## Supplementary material

# Birth weight, early childhood growth and lung function in middle to early old age: 1946 British birth cohort 

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## S1 Spirometry data collection in 1989, 1999 and 2006/10 in NSHD.

| Year of data <br> collection | Type of data | Method of data <br> collection | Number of <br> manoeuvres | Satisfactory <br> techniques recorded |
| :---: | :---: | :---: | :---: | :---: |
| 1989 | $\mathrm{FEV}_{1}$ and FVC | Home visit | Three | No |
| 1999 | $\mathrm{FEV}_{1}$ and FVC | Home visit | Two | Yes |
| $2006-2010$ | $\mathrm{FEV}_{1}$ and FVC | Clinic and home visits | Two | Yes |

## Lung function cleaning procedure for 1989, 1999 and 06-10

1989
Three manoeuvres were taken for both $\mathrm{FEV}_{1}$ and FVC.

## 1999

Two manoeuvres were taken for $\mathrm{FEV}_{1}$ and FVC and an assessment given by the nurse as to whether the technique was satisfactory or not.

## 2006-10

Two manoeuvres were taken for $\mathrm{FEV}_{1}$ and FVC and an assessment given by the nurse as to whether the technique was satisfactory or not.

## Step 1

The values were converted to litres (Divide values by 100)

Any values less than 0.30 and more than 9.0 were considered outliers and excluded (these values are considered implausible according to medical practice but have been retained in data file to allow for comparative investigation and checks on potential bias).

In 1999 and 2006/10 those who had 'unsatisfactory' techniques were also excluded.

## Step 2

The maximum valid value recorded from each study member was computed. If there was only 1 valid manoeuvres then this was counted as the 'maximum' value; if there were two or more valid values then the maximum was the highest of all the valid values for that study member.

## Step 3

The maximum value from the 3 manoeuvres was generated provided there were at least 2 valid measures available. (i.e. those who only gave one valid measurement were excluded)

## Step 4

If the difference between the maximum two manoeuvres is more than 0.30 L the respondent is this is considered to be an outlier and should be removed.

## Step 5

Using the ATS method ${ }^{[1]}$

The ATS has stricter criteria. If the difference between the maximum two manoeuvres is more than 0.15 L the respondent is this is considered to be an outlier and should be removed.

## Optional

Comparing the NSHD distribution to other European cohorts it appears that the NSHD is systematically lower than these cohorts.

Orfei et al ${ }^{[2]}$ have used the following correction when comparing the 1946 cohort to the 1958 cohort: 0.24 L is added to $\mathrm{FEV}_{1}$ and 0.34 L to FVC .

Figure S1: Flowchart explaining the cleaning stages and numbers excluded in various stages for the 1989 variables

Available manoeuvres for each variable

Clear outliers excluded

Measures after removing clear outliers (FEV189u, FEV289u, FEV389u, FVC189u, FVC289u, FVC389u)

Maximum values generated for those individual who have at least 2 manoeuvres
(FEV89u, FVC89u)

Number of outliers removed by using difference of more than 0.3 L between the maximum manoeuvres and final sample size ready for analysis if this method is chosen(FEV89s, FVC89s)

Number of outliers removed by using the ATS method (difference of more than 0.15 L between the maximum manoeuvres) and final sample size ready for analysis if this method is chosen (variables FEV89ats, FVC89ats)


Figure S2: a flowchart explaining the cleaning stages and numbers excluded in various stages for the 1999 variables.

Available manoeuvres for each variable

Unsatisfactory techniques excluded

Clear outliers excluded

Measures after removing clear outliers and unsatisfactory techniques

Maximum values generated for those individual who have at least 2 manoeuvres

Number of outliers removed by using the difference of more than 0.3 L between the maximum manoeuvres and final sample size ready for analysis if this method is chosen(FEV99S, FVC99S)

Number of outliers removed if using the ATS method* (difference of more than 0.15 L between the maximum manoeuvres) and final sample size ready for analysis if this method is
 chosen (variables FEV99ATS FVC99ATS)
*NB: $\underline{\text { ATS/ERS criteria apply to minimum of three satisfactory manoeuvres }}$

Figure S3: a flowchart explaining the cleaning stages and numbers excluded in various stages for the 2006/10 variables.

