (Activity monitor mailing)

Activity monitor related mailing and returns have been securely logged in detail at ICH. The data are stored in a password protected Access database so that named children cannot be matched to descriptive data. The data from the feedback questionnaires have also been entered onto a secure database.

6.1 Sent documents

Parents/ guardians were told that their child's activity monitor would be posted to them within 4 weeks after the interview, unless they requested a later start date, for example, if they were going on holiday.

- *How many children were sent activity monitors?*

All those that gave consent at the interview were sent activity monitors.

- *How long after the interview date were the activity monitors sent?*

The activity monitor sample details were sent to ICH in weekly batches between 26/07/07 and 22/08/2007. The interviews took place between 20/07/2007 and 14/08/2007.

The table below shows how many days after the interviews took place the monitors (n=89) were sent.

Interval from interview by NatCen to sending at ICH (days)	No. of monitors	Percentage (%)	Cumulative percentage (%)
4	1	1	1
5	0	0	1
6	1	1	2
7	2	2	4
8	5	6	10
9	2	2	12
10	4	5	17
11	14	16	33
12	6	7	40
13	5	6	46
14	7	8	54
15	10	11	65
16	5	6	71
17	3	3	74
18	1	1	75
19	2	2	77
20	1	1	78
21	0	0	78
22	6	7	85
23	0	0	85
24	1	1	86
25	2	2	88
26	1	1	89
27	0	0	89
28 (4 weeks after interview)	2	2	91
> 28	8	9	100
Total	*89*	*100*	100

- *What were the reasons for sending the 8 monitors later than 4 weeks after the interview ?*

  - 5 families requested at the interview to be sent later (on holiday).
  - 2 families rang ICH after receiving reminder letters to say that they had not received the monitor at all. Further monitors were sent. It is likely that these went missing in the post.
  - 1 family rang ICH after receiving the monitor explaining that they had forgot to wear the monitor and the light had stopped flashing. As a result monitor was returned and reprogrammed then sent at a later date.

6.2 Returned documents

6.2.1 Activity monitor

Parents/ guardians were asked to return the activity monitors and belts as soon as possible after the seven day monitoring period. If the monitors were not returned within 21 days of being sent, a reminder letter was sent. Subsequent reminders were sent 28 days and 35 days after sending the activity monitors.

- *How many parents/ guardians have returned the physical activity monitors?*

At present, 74 out of 89 (83%) activity monitors have been returned. All of these were attached to a belt. There is currently a postal strike taking place that is likely to affect the return of monitors.

- *How many parents/ guardians have received reminder letters?*

At present, 7 families have been sent just one reminder letter, and 6 have since returned their monitor. 9 families have been sent two reminders, and 7 have since returned their monitors. 18 families have been sent all 3 reminder letters, of which 5 family has since returned their monitor.

- *How long did it take the parents/ guardians to return the activity monitors?*

The table below shows how many days it took for the monitors (n = 74) to be returned.

Interval from sending at ICH to receiving back at ICH (days)	No. of monitors	Percentage (%)	Cumulative Percentage (%)
7	1	1	1
8	2	3	5
9	1	1	6
10	5	7	13
11	4	4	17
12	6	8	25
13	6	8	33
14	10	14	47
15	5	7	54
16	3	4	58
17	3	4	62
18	1	1	63
19	1	1	64
20	0	0	64
21 – 27	10	14	78
> 28	16	22	100
Total	*74*	*100 %*	*100%*

- *Was there any damage to the activity monitors?*

No functional damage occurred to the activity monitors during the mail out. However, the USB port protector was missing from six monitors when returned. None of the belts were damaged, and all had remained in good condition.

6.2.2 Timesheets

Parents/ guardians were sent a timesheet and asked to record the dates that the monitor was worn, the times put on in the morning and taken off at night, any periods spent swimming, cycling, or playing vigorous sports, and any additional minutes when the monitor was not worn. They were also asked whether the week was typical for their child in terms of their usual activity. They were asked to return the completed timesheet with the activity monitor as soon as possible after the seven day monitoring period.

- *How many parents/ guardians returned the timesheets*?

A completed timesheet was returned for all of the children that wore the activity monitor.

- *Were the timesheets completed correctly*?

With the exception of one timesheet with dates monitor worn missing, all timesheets were completed correctly.

6.2.3 Feedback questionnaires

Parents/guardians were asked to complete and return the feedback questionnaire in the pre-paid envelope with the activity monitor and completed timesheet.

How many parents/ guardians returned the feedback questionnaire?
At present, 46 feedback questionnaires out of 74 returned activity monitors have been received.

6.3 Evidence from the feedback questionnaires

Responses from 46 feedback questionnaires have been logged, and the answers are shown below.

Q1. On the whole, how did you feel about your child being asked to wear an activity monitor for a week? Do you feel that you understood why and how the activity monitor was worn? Was there anything else you would have liked to have known?

I had no problems and was interested to see the outcome.

Felt ok about it, although I was not expecting to receive it as was told by interviewer that in the pilot would not be using them.

Didn't mind him wearing monitor. Understood all that was asked. Didn't need to know anything else.

Happy for her to wear it as long as she was happy and comfortable. Completely understood reasons.

I was happy for her to wear the activity monitor and fully understood what the research entailed. Good explanation and instructions so no additional questions.

I had no problems and was interested to see the outcome.

Everything was explained very clearly and I had no objections to my child wearing the device

He was alright with it when he had to wear it. I didn't really understand why he had to wear it.

It would be useful to know a little more about how the monitor works and how the information is retrieved from it.

Was ok with the request. Maybe to have seen a dummy model before it was delivered.

I was fine about her wearing the monitor. The only problem we had was that the week it rained most of the time, so a lot of activities we couldn't do.

I understood why but she was reluctant to wear it because she felt different from her friends.

I understand why it was worn and was happy for her to wear it.

OK. Not worried at all. Everything was explained. I was happy that my child was happy to wear it.

All the information was well explained before starting the physical activity monitoring. Absolutely fine, but a bit of confusion as we were told it was to be when he returned to school.

We were happy for her to wear the monitor and understood why and how it was worn.

Very happy for him to wear monitor. We both are interested in taking part in CNC.

I felt quite confident in my child wearing the monitor. I fully understood why and how the monitor was worn. There is nothing else I would have liked to have known.

She didn't mind wearing the monitor. The information we were given about the monitor told us everything we needed to know.

Ok. She enjoyed it.

Child didn't like wearing the monitor. He said it made him itch, but he understood why I asked him to wear it.

I felt ok having my daughter wear the monitor, and it was explained to me, both by the lady carrying out the survey on your behalf and the literature.

We both felt ok with our child wearing the belt it's a good idea to see how active he is.

I didn't feel any different from other days when my daughter was wearing the activity belt. I understood the reason for my daughter to wear the belt. I regard the exercise as another exercise with my daughter.

No problems. Child was very aware of why she was wearing it.

Interviewer fully explained it all to my son and he was fine with wearing and understanding why.

A bit daunted at first, but everything was quite clear and after day 1 it was fine.

I felt fine about him wearing it. I'm interested to see the results on how active he is.

I felt alright about my son wearing it.

Everything was explained well, quite happy.

I thought it was a fun idea and would produce interesting results.

I am pleased that my daughter wore it as it goes to future research.

We didn't mind her wearing the monitor, and we did understand and no there was nothing else we needed to know. We were happy to help.

Q2. Overall, how easy or difficult did you find it to understand the letter, information leaflet and teacher letter?

Very easy	33	72 %
Easy	12	26 %
Difficult	0	0 %
Very difficult	0	0 %
Missing	1	2 %
Total	*46*	*100%*

Q3. Overall, how easy or difficult did you find it to understand and complete the timesheet?

Very easy	33	72 %
Easy	9	20 %
Difficult	2	4 %
Very difficult	0	0 %
Missing	*2*	*4 %*
Total	*46*	*100%*

Q4. Overall, how confident or unconfident are you that the information on the timesheet is accurate?

Very confident	21	46 %
Confident	22	48 %
Unconfident	1	2 %
Very unconfident	1	2 %
Missing	1	2 %
Total	*46*	*100 %*

Q5. Was your child able to provide the information needed to fill out the timesheet on days when they were at school?

Always	10	22 %
Sometimes	2	4 %
A little	1	2 %
Not at all	1	2 %
N/a	31	67 %
Missing	1	2 %
Total	*46*	*100 %*

Please note that 67% of children were on school holidays during the activity monitoring

Q6. Which of these statements best describes your child's activity during the monitoring week?

My child was much more active than usual	2	4 %
My child was a little more active than usual	4	9 %
My child was as active as usual	26	57 %
My child was a little less active than usual	12	26 %
My child was a lot less active than usual	0	0 %
Missing	2	4 %
Total	*46*	*100 %*

Q7. If your child was more or less active than usual, was this change in activity mainly because their activity was being monitored?

Yes	0	0 %
No	18	39 %
I don't know	0	0 %
N/ a	28	61 %

Total	*46*	*100 %*

Q8. Did your child's teacher allow your child to wear the monitor at school?

Yes	13	28 %
No	0	0 %
I don't know	1	2%
N/a	31	67 %
Missing	*1*	*2 %*
Total	*46*	*100 %*

Q9. Do you have any other comments on the letter, leaflet, time sheet, teacher information letter or teacher involvement?

I had no problems.

School teacher information was a bit confusing as it was school holiday week.

Did not wear the monitor at school because she was on holiday.

Why was this needed?
Child was not at school during the time of being monitored.
School holidays. I was at work so I got my information from my childminder.

The teacher thought it was very exciting.

Part of the time she wore the monitor she was still on school holidays so she was probably a bit more active on these days.

Q10. Were you confused about when you had to start wearing the activity monitor?

Not confused at all	41	89 %
A little confused	3	7 %
Very confused	0	0 %
Missing	2	4 %
Total	*46*	*100 %*

Q11. In relation to returning the activity monitor, were you confused about when and how you were supposed to return it?

Not confused at all	42	92 %
A little confused	1	2 %
Very confused	0	0 %
Missing	3	6 %
Total	*42*	*100 %*

Q12. Did your child wear his/ her activity monitor at all the required times?