Available measures for each variable

Unsatisfactory techniques /no valid measure excluded

Clear outliers excluded

Measures after removing clear outliers and unsatisfactory techniques

Maximum values generated for those individual who have at least 2 manoeuvres

Number of outliers removed by using difference of more than 0.3L between the maximum manoeuvres and final sample size ready for analysis if this method is chosen(FEV09S, FVC09S)

Number of outliers removed if using the ATS method* (difference of more than 0.15 L between the maximum manoeuvres) and final sample size ready for analysis if this method is chosen (variables FEV09ATS, FVC09ATS)
*NB: $\underline{\text { ATS/ERS criteria apply to minimum of three satisfactory manoeuvres }}$

S2a Associations (coefficient and $95 \% \mathrm{Cl}$ ) between birth weight and both $\mathrm{FEV}_{1}(\mathrm{ml})$ and $\mathrm{FVC}(\mathrm{ml})$ at every age in men: complete-case analysis

| Men( $\mathrm{N}=313$ ) | $\mathrm{FEV}_{1}(\mathrm{ml})$ |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Birth weight (per 1 kg increase) | Age 43 years |  | Age 53 years |  | Age 60-64 years |  |
| M0: unadjusted | 61.5 | $\begin{aligned} & \text { (-67.2 to } \\ & \text { 190.2) } \end{aligned}$ | 139.6 | $\begin{aligned} & (16.6 \text { to } \\ & 262.6) \end{aligned}$ | 164.3 | $\begin{aligned} & \text { (28.9 to } \\ & 299.6 \text { ) } \end{aligned}$ |
| M 1 : M0+ adult height $\dagger$ | -83.3 | $\begin{aligned} & (-207.6 \text { to } \\ & 41.0) \end{aligned}$ | -14.2 | $\begin{aligned} & (-130.2 \text { to } \\ & 101.8) \end{aligned}$ | 2.0 | $\begin{aligned} & (-12.5 \text { to } \\ & 128.9) \end{aligned}$ |
| M2: M1+adult covariates $\ddagger$ | -79.3 | $\begin{aligned} & (-199.8 \text { to } \\ & 41.3) \end{aligned}$ | -11.2 | $\begin{aligned} & (-121.9 \text { to } \\ & 99.5) \end{aligned}$ | 19.1 | $\begin{aligned} & (-99.2 \text { to } \\ & 137.4) \end{aligned}$ |
| M3: M2+early life covariates* | -66.1 | $\begin{aligned} & (-188.5 \text { to } \\ & 56.2) \end{aligned}$ | 4.6 | $\begin{aligned} & (-107.7 \text { to } \\ & 11.7) \\ & \hline \end{aligned}$ | 39.0 | $\begin{aligned} & \text { (-80.9 to } \\ & 158.9) \\ & \hline \end{aligned}$ |
| Men( $\mathrm{N}=247$ ) | FVC(ml) |  |  |  |  |  |
| Birth weight (per 1 kg increase) | Age 43 years |  | Age 53 years |  | Age 60-64 years |  |
| M0: unadjusted | $221.1$ | $\begin{aligned} & \text { (17.9 to } \\ & \text { 424.3) } \end{aligned}$ | 252.1 | $\begin{aligned} & \text { (88.6 to } \\ & 415.7 \text { ) } \end{aligned}$ | 210.5 | $\begin{aligned} & \text { (29.2 to } \\ & 391.8 \text { ) } \end{aligned}$ |
| M 1 : M0+ adult height $\dagger$ | 46.3 | $\begin{aligned} & (-155.3 \text { to } \\ & 247.9) \end{aligned}$ | 51.6 | $\begin{aligned} & (-98.6 \text { to } \\ & 201.8) \end{aligned}$ | 19.1 | $\begin{aligned} & (-150.1 \text { to } \\ & 188.3) \end{aligned}$ |
| M2: M1+adult covariates $\ddagger$ | 46.1 | $\begin{aligned} & (-146.3 \text { to } \\ & 238.6) \end{aligned}$ | 76.6 | $\begin{aligned} & (-70.8 \text { to } \\ & 224.1) \end{aligned}$ | 40.1 | $\begin{aligned} & (-122.7 \text { to } \\ & 202.9) \end{aligned}$ |
| M3: M2+early life covariates* | 61.1 | $\begin{aligned} & (-135.0 \text { to } \\ & 257.1) \end{aligned}$ | 102.8 | $\begin{aligned} & (-46.0 \text { to } \\ & 251.5) \\ & \hline \end{aligned}$ | 65.3 | $\begin{aligned} & (-99.9 \text { to } \\ & 230.5) \\ & \hline \end{aligned}$ |