Yes	34	74 %

No	10	22 %
I am not sure	2	4 %
Total	*46*	*100 %*

Q13. Did your child find the activity monitor comfortable or uncomfortable to wear?

Very comfortable	15	33 %
Quite comfortable	24	52 %
Quite uncomfortable	6	13 %
Very uncomfortable	1	2 %
Total	*46*	*100 %*

Q14. Did your child find the activity monitor belt too big or too small to wear?

Too big	6	13 %
The right size	38	83 %
Too small	0	0 %
Missing	2	4%
Total	*46*	*100 %*

Q15. Was your child able to put the belt on, and take if off on their own?

Yes	42	91 %
No	3	7 %
Missing	*1*	*2 %*
Total	*46*	*100%*

Q16. Do you have any other comments regarding the comfort, ease and convenience of wearing the activity monitor?

Felt it was a bit bulky as the monitor had to sit on the hip

Excess, dangly strap got in the way sometimes.

Having now used it for a week I would not be happy to let my child wear it to school as it identifies them as being different and other children seem to enjoy fiddling with it.

The strap dangled down and monitor moved off my hip when I exercised.
At the beginning of the week she was more conscious of the monitor.

The black rubber fell off on the first day!

It kept becoming loose and not holding position
Too obvious, it could be seen under her clothes.

She said the black stopper on the side of the red box kept coming out.
First couple of days he fiddled with it as it kept moving around his body, but after a couple of days he did not notice that he had it on. Concerned about little black rubber bit on monitor kept coming off! The monitor was fitted on his vest and covered with baggy T-shirt so it was not noticeable to anyone.

The monitor did not always stay in the right position (on the hip) but moved around slightly if she was being particularly active.

The belt tended to ride up from his hip to his waist.

The monitor was easy to put on and she found it very comfortable.

Because it was school holidays we weren't in a routine so unfortunately it was off or not put on for some of the time.

It didn't tend to stay around the hip area but settled around the waist.

After wearing for just one day she had a bruise on her hip and refused to wear again. Sorry. We didn't let her take the monitor off or put in on because if she had her way she wouldn't wear it at all.

6.4 Data completeness and quality

Monitors were returned by 18 of 74 (24 %) families unworn. Five had written to say that they did not want their child to start wearing the monitor as it was the start of their school term, so did not think it was the best time for their child to wear it. Two had written to say that their child had refused to wear the monitor. One family had just had a new baby, and felt it was too demanding for their other child at the present time. One activity monitor pack was returned by Royal Mail as the 'addressee had gone away'. The remaining unworn activity monitors were returned without any timesheets or any explanation.

Thus activity monitors were returned by 56 children with at least one valid day of data. The table below summarises the number of valid days (defined as wearing the monitor for a minimum of 600 minutes per day) data for these 56 children.

No. of valid days	No. of monitors	Percentage (%)	Cumulative frequency (%)
7	11	20	20
6	11	20	40
5	7	13	53
4	9	16	69
3	8	14	83
2	5	9	92
1	5	9	99
Total	*56*	*100%*	*100*

38 children provided at least four valid days of data, and all monitors had at least one valid day of data.
Three of the five children with only one valid day of data had worn the monitor for one day only.

Findings from the feedback questionnaire show that the children's behaviour was not altered as a result of them wearing the activity monitors, therefore the data represents the children's 'normal' physical activity. Although, 37 % of children changed their physical activity levels slightly, and 5 % changed their physical activity levels dramatically, these changes were not because they

were wearing the monitors. Nearly all parents said this was because their children were on school holidays.

7. Findings from Pilot Mailing (Feedback Certificate mailing)

7.1 Sent documents

Once parents had returned their child's activity monitors to ICH, the activity data were downloaded and feedback certificate packs were sent. Parents/ guardians were told that their child would receive a certificate summarising their activity levels within 4 weeks after sending back the activity monitor. The feedback certificate mailing comprised of the following enclosures:

1. Cover letter to explain the graph on the feedback certificate (Appendix 5)
2. Feedback certificate showing a graph summarising one day of the child's activity levels
3. Feedback questionnaire for the parent and child to tell us their views on the feedback certificate
4. Pre-paid 1st class envelope for posting back the completed feedback questionnaire

The feedback certificates were produced by downloading and saving the activity data from the monitors using ActiLife software. This data is then processed by a macro that was used in the ALSPAC study, which produces a certificate with a personalised graph summarising the child's first day of activity. Parents/ guardians were told which date this graph represented. Each graph also had a red line which corresponds to 3600 counts/minute. It was explained to parents that any activity above this line on the graph shows when their child was moderately intense. Additional information on the current advice from the Department of Health was also given (i.e. that children should exercise at this level or higher for about an hour a day on average).

Any monitors that were worn but did not have enough valid data to produce a summary graph were sent a certificate without a graph on. The corresponding cover letter apologised and explained that unfortunately their child's monitor had problems in correctly identifying their child's activity.

- *How many children have been sent their feedback certificates?*

All 56 children that wore and have returned their activity monitors have been sent their feedback certificates.

- *How long after the activity monitor return date were the feedback certificates sent?*

The table below shows how many days after the activity monitors were returned (n=56) the feedback certificates were sent

Interval between receiving monitor back at ICH to sending feedback certificate (days)	No. of monitors	Percentage (%)
≤7	38	68
8 - 14	18	32
15 - 21	0	0
22 - 28	0	0

≥ 29 (4 weeks)	0	0
Total	*56*	*100*

- *Were there any complications sending the feedback certificates ?*

None.

7.2 Returned documents – feedback questionnaire

Parents/guardians were asked to complete and return the feedback questionnaire on the feedback certificate in the pre-paid envelope supplied.

How many parents/ guardians returned the feedback questionnaire?
At present, 16 out of 49 feedback certificates have been received.

7.3 Evidence from the feedback questionnaires

Responses from 16 feedback questionnaires have been logged into a password protected database, and the answers are shown below.

*Q1. How easy or difficult did **you** find it to understand the feedback certificate and the information leaflet?*

Very easy	8	50 %
Easy	4	25 %
Difficult	2	12.5 %
Very difficult	0	0 %
Missing	*2*	*12.5 %*
Total	*16*	*100 %*

*Q2. How easy or difficult did **your child** find it to understand the feedback certificate?*

Very easy	3	19 %
Easy	11	69 %
Difficult	0	0 %
Very difficult	1	6 %
Missing	1	6 %
Total	*16*	*100 %*

*Q3. How interesting did **you** find the feedback certificate?*

Very interesting	7	44 %
Interesting	7	44 %
Uninteresting	1	6 %
Very uninteresting	0	0 %
Missing	1	6 %
Total	*16*	*100 %*

*Q4. How interesting did **your child** find the feedback certificate?*

Very interesting	4	25 %
Interesting	8	50 %
Uninteresting	3	19 %
Very uninteresting	0	0 %
Missing	*1*	*6 %*
Total	*16*	*100 %*

*Q5. Did **you** find the feedback certificate and the information leaflet useful?*

Very useful	11	73 %
A little useful	3	19 %
Not at all useful	1	7 %
Missing	*1*	*6 %*
Total	*16*	*100 %*

Q6. Do you or your child have any other comments on the feedback certificate and the information leaflet?

As the certificate only shows one day activity out of the seven monitored it's hard to get a true figure, as it could be possible that the day covered was the least active of all days monitored.
Just wondered if the day you picked to show on the graph was the average, or the most active
I didn't understand how he was more active at 8pm when there were other times in the day where he was more active. There was no way that was the time when he was most active.
We were hoping for graphs showing all days, not just one. I was also hoping for a more detailed summary / interpretation of the graphs & an example of an average graph with which to compare. I think graphs should not be on the certificates, the dates should be eg from … to … Perhaps instead of a graph something saying you achieved …. counts per minute.
Unfortunately our certificate was unable to indicate how the trial had worked, due to the monitor he wore having problems identifying his activity, although it was nice to have it was of little real interest.
It was interesting to know that my daughter is getting quite a bit of exercise through the day. My daughter was pleased with her certificate.
We really enjoyed doing the whole thing. Thank you!
It would be interesting to see a printout for the activity levels for each of the 7 days instead of just one.

8. Conclusions and Recommendations for Main Stage

8.1 Acceptability

In general, the findings from the dress rehearsal study show a good degree of acceptability from parents and children in relation to the wearing of the physical activity monitor for the purposes of measuring activity levels .

At the interview nearly all parents/ guardians (87%) agreed and gave consent for their children to take part in wearing the activity monitor. Most (81%) children that were sent activity monitors packs took part by wearing the monitor.

The physical activity monitor was well received by most parents and children. Parents were interested in the idea of the physical activity measurement. Respondents and cohort children were very pleased to find this out that they would receive a feedback certificate summarising their child's activity over the week they wore the monitor.

There were mixed reactions to the idea of wearing the monitor from the cohort children. The majority had no problems with wearing it, and some were excited about the idea. Some, however, were worried about being picked on by their friends. The cohort children were more keen than their parents to know why they were wearing the monitor.

8.2 Feasibility

In general, the findings from the pilot study show that direct collection of children's physical activity levels using Actigraph physical activity monitors in cohort members is feasible. Previous studies such as ALSPAC have been based on subjects visiting a clinic where a trained interviewer fits and explains the activity monitor. The current pilot study shows that posting physical activity monitors to subjects can be a reliable and efficient way of obtaining valid data on children's activity levels.
Of the families that gave consent at the interview 69% have returned Actigraphs that satisfied the validity criteria (> 4 days with 10 hours recording). This included 19% that satisfied the validity criteria for seven days. The compliance achieved is comparable, and even higher than some levels reported in previous large fields studies that administer Actigraph's through clinic visits (Van Coevering, 2005).

8.3 Changes to documents

Prior to their interview families were sent a basic information leaflet explaining the physical activity project. At the interview children were asked if they would like to participate in wearing the monitor. Parents/ guardians that did agree to their child wearing the Actigraph were asked to sign a consent form. At the interview families were not given any documents, but were told that detailed information would be sent. Initial feedback from the interviewers was positive, but they suggested that they could be given copies to show parents in case they were interested. It is recommended that in the main stage interviewers are given laminated copies of the information leaflet, timesheet and the teacher letter.