†: adjusted for age at 2006-10 follow-up (aged 60-64 years).
$\ddagger$ : Adult covariates included education level, smoking status, asthma status, smoking pack years.
*: Early life covariates included weight gain at aged 2 years, LRTI under aged 2 years, and childhood social class at aged 4 years

S2b Associations (coefficient and 95\%Cl) between birth weight and both $\mathrm{FEV}_{1}$ ( ml ) and FVC (ml) at every age in women: complete-case analysis

| Women( $\mathrm{N}=374$ ) | $\mathrm{FEV}_{1}(\mathrm{ml})$ |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Birth weight (per 1kg increase) | Age 43 years |  | Age 53 years |  | Age 60-64 years |  |
| M0: unadjusted | 104.3 | $\begin{aligned} & \text { (20.9 to } \\ & \text { 187.7) } \end{aligned}$ | 28.0 | $\begin{aligned} & \text { (-49.5 to } \\ & 105.6) \end{aligned}$ | 42.8 | $\begin{aligned} & \text { (-40.6 to } \\ & \text { 126.1) } \end{aligned}$ |
| M1: M0+ adult height $\dagger$ | 30.3 | $\begin{aligned} & (-48.5 \text { to } \\ & 109.1) \end{aligned}$ | -42.0 | $\begin{aligned} & (-114.7 \text { to } \\ & 30.8) \end{aligned}$ | -9.7 | $\begin{aligned} & \text { (-89.1 to } \\ & 69.7) \end{aligned}$ |
| M2: M1+adult covariates | 52.4 | $\begin{aligned} & (-25.5 \text { to } \\ & 130.3) \end{aligned}$ | -8.2 | $\begin{aligned} & (-79.7 \text { to } \\ & 63.3) \end{aligned}$ | 29.7 | $\begin{aligned} & \text { (-44.2 to } \\ & 103.5) \end{aligned}$ |
| M3: M2+early life covariates* | 52.1 | (-26.8 to 131) | -6.8 | $\begin{aligned} & \text { (-79.0 to } \\ & 65.3) \\ & \hline \end{aligned}$ | 27.4 | $\begin{aligned} & \text { (-47.4 to } \\ & 102.2) \\ & \hline \end{aligned}$ |
| Women( $\mathrm{N}=342$ ) | FVC(ml) |  |  |  |  |  |
| Birth weight (per 1kg increase) | Age 43 years |  | Age 53 years |  | Age 60-64 years |  |
| M0: unadjusted | $104.5$ | $\begin{aligned} & \text { (-13.1 to } \\ & \text { 222.1) } \end{aligned}$ | 90.1 | $\begin{aligned} & \text { (-13.2 to } \\ & 193.5) \end{aligned}$ | 33.6 | $\begin{aligned} & \text { (-68.6 to } \\ & 135.7) \end{aligned}$ |
| M1: M0+ adult height $\dagger$ | 27.6 | $\begin{aligned} & \text { (-83.3 to } \\ & 138.5) \end{aligned}$ | 5.8 | $\begin{aligned} & (-87.2 \text { to } \\ & 98.7) \end{aligned}$ | -39.2 | $\begin{aligned} & (-131.8 \text { to } \\ & 53.4) \end{aligned}$ |
| M2: M1+adult covariates | 43.6 | $\begin{aligned} & (-67.5 \text { to } \\ & 154.7) \end{aligned}$ | 11.5 | $\begin{aligned} & \text { (-82.9 to } \\ & \text { 105.9) } \end{aligned}$ | -16.9 | $\begin{aligned} & (-106.5 \text { to } \\ & 72.7) \end{aligned}$ |
| M3: M2+early life covariates* | 38.4 | $\begin{aligned} & (-73.3 \text { to } \\ & 150.1) \\ & \hline \end{aligned}$ | 7.6 | $\begin{aligned} & (-87.2 \text { to } \\ & 102.5) \\ & \hline \end{aligned}$ | -25.3 | $\begin{aligned} & (-115.3 \text { to } \\ & 64.8) \\ & \hline \end{aligned}$ |

t: adjusted for age at 2006-10 follow-up (aged 60-64 years).
\#: Adult covariates included education level, smoking status, asthma status, smoking pack years.
*: Early life covariates included weight gain at aged 2 years, LRTI under aged 2 years, and childhood social class at aged 4 years.