8.3.1 Parent cover letter

In general, the parent cover letter was well received and all parents/ guardians said that they found the letter 'very easy' or 'easy' to understand.

The only suggested change to the cover letter for the main stage is that any information regarding the feedback questionnaire should be removed. In addition, it should be made clear that parents/ guardians will not be charged if they lose or damage the monitor, but that they should still ring ICH to let them know of the situation.

8.3.2 Information leaflet

The information leaflet was also positively received and all parents/ guardians found it 'easy' or 'very easy' to understand.

In addition, nearly all parents/ guardians were 'not confused at all' about when they had to start wearing the monitor, suggesting that the information sheet served its purpose. Only 7% of parents/ guardians said they were a 'little confused' as to when they should start wearing the monitor. Furthermore, nearly all were 'not confused at all' about when and how they were supposed to return the monitor.

There a few recommended changes to the information leaflet. Firstly, we suggest that any information regarding removing the activity monitor during vigorous activities should be removed as parents may interpret this in variable way and there is not objective reason for this. This would affect data validity dramatically, and the aim of the study is to monitor all physical activity, particularly vigorous activity. It is also recommended that any information regarding the flashing light being present when the monitor is on should be omitted from the information leaflet. This is because we now plan to disable the flashing light on the activity monitor for two reasons. Firstly, we would like to sample data at a higher frequency using 10 second epochs which is now recommended for children of this age so that sporadic bursts of activity can be captured. This shorter epoch requires more battery and is possible for the full 7 days with these latest models of accelerometers if the 'flashing light' setting is disabled. Secondly, it eradicates the problem of parents calling, and often worrying when monitors have unknowingly been sent without the flashing mode being enabled. The only function of the flashing mode is to show that the activity monitor is on, but by turning this off data collection is not affected. The final recommended change to the information leaflet is that it is made more personal by replacing 'the child' to 'your child' throughout.

8.3.3 Physical activity monitor and belt

Belt

Children were allocated different sized belts according to their waist measurement. Any children with a waist measurement of under 52cm were sent a small (24"/ 61cm) belt, and any children with a waist measurement of 52cm or over were sent a larger belt (32"/ 81.3cm). 18% of children had a waist measurement of less than 52cm, and 82% of children had a waist circumference of 52cm or larger.

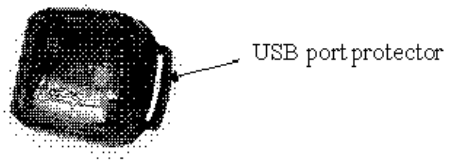
Information received from the feedback questionnaire regarding the comfort, size and ease of wearing the activity monitor was conflicting. Most children found the activity monitor 'quite comfortable' to wear and 'the right size'. Furthermore, nearly all parents/ guardians stated that their child was able to put the belt on and take it off on their own. There were also several comments mentioning how happy their child was to wear the monitor, and that they had encountered no problems.

However, there were some negative findings regarding the belts. The main concern from the feedback questionnaires was that 14% of children of children found their activity monitor belt too big. All six children that did find their belt too big had been sent larger belts. However, their waist sizes ranged from 54cm – 64cm. A few families also commented that the strap dangled down and got in the way a bit, as well as saying that the monitor moved around quite frequently because the belt was too big.

To help make the belts more comfortable to wear, and to resolve any problems with the sizes of the belts it is recommended that the waist boundaries for the allocation of belt sizes be amended. The smaller belts should possibly be given to children with a waist measurement under 62cm, and children with a waist measurement of 62cm or larger should be given the larger sized belt.

Activity Monitor

An additional unanticipated issue with the activity monitor was regarding the USB port protectors. In six of the returned monitors the USB port protectors were missing. Three parents/ guardians also commented that the USB protector kept coming out. This is of particular concern because the protectors are needed in order to prevent any damage to data collection and download. It is recommended that spare protectors are purchased from Actigraph.



Another problem that occurred with the activity monitors was regarding the stickers that were put on the back of the monitors. Each monitor had an activity monitor ID number and a number to call if the monitor was found by anyone. Some families had tried to remove the stickers, despite being asked not to. It is suggested that the same information is put on anti- tamper labels which cannot be removed.

8.3.4 Timesheet and summary

Feedback regarding the timesheet from the initial interviews was positive, with parents understanding the importance of accurately recording the activities of the child. Although interviewers expressed doubts over whether parents would remember to fill the sheets in, all families returned their completed timesheets and nearly all families correctly filled in the timesheets.

Findings from the feedback questionnaire found that nearly all parents/ guardians found the timesheet 'very easy' or 'easy' to understand and complete, although two families did say that it was 'difficult' to understand and complete. Also, nearly all were either 'very confident' or 'confident' that the information on the timesheet was accurate. Furthermore, for those children that were at school during the monitoring period nearly all parents/ guardians

felt that their child was able to provide the information needed to fill out the timesheet on days when they were at school.

Only two parents/ guardians felt 'unconfident' that the information on the timesheet was accurate, and two families stated that their children could provide only 'a little' or 'no' information to fill out the timesheet on days when they were at school. There were no further written comments regarding the timesheet.

The only recommended change to the timesheet is that the 'time spent in vigorous activities' column should be removed because it is now recommended that the monitor is worn during vigorous activities.

8.3.5 Letter for child's class teacher.

In general, the letter for child's class teacher was well received and all parents/ guardians said they found it 'easy' or 'very easy' to understand.

At the interviews there was some concern that the child wearing the activity monitor in class would pose an unwelcome burden for their teacher. However, the feedback questionnaire revealed that all of the teachers of children who wore the monitor during term time did allow them to wear the monitor. One family even commented that their child's teacher thought it was very exciting.

The majority of children who took part in the activity monitoring were on school holidays. As a result a few parents commented that the teacher letter was not necessary, and one parent even said that this confused her. It would, however, be extremely difficult to know when children are on holidays as term time varies by country as well as by school! It is recommended that all families continue to be sent the teacher letter, but it should be stressed on the information leaflet and also by interviewers that this letter is only needed during school term time.

No other recommended changes to the letter for the child's class teacher are to be made for the main stage.

8.3.6 Feedback questionnaire (activity monitor mailing)

We have received no negative comments regarding the feedback questionnaire. However, no feedback questionnaire will be sent during the main stage as we will no longer need information to aid the main stage design.

8.3.7 Feedback certificate

There were mixed responses from the feedback questionnaire regarding the feedback certificate.

Nearly all parents/ guardians (86%) and their children (93%) found the feedback certificate 'very easy' or 'easy' to understand. In addition, nearly all parents/ guardians (93%) and their children (80 %) found the feedback certificate 'very interesting' or 'interesting'. Furthermore, nearly all parents/

guardians (73%) found the feedback certificate and the information leaflet very useful.

Half of all parents that returned feedback forms recommended changes that would make the feedback certificate more useful. A few parents suggested that it would have been useful to see graphs for all the days that their child wore the monitor, because it could be possible that the day covered was the least active of all the days monitored. One parent recommended that the graphs should not be on the certificate as their child was not really interested in this.

It is recommended that children will continue to receive a feedback certificate. However, the format of this certificate will be revised. It is recommended that the following changes are considered:

1. Getting the certificate templates designed professionally.
2. Printing graphs on a separate page to the certificate.
3. Either; 1) producing a graph that summarizes the child's activity throughout the week, in addition to the graph summarising one day of activity, or 2) producing graphs for all days that the physical activity monitor was worn.

8.3.8 Cover letter to explain the feedback certificate

The feedback questionnaire revealed that nearly all parents/ guardians (73%) found the information leaflet useful.

As a result, it is therefore recommended that families still receive the cover letter which thanked participants for taking part in the activity monitoring and also explained the graphs. However, the appearance of the cover letter was not very professional. It is recommended that the cover letter is designed and printed professionally. Depending on the decision of which changes are to be made to the feedback certificate the content of the cover letter will need to be revised.

8.3.9 Feedback questionnaire (feedback certificate mailing)

We have received no negative comments regarding the feedback questionnaire for the feedback certificate mailing. However, no feedback questionnaire will be sent during the main stage as we will no longer need information to aid the main stage design.

8.3.10 Envelopes

Activity monitor mailing envelope

The physical activity monitor pack was sent out in an A4 windowed envelope. In order to prevent loss of activity monitors 'return to sender' information was pre-printed on the front of the envelope. It is recommended for practical reasons and to save time that in the main stage the envelopes will continue to

be pre-printed with 'return to sender' information. A reasonable quote for the main stage envelopes has already been obtained from a printer.

The main stage activity monitor mailing will include the same enclosures as the dress rehearsal except for the feedback certificate. As the contents were quite bulky 'peel and seal' window envelopes were used to prevent any envelopes opening unnecessarily. These proved to be effective in preventing this, and therefore it is recommended that the same envelopes will be used in the main stage.

One unanticipated practical issue with the envelopes was the time consuming process of writing the department cost code and '1st class' on each envelope. It is therefore recommended that this information is pre-printed on the envelopes in addition to the 'return to sender' information. Alternatively, if this is not cost effective suitable self inking 'stampers' could be purchased.

Pre-paid envelope for returning activity monitor to ICH

All families returned the activity monitor and belt in the correct pre-paid envelope. The padded material suitably protected the activity monitors, and the size was suitable for returning all documents in addition to the activity monitors. This should therefore remain the same for the main stage.

Feedback certificate mailing envelope

The feedback certificate mailing was sent out in an A4 envelope. There were no reported problems with this and as a result this will remain the same for the main stage. It is recommended that a self inking 2nd class 'stamper' be purchased, in addition to a number 'stamper' for the department code to help save time on mailing procedures.

9. Conclusion

The dress rehearsal has shown a good degree of acceptability from parents and children in relation to wearing the physical activity monitor for the purposes of measuring activity levels. The current study also shows that posting physical activity monitors to subjects is a feasible way of obtaining valid data on children's activity levels. The lose rate of 17% of monitors with each issue is comparable with other studies. The data quality seems good by comparison with studies using fitting of monitors by trained staff. Given the importance of obtaining objective measurements of physical activity this seems a reasonable loss as alternative self report measures of activity are known to be unreliable. The current work provides sufficient confidence to recommend inclusion of accelerometers in main fieldwork pending funding.

APPENDICES

Appendix 1

Our Ref: «Serial_No»/ «Child_No»

«Main_title» «Main_forename» «Main_surname» and «Partner_title»
«Partner_forename» «Partner_surname»
«Address_line_1»
«Address_line_2»
«Address_line_3»
«Address_line_4» «Address_line_5»
«Postcode»

15 October 2012

Dear «Main_forename» and «Partner_forename»,

Child of the New Century - Age 7 Survey Pilot
Physical Activity Monitoring

Thank you very much for your help with this important part of the study.

Please find enclosed your physical activity monitor pack containing:

1. **information leaflet** - please take some time to read through this
2. **physical activity monitor and belt**
3. **timesheet** for you and your child to complete
4. **teacher letter** for you to fill in and give to your child's class teacher
5. **feedback questionnaire** for you and your child to tell us your views
6. **pre-paid envelope** for posting back the monitor and completed documents

Your child should start wearing the activity monitor tomorrow morning, and continue to wear it every day for 7 days.

Please return the activity monitor, belt, completed timesheet, and completed feedback questionnaire back to us in the pre-paid envelope as soon as possible after the 7 days. We will then send your child a certificate summarising their activity levels.

If you or your child no longer wish to take part in the activity monitoring, please return the monitor and belt in the pre-paid envelope provided. If the monitor is lost or damaged, please call Carly Rich on 020 7905 2691.

If you have any other questions or would like further information about this part of the study please call Carly Rich on 020 7905 2691.

Yours sincerely,

Professor Heather Joshi OBE
Study Director

Professor Carol Dezateux
Institute of Child Health

Carly Rich
Institute of Child Health

Appendix 2

enclosed feedback questionnaire. This is helpful for the design of the main stage of the survey.

When should I return the activity monitor and completed documents?
The activity monitors, belts, completed timesheet, and completed feedback form must be returned as soon as possible after the 7-day monitoring period is over. Enclosed is a pre-paid envelope to send them back in. You do not need a stamp. It is very important that the activity monitor is returned promptly. This is because we only have a limited number and the monitor will be sent to another family.

Please try not to lose or damage the activity monitor. However, if you do lose or damage the monitor, please call Carly Rich on 020 905 2691. We will not charge you to replace or repair it. We would still like you to return the monitor even if it is damaged.

What will happen to the information collected on the activity monitor?
The information will be treated in strict confidence in accordance with the Data Protection Act. The information you provide will be used solely to help with the design of the main survey.

Will I get any feedback about my child's activity levels?
Your child will receive a feedback certificate summarising their activity levels within 4 weeks of sending back the activity monitor.

How do I find out more about this part of the study?
This part of the study in being carried out in collaboration with the researchers at the Institute of Child Health, University College London. They are responsible for sending out the activity monitors and sending you feedback after the monitor has been returned to them. **If you have any other questions or would like further information about this part of the study, please call Carly Rich on 020 7905 2691.**

Thank you for your help

Child of the New Century
Age 7 Survey Pilot
Physical Activity Monitoring

We would like to measure your child's physical activity using an activity monitor. This leaflet explains more about the activity monitor and activity monitor documents.

What is the Actigraph activity monitor?
The activity monitor is a small, lightweight device that is worn around the waist on a belt. It is designed to measure physical activity by measuring and recording all your child's movements.

The activity monitor contains a spring which moves up and down when your child moves around. The movements of the spring are recorded onto a micro-chip inside the activity monitor. There is a flashing light on the activity monitor which indicates that it is on. You might have an on/off button on the activity monitor but these have been disabled. Nothing will happen if it is pressed.

On the back of your child's activity monitor is a number. This will be the same number that is on your child's timesheet. It would be helpful if you and your child could remember their activity monitor number. This is because another family member or friend might also be wearing a monitor and we do not want them to get mixed up. Please do not take the sticker off the monitor when you return it.

How should the activity monitor be worn?
The activity monitor is worn on a belt around the waist. The activity monitor should be positioned on the side of the hip (on top of the 'bony' part of the hip). The activity monitor should be fitted tightly but comfortably to your child's body. The belt can be adjusted to the correct fit. In order to accurately record you child's movement, it is important that the activity monitor only moves when your child's body moves. For this reason, it is essential that the activity monitor

should be fitted snugly against the child's body and not have any 'free movement' i.e. it should not be allowed to 'flop around'.

It should usually be worn on top of indoor clothing. If your child prefers he or she can also wear it against the skin underneath their clothing, though they may find that the belt rubs slightly on their skin or that the monitor feels cold. It should not be worn on top of outdoor clothing like coats. Finally, it doesn't really matter which way up the monitor goes.

When should my child start wearing the activity monitor?
Your child should start wearing the activity monitor on the morning after you receive it. It doesn't matter which day of the week your child starts on. The activity monitor is pre-programmed to turn on automatically at 5am in the morning of the second day after it is posted out. Unless the monitor has been delayed in the post, this should be the morning of the day after you receive it. When the monitor is turned on, a flashing light is visible on the monitor. **If this flashing light is not visible on the morning after you receive it, the monitor should not be worn and you should contact Carly Rich on 020 7905 2691.**

If the monitor has been delayed in the post, you may find that the monitor is already on when you receive it i.e. the flashing light is visible. That's fine. Your child should still start to wear it on the morning after it is received as normal. We will know from the timesheet when your child actually started wearing it. The monitor is not programmed to turn off on a particular date so it should remain on for seven days (even if there is a delay receiving it).

At what times should my child wear the activity monitor?
The activity monitor should be worn every day for 7 continuous days, and should be put on first thing in the morning as soon as the child gets up and worn until the child goes to bed. The activity monitor should not be worn during swimming or when the child is having a bath or shower. However, the monitors are shower proof so it doesn't matter if they get a little bit wet in the rain. In addition, if the child is taking part in extremely vigorous sports e.g. rugby where there is a danger that the monitor might injure someone or get damaged, they should take it off. We would like your child to behave just as they would normally.

What is the timesheet for?
You will be sent a timesheet and asked to keep a record of the dates that the activity monitor is worn, the time the activity monitor is put on in the morning and taken off at night and any periods that the monitor was not worn for any reason. In addition, any periods spent swimming, cycling, or playing vigorous sports should be recorded on the timesheet.

We want to record the time the child has spent swimming and playing vigorous sports as these are the only kinds of physical activity for which the monitor cannot be worn. We want to record the time the child has spent cycling because this kind of activity cannot be measured very accurately by the monitor (though it should still be worn during cycling). We would also like you to indicate whether or not the week that the child wore the activity monitor was a typical week in terms of their physical activity.

What about when my child is at school?
If your child receives their activity monitor during term time please encourage your child to wear it at school. We hope that most teachers will be happy for children to wear the monitors at school. A letter is enclosed for your child's class teacher which explains to them why your child is wearing the monitor. You should fill in the relevant details on the letter, including your child's activity monitor number which you can find on the back of the activity monitor or on the timesheet. We understand that you may not always know if the child has taken the activity monitor off when they are at school. If possible, it would be helpful if you could ask your child if they took the activity monitor off at school for any reason, and record this on the timesheet.

What is the feedback questionnaire for?
We would be very grateful if you could complete and return the

Appendix 3

Child of the new Century

Child of the New Century
Age 7 Survey Pilot
Physical Activity Monitoring

The child first and always

Summary of key points

Your child should wear the monitor...

- Every day for 7 continuous days starting the morning after received
- At all times from first thing in the morning to last thing at night - except when swimming, in shower or bath, or playing extremely vigorous sports
- On a belt around the waist
- On the right hip (on the 'bony' part of the hip)
- On top of indoor clothing (or against skin if preferred)
- Tightly but comfortably against body (not 'flopping around')

You should record on the timesheet (on the back of this form)...

- Dates that the monitor was worn
- Times monitor was put on in the morning and taken off at night
- Any periods spent swimming, cycling (the monitor should still be worn during cycling), or playing vigorous sports
- Any other periods when monitor not worn
- Whether typical week or not

You should also...

- Fill in and give the letter about the activity monitor to your child's class teacher
- Fill in the feedback questionnaire
- Return the activity monitor, belt, completed timesheet and completed feedback questionnaire **as soon as possible** after the 7 day period in the pre-paid envelope provided

We will...

- Send you a summary of your child's activity within 4 weeks after the monitor is sent back
- Treat the information recorded on the timesheet in strict confidence in accordance with the Data Protection Act.
- Answer any questions you may have. If you have any questions or problems with the monitor or timesheet, please call Carly Rich from the Institute of Child Health on 020 7905 2691.

Appendix 3

Child of the new Century

Child of the New Century
Age 7 Survey Pilot
Physical Activity Monitoring

The child first and always

Summary of key points

Your child should wear the monitor...

- Every day for 7 continuous days starting the morning after received
- At all times from first thing in the morning to last thing at night - except when swimming, in shower or bath, or playing extremely vigorous sports
- On a belt around the waist
- On the right hip (on the 'bony' part of the hip)
- On top of indoor clothing (or against skin if preferred)
- Tightly but comfortably against body (not 'flopping around')

You should record on the timesheet (on the back of this form)...

- Dates that the monitor was worn
- Times monitor was put on in the morning and taken off at night
- Any periods spent swimming, cycling (the monitor should still be worn during cycling), or playing vigorous sports
- Any other periods when monitor not worn
- Whether typical week or not

You should also...

- Fill in and give the letter about the activity monitor to your child's class teacher
- Fill in the feedback questionnaire
- Return the activity monitor, belt, completed timesheet and completed feedback questionnaire **as soon as possible** after the 7 day period in the pre-paid envelope provided

We will...