S3 Changes of effects between birth weight and $\mathrm{FEV}_{1}(\mathrm{ml})$ and $\mathrm{FVC}(\mathrm{ml})$ from ages 43 years to 60-64 years: a complete-case analysis of multilevel model

|  | $\mathrm{FEV}_{1}$ |  |  |  | FVC |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Men ( $\mathrm{N}=875$ ) | Age 43 years (ml), |  | Linear change from age 43 years, (ml/year), |  | Age 43 years (ml) |  | Linear change from age 43 years, (ml/year) |  |
| Birth weight(per 1 kg increase) |  |  |  |  |  |  |  |  |
| MO: age, quadratic age, age* birth weight | 121.7 | $\begin{aligned} & \text { (43.4 to } \\ & 200.0) \end{aligned}$ | 2.4 | (-1.5 to 6.4) | 162.1 | (55.3 to 268.9) | 4.4 | (-2.0 to 10.7) |
| M1: M0+ adult height | 2.7 | (-72.5 to 77.8) | 2.3 | (-1.7 to 6.3) | -11.0 | (-113.2 to 91.2) | 3.7 | (-2.6 to 10.0) |
| M2: M1+adult covariates $\ddagger$ | 31.1 | $\begin{aligned} & (-41.2 \text { to } \\ & 103.4) \end{aligned}$ | 2.7 | (-1.2 to 6.5) | 8.6 | (-90.8 to 108.0) | 3.7 | (-2.5 to 10.0) |
| M3: M2+ early life covariates* | 41.8 | $\begin{aligned} & (-31.1 \text { to } \\ & 114.8) \end{aligned}$ | 2.7 | (-1.2 to 6.5) | 16.2 | (-84.1 to 116.5) | 3.7 | (-2.5 to 9.9) |
|  | $\mathrm{FEV}_{1}$ |  |  |  | FVC |  |  |  |
| Women ( $\mathrm{N}=893$ ) | Age 43 years (ml), |  | Linear change from age 43 years, (ml/year), |  | Age 43 years (ml) |  | Linear change from age 43 years, (ml/year) |  |
| Birth weight(per 1kg increase) |  |  |  |  |  |  |  |  |
| MO: age, quadratic age, age* birth weight | 110.6 | $\begin{aligned} & \text { (53.1 to } \\ & \text { 168.1) } \end{aligned}$ | -2.5 | (-4.8 to -0.1) | 135.0 | (60.3 to 209.7) | -3.7 | (-7.3 to -0.1) |
| M 1 : M0+ adult height | 50.9 | (-3.5 to 105.4) | -2.5 | (-4.8 to -0.1) | 50.7 | (-20.0 to 121.4) | -3.7 | (-7.3 to -0.05) |
| M2: M1+adult covariates $\ddagger$ | 54.2 | (1.6 to 106.9) | -2.3 | (-4.6 to -0.01) | 48.8 | (-20.5 to 118.1) | -3.6 | (-7.3 to 0.007) |
| M3: M2+ early life covariates* | 60.3 | (7.6 to 113.0) | -2.4 | (-4.7 to -0.1) | 54.7 | (-14.5 to 123.8) | -3.9 | (-7.5 to -0.2) |

## References:

(1) M.R. Miller, J. Hankinson, V. Brusasco, F. Burgos, R. Casaburi, A. Coates, R. Crapo, P. Enright,C.P.M. van der Grinten, P. Gustafsson, R. Jensen,D.C. Johnson, N. MacIntyre, R. McKay, D.Navajas, O.F. Pedersen, R. Pellegrino,G. Viegi and J. Wanger.. Eur Respir J 2005; 26: 319-338
(2) Orfei L, Strachan DP, Rudnicka AR, Wadsworth ME. Early influences on adult lung function in two national British cohorts. Archives of Disease in Childhood 2008 Jul;93(7): pp. 570-574.