- Send you a summary of your child's activity within 4 weeks after the monitor is sent back
- Treat the information recorded on the timesheet in strict confidence in accordance with the Data Protection Act.
- Answer any questions you may have. If you have any questions or problems with the monitor or timesheet, please call Carly Rich from the Institute of Child Health on 020 7905 2691.

Appendix 4

Child of the New Century
Age 7 Survey Pilot

Physical Activity Monitoring
Letter for Class Teacher

Dear ……

My child: ……

is taking part in the pilot study for the Age 7 Survey of the Child of the New Century study.

This is an important national survey which is exploring what it is like to grow up in the 21st Century by following around 19,000 children born in the UK in 2000/2001. The study is run by the Centre for Longitudinal Studies, a research centre in the Institute of Education, based at the University of London. The interviews are being carried out by the National Centre for Social Research (NatCen), an independent research organisation. Child of the New Century is paid for the ESRC (the government's Economic and Social Research Council) and other government departments from all countries of the UK.

We have already taken part in the pilot interviews for this study. The study also involves collecting information about my child's physical activity over a period of 7 days using an activity monitor. The activity monitor is a small, lightweight device that is worn around the waist on a belt. This part of the study is being carried out in collaboration with researchers at the Institute of Child Health (ICH), University College London.

I am writing to let you know that my child is wearing an activity monitor for 7 days for this research project. It is important that the monitor is worn at all times, including when he or she is at school. The only exceptions are during activities such as swimming, bathing or showering when the monitor will get wet and during extremely vigorous contact sports such as rugby where there is a danger that the monitor might injure someone or get damaged.

Thank you for your co-operation

My child's activity monitor number is……

Name ……

Signed…… ***Date***……

If you would like to know more about the Child of the New Century study, please contact the Centre for Longitudinal Studies on 0800 092 1250, or if you have any queries on the physical activity monitor please contact Carly Rich at the Institute of Child Health on 020 7905 2691.

Appendix 5

Child of the New Century – Age 7 Survey Activity Monitor Certificate

Thank you and your child very much for your help with this important part of the study. As a way of us saying thank you please find enclosed an activity certificate for your child. Please take some time to read through this leaflet as it will help you to understand the activity graph on your child's certificate, and also help you to explain the graph to your child.

Your Child's Activity Graphs

For You

- The graph on your child's certificate shows how active your child was from 5 o'clock in the morning until midnight, on one day of the week that they were wearing the activity monitor.
- The bars on the graph shows how active your child was at any particular time.
- When the bars are higher this shows when you child was more active, and when the bars are lower this shows when you child was less active.
- If there are no bars on the graph at certain times this is when they were not wearing the monitor (e.g. when they were asleep or when they forgot to wear the monitor).
- Any bars above the red line at 3600 counts/min show when you child's activity was moderately intense.
- Current advice from the Department of Health is that children should exercise at this level or higher for about an hour a day on average.

For You To Explain To Your Child

- See if your child can see when they first put the monitor on (the first time when the bars appear on the graph), and probably when they first got up.
- Ask your child to spot some points when the bars are higher (when they were most active).
- Your child might be able to pick out when they went to school or when they first went out (particularly if they walked), and also when they took part in any sports activities or had a PE lesson.
- They might also be able to see when they took part in anything else active such as playing with friends, taking the dog for a walk, or going shopping.
- Try to see if your child can spot some times when the bars on the graph are lower (when [they were doing inactive things).
- Your child might be able to spot times when they were sitting down (in class or at home), watching TV, having something to eat, or playing a computer game.

We would be very grateful if you could complete and return the enclosed feedback questionnaire in the pre-paid envelope. This is very helpful for the design of the feedback certificates in the main stage of the survey.
If you have any other questions or would like further information about this part of the study please call Carly Rich on 020 7905 2691.

Appendix 6

Timetable and Sample

Fieldwork (NatCen/ IOE)
It is anticipated that the timetable and sample characteristics for the main stage activity monitoring fieldwork will be as follows:

Wave	**Country**	**Estimated Dates of birth**	**Fieldwork period**	**Estimated Number of Issued Families**	**Estimated Number of Interviewed Families**	**Estimated Number of Children agreeing to Activity Monitor (assume 85% consent rate and apply multiplication factor of 1.014 for multiple births)**
E1	England	Sept 1 2000-February 28th 2001	January 21st 2008-June 6th 2008 (20 weeks)	5725	4725	4070
W1	Wales	Sept 1 2000-February 28th 2001	January 21st 2008-June 6th 2008 (20 weeks)	1275	1050	905
E2	England	March 1st 2001-January 11th 2002	March 31st 2008-September 12th 2008 (24 weeks)	5725	4725	4070
W2	Wales	March 1st 2001-January 11th 2002	March 31st 2008-September 12th 2008 (24 weeks)	1275	1050	905
S1	Scotland	Nov 24th 2000-Feb 28th 2001 (if started school in August 2005)	February 25th 2008-August 29th 2008 (26 weeks)	400	350	300
N1	Northern Ireland	Nov 24th 2000-July 1st 2001	February 25th 2008-August 29th 2008 (26 weeks)	900	755	650
S2	Scotland	March 1st 2001-January 11th 2002 (+any earlier births started school August 2006)	August 1st 2008-December 31st 2008 (22 weeks)	1700	1420	1225
N2	Northern Ireland	July 2nd 2001-Jan 11th 2002	September 1st 2008-December 31st 2008 (18 weeks)	900	755	650
TOTAL				17, 900	14,830	12,775

Laboratory Work (ICH)
However, the table below shows an estimated timetable with the aim of delivering activity monitors within 6 weeks of interviews.

Wave	Interviews	ICH Receives samples (+28 days)	ICH sends monitors (+7 days)	Monitors Returned (4 week cycle)	Feedback Certificate Sent (within 4 weeks)
E1	January 21st 2008- June 6th 2008 (20 weeks)	February 18th 2008 – July 4th 2008	February 25th 2008 – July 11th 2008	March 24th 2008 – August 8th 2008	April 21st 2008 – September 5th 2008
W1	January 21st 2008- June 6th 2008 (20 weeks)	February 18th 2008 – July 4th 2008	February 25th 2008 – July 11th 2008	March 24th 2008 – August 8th 2008	April 21st 2008 – September 5th 2008
E2	March 31st 2008- September 12th 2008 (24 weeks)	April 28th 2008- October 10th 2008	May 5th 2008 – October 17th 2008	June 2nd 2008 – November 14th 2008	June 30th 2008 – December 12th 2008
W2	March 31st 2008- September 12th 2008 (24 weeks)	April 28th 2008- October 10th 2008	May 5th 2008 – October 17th 2008	June 2nd 2008 – November 14th 2008	June 30th 2008 – December 12th 2008
S1	February 25th 2008-August 29th 2008 (26 weeks)	March 24th 2008 -September 26th 2008	March 31st 2008 – October 3rd 2008	April 28th 2008 - October 31st 2008	May 26th 2008 – November 28th 2008
N1	February 25th 2008-August 29th 2008 (26 weeks)	March 24th 2008 -September 26th 2008	March 31st 2008 – October 3rd 2008	April 28th 2008 - October 31st 2008	May 26th 2008 – November 28th 2008
S2	August 1st 2008- December 31st 2008 (22 weeks)	August 29th 2008-January 28th 2009	September 5th 2008 – February 4th 2009	October 3rd 2008 – March 4th 2009	October 31st 2008 – April 1st 2009
N2	September 1st 2008- December 31st 2008 (18 weeks)	September 29th 2008- January 28th 2009	October 6th 2008 – February 4th 2009	November 3rd 2008 – March 4th 2009	December 1st 2008 – April 1 2009

Appendix C: Parent cover letter

Our Ref: «Serial_No»/ «Child_No»

«Main_title» «Main_forename» «Main_surname» and «Partner_title» «Partner_forename»
«Partner_surname»
«Address_line_1»
«Address_line_2»
«Address_line_3»
«Address_line_4» «Address_line_5»
«Postcode»

25 July 2012

Dear «Main_forename» and «Partner_forename»,

Child of the New Century - Age 7 Survey
Physical Activity Monitoring

Thank you very much for your help with this important part of the study.

Please find enclosed your physical activity monitor pack containing:

1. **information leaflet** - please take some time to read through this
2. **physical activity monitor and belt**
3. **timesheet** for you and your child to complete
4. **teacher letter** for you to fill in and give to your child's class teacher (if your child is at school during the 7-day monitoring period)
5. **pre-paid envelope** for posting back the monitor and completed documents

Your child should start wearing the activity monitor tomorrow morning, and continue to wear it every day for 7 days.

Please return the activity monitor, belt, and completed timesheet back to us in the pre-paid envelope as soon as possible after the 7 days. We will then send your child a certificate summarising their activity levels.

If you or your child no longer wish to take part in the activity monitoring, please return the monitor and belt in the pre-paid envelope provided. If the monitor is lost or damaged we will not charge you to replace or repair it, but please let Carly Rich know on 0800 030 4124 (free phone).

If you have any other questions or would like further information about this part of the study please call Carly Rich on 0800 030 4124 (free phone).

Yours sincerely,

Professor Heather Joshi OBE Study Director	Professor Carol Dezateux UCL, Institute of Child Health	Carly Rich UCL, Institute of Child Health

Appendix D: Information leaflet

NatCen

Child of the New Century

Age 7 Survey Physical Activity Monitoring

We would like to measure your child's physical activity using an activity monitor. This leaflet explains more about the activity monitor and activity monitor documents.

What is the Actigraph activity monitor?

The activity monitor is a small, lightweight device that is worn around the hips on a belt. It is designed to measure physical activity by measuring and recording all your child's movements.

The activity monitor contains a spring which moves up and down when your child moves around. The movements of the spring are recorded onto a micro-chip inside the activity monitor.

On the back of your child's activity monitor is a number. This will be the same number that is on your child's timesheet. It would be helpful if you and your child could remember this activity monitor number. This is because a family member, friend or another child in their class might also be wearing a monitor and we do not want them to get mixed up. Please do not take the sticker off the monitor when you return it.

How should the activity monitor be worn?

The activity monitor is worn on a belt. It should be positioned on top of the right hip (on top of the 'bony' part of the hip). The activity monitor should be fitted tightly but comfortably to your child's body. The belt can be adjusted to the correct fit. In order to accurately record your child's movement, it is important that the activity monitor only moves when your child's body moves. For this reason, it is essential that the activity monitor is fitted snugly against your child's body and that it does not have any 'free movement' i.e. it should not be allowed to 'flop around'.

It should usually be worn on top of indoor clothing. If your child prefers he or she can also wear it against the skin underneath their clothing, though they may find that the belt rubs slightly on their skin or that the monitor feels cold. It should not be worn on top of outdoor clothing like coats. Finally, it doesn't matter which way up the monitor goes.

What will happen to the information collected on the activity monitor and timesheet?

The information will be treated in strict confidence in accordance with the Data Protection Act. The information you provide will be used solely to build up a picture of life in the UK today and will not be released in any way that enables you to be identified.

Will I get any feedback about my child's activity levels?

Your child will receive a feedback certificate summarising their activity levels within 4 weeks of sending back the activity monitor.

How do I find out more about this part of the study?

This part of the study in being carried out in collaboration with the researchers at the Institute of Child Health, University College London. They are responsible for sending out the activity monitors and sending you feedback after the monitor has been returned to them. **If you have any other questions or would like further information about this part of the study, please call Carly Rich on 0800 030 4124 (free phone).**

Thank you for your help

When should my child start wearing the activity monitor?

Your child should start wearing the activity monitor on the morning after you receive it. It doesn't matter which day of the week your child starts on. The activity monitor is pre-programmed to turn on automatically at 5am in the morning of the second day after it is posted out. Unless the monitor has been delayed in the post, this should be the morning after you receive it.

If you think your monitor has been delayed in the post, this is fine. Your child should still start to wear it on the morning after it is received as normal. We will know from the timesheet when your child actually started wearing it. The monitor is not programmed to turn off on a particular date so it should remain on for 7 days (even if there is a delay receiving it).

At what times should my child wear the activity monitor?

The activity monitor should be worn every day for 7 continuous days. It should be put on first thing in the morning as soon as your child gets up and worn until your child goes to bed. The activity monitor should not be worn during swimming or when your child is having a bath or shower. However, the monitors are shower proof so it doesn't matter if they get a little bit wet in the rain. The monitors are robust so don't worry about them getting damaged during your child's usual activities even if this includes things like contact sports (e.g. rugby). It is important for us to measure your child's activity during these times. Equally, wearing the monitor during activities like these should not injure your child or other children. However, if you are concerned about this, it is fine to ask your child to remove the monitor for example during contact sports. We would like your child to behave just as they would normally.

What is the timesheet for?

You will be sent a timesheet and asked to keep a record of the dates that the activity monitor is worn, the time that the activity monitor is put on in the morning and taken off at night and any periods that the monitor was not worn for any reason. In addition, any periods spent swimming or cycling should be recorded on the timesheet.

We want to record the time your child has spent swimming as this is the only kind of physical activity for which the monitor cannot be worn. We also want to record the time your child has spent cycling because this kind of activity cannot be measured very accurately by the monitor (though it should still be worn during cycling). We would also like you to indicate whether or not the week that your child wore the activity monitor was a typical week in terms of their physical activity.

What about when my child is at school?

If your child receives their activity monitor during term-time please encourage your child to wear it at school. We hope that most teachers will be happy for children to wear the monitors at school. A letter is enclosed for your child's class teacher which explains to them why your child is wearing the monitor. You should fill in the relevant details on the letter, including your child's activity monitor number which you can find on the back of the activity monitor or on the timesheet. We understand that you may not always know if your child has taken the activity monitor off when they are at school. It would be helpful if you could ask your child if they took the activity monitor off at school for any reason, and record this on the timesheet. If your child receives their activity monitor outside term-time, they should still start to wear the monitor straight away. Please do not wait until your child goes back to school to start wearing the monitor. You don't need to give the letter to the teacher if your child is not at school during the 7-day monitoring period.

When should I return the activity monitor and completed documents?

The activity monitor, belt and completed timesheet must be returned as soon as possible after the 7-day monitoring period is over. Enclosed is a pre-paid envelope to send them back in. You do not need a stamp. It is very important that the activity monitor is returned promptly. This is because we only have a limited number and the monitor will be sent to another family.

Please try not to lose or damage the activity monitor. However, if you do lose or damage the monitor, please call Carly Rich on 0800 030 4124 (free phone). We will not charge you to replace or repair it. We would still like you to return the monitor even if it is damaged.

Appendix E: Timesheet

NatCen

Physical Activity Monitoring

Summary of key points

Child of the New Century
Age 7 Survey

Your child should wear the monitor...

- Every day for 7 continuous days starting the morning after received
- At all times from first thing in the morning to last thing at night – except when swimming, in the shower or in the bath.
- On the belt on top of the right hip (on the 'bony' part of the hip)
- On top of light indoor clothing (or against skin if preferred)
- Tightly but comfortably against body (not 'flopping around')

You should record on the timesheet (on the back of this form)...

- The dates that the monitor was worn
- The times that the monitor was put on in the morning and taken off at night
- Any periods spent swimming or cycling (the monitor should still be worn during cycling)
- Any other periods when the monitor is not worn
- Whether the week the monitor was worn was a typical week in terms of your child's activity levels

You should also...

- Fill in and give the letter about the activity monitor to your child's class teacher (if your child is at school during the 7 day monitoring period)
- Return the activity monitor, belt, and completed timesheet **as soon as possible** after the 7 day period in the pre-paid envelope provided

We will...

- Send your child a certificate and a summary of their activity within 4 weeks after the monitor is sent back
- Treat the information collected by the monitor and recorded on the timesheet in strict confidence in accordance with the Data Protection Act.
- Answer any questions you may have. If you have any questions or problems with the monitor or timesheet, please call Carly Rich from the Institute of Child Health on 0800 030 4124 (free phone)

Timesheet

	Example	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Date	10/05/08							
Time put on in morning	7:45am	:	:	:	:	:	:	:
Time taken off at night	8:30pm	:	:	:	:	:	:	:
How many minutes spent swimming	0							
How many minutes spent cycling	65							
How many additional minutes not worn (i.e. they forgot, did not want to wear it)	45							

Was this week typical for your child in terms of their usual activity? Yes / No

IF NO: why not? (e.g. sprained ankle on day 3, not at school) .....

.....

.....

.....

For office use only

Appendix F: Teacher letter

Child of the new Century

The child first and always

Child of the New Century
Age 7 Survey

Physical Activity Monitoring
Letter for Class Teacher

Dear ……

My child: ……..……

is taking part in the Age 7 Survey of the Child of the New Century study.

This is an important national survey which is exploring what it is like to grow up in the 21st Century by following around 19,000 children born in the UK in 2000/2001. The study is run by the Centre for Longitudinal Studies, a research centre in the Institute of Education, based at the University of London. The interviews are being carried out by the National Centre for Social Research (NatCen), an independent research organisation. Child of the New Century is paid for the ESRC (the government's Economic and Social Research Council) and other government departments from all countries of the UK.

We have already taken part in the interviews for this study. The study also involves collecting information about my child's physical activity over a period of 7 days using an activity monitor. The activity monitor is a small, lightweight device that is worn on a belt, and should be positioned on top of the right hip. This part of the study is being carried out in collaboration with researchers at the Institute of Child Health (ICH), University College London.

I am writing to let you know that my child is wearing an activity monitor for 7 days for this research project. It is important that the monitor is worn at all times, including when he or she is at school. The only times the monitor should not be worn is during activities such as swimming, bathing or showering when the monitor will get wet. The monitors are robust and can be worn during things like contact sports (e.g. rugby). They should not get damaged or injure my child or other children. I have indicated below whether or not I wish my child to remove the monitor during things like contact sports. However, if you or the school are concerned about this, it is fine to ask my child to remove the monitor during contact sports.

I wish my child to remove the monitor during contact sports: YES/NO (please delete one)

My child's activity monitor number is……

Thank you for your co-operation

Name .....

Signed ..... ***Date*** .....

If you would like to know more about the Child of the New Century study, please contact the Centre for Longitudinal Studies on 0800 092 1250 (free phone), or if you have any queries on the physical activity monitor please contact Carly Rich at the Institute of Child Health on 0800 030 4124 (free phone).

Appendix G: Reminder letter

May 2009

Dear Parent/ Guardian,

Child of the New Century - Age 7 Survey

Activity Monitor Return

A few weeks ago you were sent your physical activity monitor pack as part of the 'Child of the New Century' – an important national survey which is exploring what it is like to grow up in the 21st century.

We have not yet received your activity monitor, belt, and completed timesheet. It is very important that the activity monitor is returned promptly. This is because we only have a limited number and they will be sent to another family. We would be very grateful if you would return the activity monitor and timesheet as soon as possible. If you require further copies of any of the documents, or you require the activity monitor to be programmed to start at an alternative date please call one of the study researchers (phone number below).

If you or your child no longer wish to take part in the activity monitoring, please return the monitor and belt in the pre-paid envelope provided in the activity monitor pack. If you require a new pre-paid envelope please call one of the researchers on the phone number below. If the monitor is lost or damaged, please let us know

If you have any other questions or would like further information about this part of the study please call one of the study researchers on 0800 030 4124 (free phone).

If you have already returned the activity monitor and completed documents to us in the last few days, please accept our thanks, and we apologise for writing to you again.

Thank you very much for your help with this important survey.

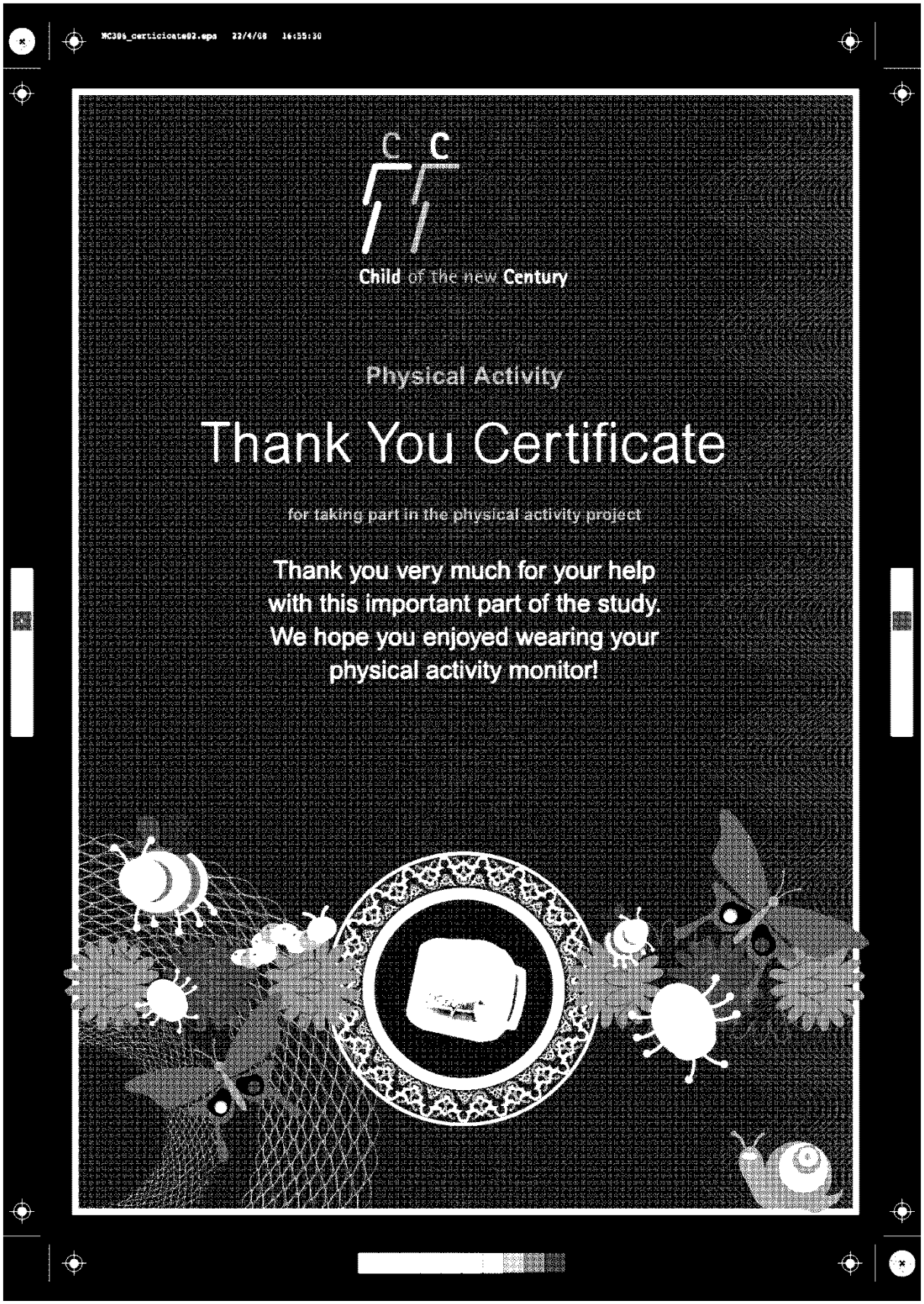
Yours sincerely,

Professor Heather Joshi OBE
Study Director

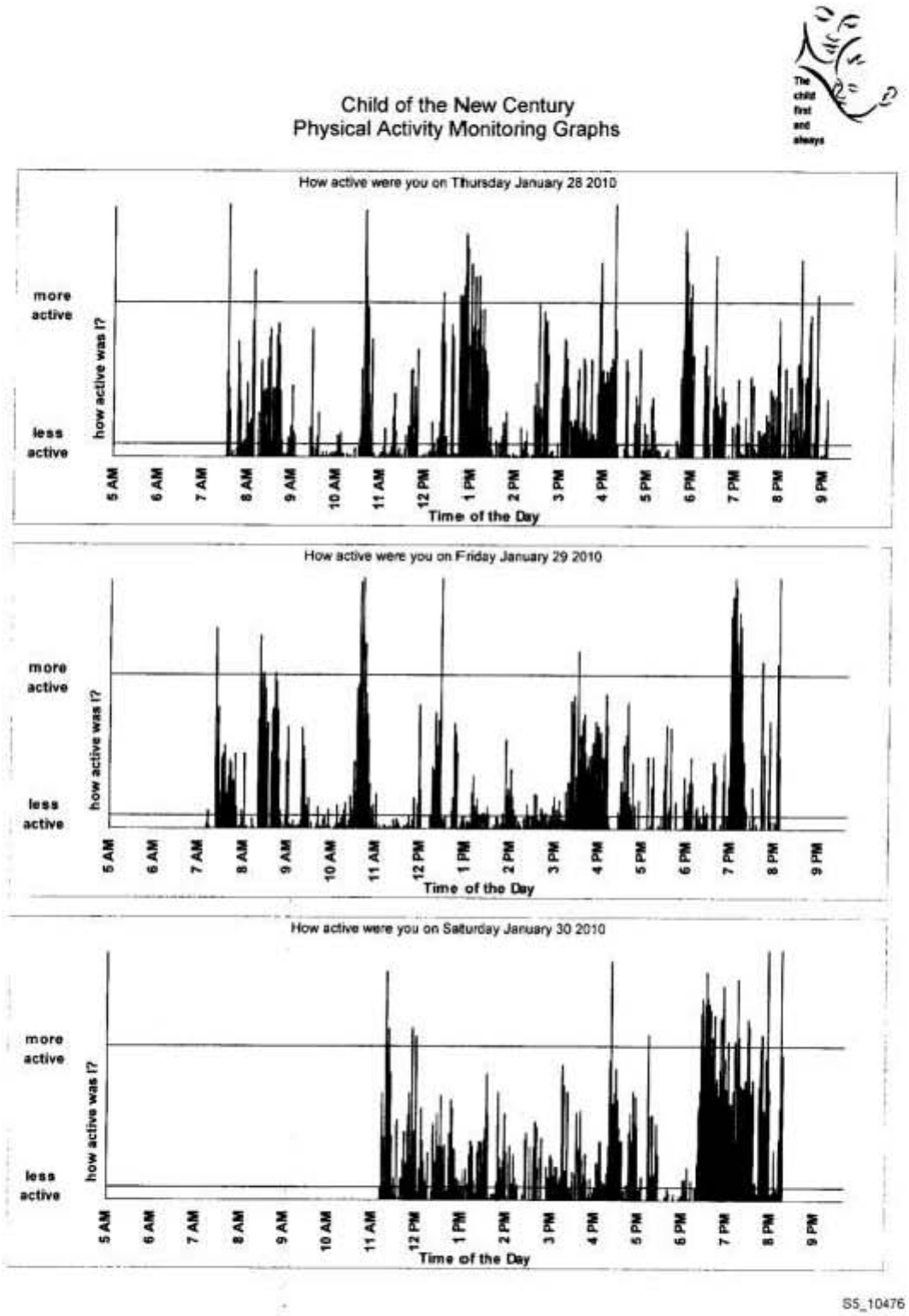
Professor Carol Dezateux
UCL, Institute of Child Health

Carly Rich
UCL, Institute of Child Health

Appendix H: Feedback certificate



Appendix I: Set of PA graphs sent to children



Appendix J: Feedback certificate graphs explanation letter

Child of the New Century – Age 7 Physical Activity Monitor Certificate

Thank you and your child very much for your help with this important part of the study.

Please find enclosed a physical activity certificate for your child and a sheet that summarises your child's activity whilst they were wearing their activity monitor. This leaflet will help you to understand the activity graphs, and also help you to explain the graphs to your child.

Your Child's Activity Graphs

For You

- Each graph shows a different day that your child was wearing their activity monitor.
- If there is not a graph for a day, the monitor may have had problems in correctly identifying activity or the monitor was not worn.
- Each graph shows how active your child was from 5 o'clock in the morning until midnight.
- The bars on the graph shows how active your child was at any particular time.
- The higher the bar, the more active your child. Low bars therefore show when you child was less active.
- If there are no bars on the graph at certain times this is when they were not wearing the monitor (e.g. when they were asleep or when they forgot to wear the monitor).
- Any bars above the 'more active' red line show when you child's activity was of moderate intensity, which refers to greater physical effort e.g. brisk walking.
- Current advice from the Department of Health is that children should exercise at this level or higher for about an hour a day on average*.

For You To Explain To Your Child

- See if your child can see the time when they first put the monitor on.
- Ask your child to spot times when the bars are higher (when they were more active).
- Your child might also be able to pick out when they went to school or when they first went out (particularly if they walked), and also when they took part in any sports activities or had a PE lesson.
- They might also be able to see when they took part in anything else active such as playing with friends, taking the dog for a walk, or going shopping.
- Try to see if your child can spot some times when the bars on the graph are lower (when they were less active).
- Your child might be able to spot times when they were sitting down (in class or at home), watching TV, having something to eat, or playing a computer game.

If you have any concerns about your child's physical activity levels please ask your GP for advice.

If you have any other questions, or would like further information about this part of the study, please call Carly Rich or one of the other study researchers on 0800 030 4124 (free phone).

*Department of Health (2004). A Report of the Chief Medical Officer: At Least Five a week: Evidence on the impact of physical activity and its relationship to health http://www.dh.gov.uk/assetRoot/04/08/09/81/04080981.pdf

Appendix K: Seasonal study invitation letter

Thursday, 26 February 2009

Child of the New Century
Physical Activity Monitoring
Seasonal Study

Once again, thank you and your child very much for taking part in the physical activity monitoring study. You will recall that we recently sent you a physical activity certificate for your child and a sheet that summarised your child's activity whilst they were wearing their activity monitor. As your child successfully completed this study we are writing to invite you and your child to be involved in a related study to measure children's physical activity levels each season of the year. This leaflet explains why we are doing the study and what it would involve for your child.

Why are we doing this study?
Physical activity is extremely important for children's health and to help tackle obesity. Scientists need to find out if children's activity levels change during different times of the year. This study will help us work out how active children of your child's age are during different seasons.

What will your child be asked to do?
- Wear a physical activity monitor three more times throughout the next year.
- The activity monitor should be worn in exactly the same way as before; around their waist, and every day for 7 continuous days.

When will my child have to wear the activity monitor?
If you agree to take part a member of the research team will contact you approximately 3 months after your child first wore the activity monitor to agree a date which is suitable for you and your child to wear the activity monitor again. This will be repeated another two times throughout the year so that your child wears the activity monitor in every season. We will always contact you to agree the dates which are suitable for you and your child to wear the activity monitor.

Will I get any feedback about my child's activity and energy levels?
Yes, we will provide you with information summarizing your child's activity levels for each time your child wears the activity monitor so that you can see how active your child is during every season. Your child will also receive a **£5 gift voucher for every time (£15 total)** they wear and return the activity monitor.

What will happen to the information collected during the study?
The information will be treated in strict confidence in accordance with the Data Protection Act. The information you provide will be used solely in this research study and will not be released in any way that enables you or your child to be identified.

How do I agree for my child to take part in this study?
It is up to you and your child to decide whether or not to take part. If you agree please sign the enclosed consent form and post it back to us in the provided pre-paid envelope. You do not need a stamp.

How do I find out more about the study?
This part of the study is being carried out by the researchers at the Institute of Child Health, University College London. They are responsible for contacting you regarding appropriate dates to send out the activity monitors, sending out the activity monitors, and sending you feedback after the monitor has been returned to them

If you have any other questions or would like further information about this part of the study, please call one of the researchers on 0800 030 4124 (free phone).

Thank you very much for your help.

Yours sincerely,

Professor Carol Dezateux
UCL, Institute of Child Health

Carly Rich
UCL, Institute of Child Health

Appendix L: Seasonal consent form

CONSENT FORM

Parents/ Guardians

I have read the information letter or it has been read to me. I have had the opportunity to ask questions and discuss the study. I understand that my child has the right to withdraw from the study at any time and I understand that any personal information will be treated as strictly confidential and handled in accordance with the Data Protection Act 1998.

I would like my child to take part in the Child of the New Century 'Seasonal' Physical Activity Monitoring Study

SIGNED:……

DATE: ……

PRINT NAME (Parent/ Guardian):……

PRINT NAME (Child):……

Please sign this consent form and post it back to us in the provided pre-paid envelope.

CONSENT FORM

Parents/ Guardians

I have read the information letter or it has been read to me. I have had the opportunity to ask questions and discuss the study. I understand that my child has the right to withdraw from the study at any time and I understand that any personal information will be treated as strictly confidential and handled in accordance with the Data Protection Act 1998.

I would like my child to take part in the Child of the New Century 'Seasonal' Physical Activity Monitoring Study

SIGNED:……

DATE: ……

PRINT NAME (Parent/ Guardian):……

PRINT NAME (Child):……

Please sign this consent form and post it back to us in the provided pre-paid envelope.

Appendix M: PA5 season invitation letter

November 2009

Child of the New Century
Physical Activity Monitoring
Final monitoring period

Thank you and your child very much for taking part in the physical activity monitoring seasonal study. You will recall that we recently sent your child a voucher, a physical activity certificate, and a set of graphs that summarised their activity during the autumn season.

As your child successfully completed this study we are writing to invite you and your child to take part in a final monitoring period during January 2010. This will help us to compare children's activity levels this winter with last winter.

Once again we will provide your child with information summarizing their activity levels and they will also receive a further **£5 gift voucher** after they wear and return the monitor.

If your child would like to take participate in this study please sign the enclosed consent form and post it back to us in the provided pre-paid envelope. You do not need a stamp.

If you have any other questions or would like further information about this part of the study, please call one of the researchers on 0800 030 4124 (free phone).

Thank you very much for your help.

Yours sincerely,

Professor Carol Dezateux
UCL, Institute of Child Health

Carly Rich
UCL, Institute of Child Health

Appendix N: Seasonal timesheet additional questions

….. SEASON (please complete for your child)

1) During the weekdays that your child wore the activity monitor, was he/she in school or on holiday?

In school □ On holiday □ Both □

If both, which days was he/she IN school? ……..

2) In general, during the week that your child wore the activity monitor, which of these best describes the weather?

Sun □ Cloud □ Rain □ Snow □

Appendix O: Seasonal study physical activity questions

We would be very grateful if you could complete the following questions about your child's physical activity **during the week that your child wore their activity monitor**.

Q1. We would like to find out whether your child was moderately to vigorously active (for example running, playing football, dancing) for 60 minutes or more each day.

Thinking about the past week, how many days do you think that your child was active for this amount of time each day? (Please tick one box)

No days↑
1 day↑
2 days↑
3 days↑
4 days↑
5 days↑
6 days↑
7 days↑
Don't know↑

Q2. During the past week which statement describes where your child's physical activities took place? (Please tick one box)

All indoors↑
Mostly indoors↑
Equally indoor and outdoors↑
Mostly outdoors↑
All outdoors↑

Please return this sheet with the activity monitor and completed timesheet in the prepaid envelope.

Thank you very much for your time

Appendix P: Pediatric Quality of Life Inventory

This questionnaire concerns your view on things that might be a problem for **your child**. Please tell us how **much of a problem** each one has been for **your child** during the **past ONE month** by circling:

0 if it is **never** a problem

1 if it is **almost never** a problem

2 if it is **sometimes** a problem

3 if it is **often** a problem

4 if it is **almost always** a problem

There are no right or wrong answers.

In the past ONE month, how much of a problem has your child had with:

(Please circle one number on each line.)

PHYSICAL FUNCTIONING (problems with…)	Never	Almost Never	Sometimes	Often	Almost Always
1. Walking more than one block	0	1	2	3	4
2. Running	0	1	2	3	4
3. Participating in sports, activity, or exercise	0	1	2	3	4
4. Lifting something heavy	0	1	2	3	4
5. Taking a bath or shower by him or herself	0	1	2	3	4
6. Doing chores around the house	0	1	2	3	4
7. Having hurts or aches	0	1	2	3	4
8. Low energy level	0	1	2	3	4

EMOTIONAL FUNCTIONING (problems	Never	Almost Never	Sometimes	Often	Almost Always

with…)					
1. Feeling afraid or scared	0	1	2	3	4
2. Feeling sad or blue	0	1	2	3	4
3. Feeling angry	0	1	2	3	4
4. Trouble sleeping	0	1	2	3	4
5. Worrying about what will happen to him or her	0	1	2	3	4

SOCIAL FUNCTIONING (problems with…)	Never	Almost Never	Sometimes	Often	Almost Always
1. Getting along with other children	0	1	2	3	4
2. Other kids not wanting to be his or her friend	0	1	2	3	4
3. Getting teased by other children	0	1	2	3	4
4. Not able to do things that other children his or her age can do	0	1	2	3	4
5. Keeping up when playing with other children	0	1	2	3	4

SCHOOL FUNCTIONING (problems with…)	Never	Almost Never	Sometimes	Often	Almost Always
1. Paying attention in class	0	1	2	3	4
2. Forgetting things	0	1	2	3	4
3. Keeping up with schoolwork	0	1	2	3	4
4. Missing school because of not feeling well	0	1	2	3	4
5. Missing school to go to the doctor or hospital	0	1	2	3	4

Finally, we would be grateful if you could state your relationship to your child:

[ ] mother

[ ] father

[ ] other (please state)……..

Thank you very much. Please return this questionnaire with the activity monitor and completed timesheet in the pre-paid envelope.

Appendix Q: Stata syntax for total valid time adjustment

```
use <"Name main daily data Stata file">, clear
keep if ISVALIDDAY == 1 & RELIABLE == 1
egen mcsidkey = concat(MCSID DCNUM00)
egen N_DAYS_V = total(ISVALIDDAY == 1), by(mcsidkey)
bysort mcsidkey:egen nrec=seq()

* Standard day
gen standard_day = 735

* Weights (with alpha calculated separately for sedentary behaviour, light and moderate to vigorous)
gen w0=(1/(TOTTIMEDAY/standard_day))^1.35
gen w1=(1/(TOTTIMEDAY/standard_day))^0.65
gen w23=(1/(TOTTIMEDAY/standard_day))^0.25

* Sedentary behaviour
gen wTOTPATY0  = TOTPATY0 * w0
egen TOTPATY0_W = total(wTOTPATY0), by(mcsidkey)
gen MNPATY0_W = TOTPATY0_W/N_DAYS_V

* Light activity
gen wTOTPATY1  = TOTPATY1 * w1
egen TOTPATY1_W = total(wTOTPATY1), by(mcsidkey)
gen MNPATY1_W = TOTPATY1_W/N_DAYS_V

* Moderate activity
gen wTOTPATY2  = TOTPATY2 * w23
egen TOTPATY2_W = total(wTOTPATY2), by(mcsidkey)
gen MNPATY2_W = TOTPATY2_W/N_DAYS_V

* Vigorous activity
gen wTOTPATY3  = TOTPATY3 * w23
egen TOTPATY3_W = total(wTOTPATY3), by(mcsidkey)
```

```
gen MNPATY3_W = TOTPATY3_W/N_DAYS_V


* Label new variables and keep summary values
label var TOTPATY0_W "Weighted total time (mins) spent in sedentary behaviour across all valid days"
label var MNPATY0_W "Weighted mean time (mins) spent in sedentary behaviour across all valid days"
label var TOTPATY1_W  " Weighted total time (mins) spent in light activity across all valid days"
label var MNPATY1_W  "Weighted mean time (mins) spent in light activity across all valid days"
label var TOTPATY2_W  " Weighted total time (mins) spent in moderate activity across all valid days"
label var MNPATY2_W "Weighted mean time (mins) spent in moderate activity across all valid days"
label var TOTPATY3_W    " Weighted total time (mins) spent in vigorous activity across all valid days"
label var MNPATY3_W "Weighted mean time (mins) spent in vigorous activity across all valid days"
keep if nrec == 1
drop nrec
```