SLS-DSU

Scottish Longitudinal Study Development & Support Unit

Modelling standard grade attainment using the Scottish Longitudinal Study

An exploration of child development measures using linked Child Health Surveillance Programme Pre-School (CHSP-PS) records

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National Records of Scotland

E·S·R·C Economic & Social Research Council

Contents

Introduction to study

- SLS Project 2011_001

A scoping study investigating low birth weight and its impact on child development, linking maternity, child surveillance and education data

http://sls.lscs.ac.uk/projects/view/2011_001/

For an introduction to the SLS, see Boyle et al. (2009)

- Context
  - Low birthweight (LBW) and socio-economic status has an impact on cognitive development (Shenkin et al. 2001 and 2004)
  - Previous research into determinants of LBW (Dibben et al 2006; Fairley 2005)
  - Extending understanding of LBW on physical and cognitive development and subsequent educational attainment.
  - Cognitive ability and Pre-School years, GUS (Bradshaw 2011).

LBW and Child Outcomes

- In twin studies, LBW a predictor of educational attainment, income and health in adulthood (Black et al. 2007, Royer 2009, Almond and Currie 2011).

- There are strong associations between:
  - parental occupation and educational attainment (Anderson et al. 2004, Breen 2005, Bukodi and Goldthorpe 2012)
  - parental education and educational attainment (Björklund and Salvanes 2011, Bukodi and Goldthorpe 2012, Chevalier et al. 2013)
  - gender and educational attainment (Croxford et al. 2003, Younger and Warrington 2005, Gayle et al. 2009).

- Evidence that birthweight is stratified by parental occupation (Blumenshine et al. 2010). Children of parents in manual occupations are more likely to have low or very low birthweight (Macfarlane and Mugford 2000, Moser et al. 2003, Macfarlane et al. 2004, Maher and Macfarlane 2004, Dibben et al. 2006).

- It is plausible that there is mediation of the low birthweight effect by socio-economic status (Currie and Hyson 1999).

LBW and Educational Attainment

- Kirkegaard et al. (2006) - 5319 children born between January 1990 and June 1992

Gestational Age and Birth Weight in Relation to School Performance of 10-Year-Old Children: A Follow-up Study of Children Born After 32 Completed Weeks

- Association between birthweight and reading, as well as spelling and arithmetic disabilities, showed a graded relationship.
- Children who weighed less than 2500g had the highest risks.
- Children who weighed between 3000g and 3499g had an increased risk of all 3 learning disabilities compared with children who weighed between 3500g and 4000g.
- Association persisted after adjustment for:
  - potential cofounders
  - when the analyses were restricted to children born at term (suggesting that the association could not be explained by a low gestational age).

LBW and SGA

- Low Birthweight (LBW)
  - Less than 2500g
- Very Low Birthweight (VLBW)
  - Less than 1500g

- Very few VLBW infants

- Require additional controls for Gestational Age
  - http://www.who.int/mediacentre/factsheets/fs363/en/
  - Pre-Term (32 to <37 weeks)
  - Very Pre-Term (28 to <32 weeks)

- Small for Gestational Age (SGA) – see Kramer et al. (2001)
  - Lowest 10% for each week of Gestational Age, Sex specific.
  - Thanks to Tom Clemens

Research Questions

- Is LBW associated with lower standard grade attainment?
  - Independent of other known correlates (such as parental occupation, parental education and other family background factors).
  - Is this also the case for Small for Gestational Age (SGA) infants?

- Are Child Development measures associated with standard grade attainment?
  - Do these indicators act as potential mediators of any supposed relationship between LBW and standard grade attainment?

CHSP-PS Assessments (1)

- Based on Woodside (see Eu 1986)

- Indicators
  - Gross Motor skills
  - Fine motor or manipulative skills; vision
  - Hearing and communication
  - Social skills and behaviour

- Classification
  - Abnormal
  - Doubtful / Uncertain
  - Incomplete
  - Normal

CHSP-PS Assessments (2)

- Reviews

Time Point	Description
t0	Public Health Nurse / Health Visitor First Visit
t1	6-8 Week Review
t2	8 to 9 Month Review
t3	21 to 24 Month Review (pre Hall 4)
t4	39 to 42 Month Review (pre Hall 4)
t5	48 Month Review/ Pre-school (pre Hall 4)

- NHS Scotland - Information Services Division (ISD)

http://www.isdscotland.org/Health-Topics/Child-Health/Child-Health-Programme/Child-Health-Systems-Programme-Pre-School.asp

CHSP-PS Cohort Construction

Dataset	n	n in SMR02	% in SMR02	Sequential Merge
SMR02 Mother's Characteristics at Birth of Child.	63886	63886	100%	63886
Public Health Nurse / Health Visitor First Visit	15419	14486	96.3%	14846
6-8 Week Review	15250	14684	96.3%	13645
8 to 9 Month Review	15995	15284	95.6%	12570
21 to 24 Month Review (pre Hall 4)	19108	18037	94.4%	11667
39 to 42 Month Review (pre Hall 4)	21245	19875	93.6%	10316
48 Month Review/ Pre-school (pre Hall 4)	20851	19465	**93.4%**	**8617**
School Review Results - P1	7845	**7311**	93.2%	4119
School Review Results - P7	10126	**9311**	92.0%	1765
School Review Results - S3	3962	**3572**	90.2%	0

Scottish Longitudinal Study

Table 2 Data currently held in the SLS

Census	Vital events
1991 Census data for SLS members including: • Age, sex, marital status • Family, household or communal establishment type • Family and household structure • Housing, including tenure, rooms and amenities • Country of birth • Ethnicity • Educational qualifications • Economic activity • Occupation, industry and social class • Migration • Limiting long-term illness • Mode of transport used in commuting	New entry datasets • New births into the sample • Immigrants into the sample Vital events to SLS members • Births to sample mothers/fathers • Stillbirths to sample mothers/fathers • Infant mortality of children of sample mothers/fathers • Marriages of sample members • Divorce of sample members • Deaths of sample members • Widow(er)hoods of sample members • Emigration out of Scotland of SLS members • Re-entries into Scotland after previous emigrations of SLS members
1991 Census data for those living in the same household as a SLS member Similar information as collected for sample members	Hospital episodes • Information on inpatients and day cases discharged from NHS hospitals (SMR01) • Information on people admitted to mental illness specialties (SMR04)
2001 Census data for SLS members Similar data to 1991, but additional information collected in 2001 includes: • Self-rated health • Religion currently and in childhood • Caregiving • Distance to work	Cancer registrations All cancers for sample members
2001 Census data for those living in the same household as a SLS member Similar information as collected for sample members.	

Source: Boyle et al. (2009: 388) – Table 2

Sample Construction

- SMR02 data contains 63,886 records
- H05 Qualifications data contains 10,679 records (years 2007-2010)

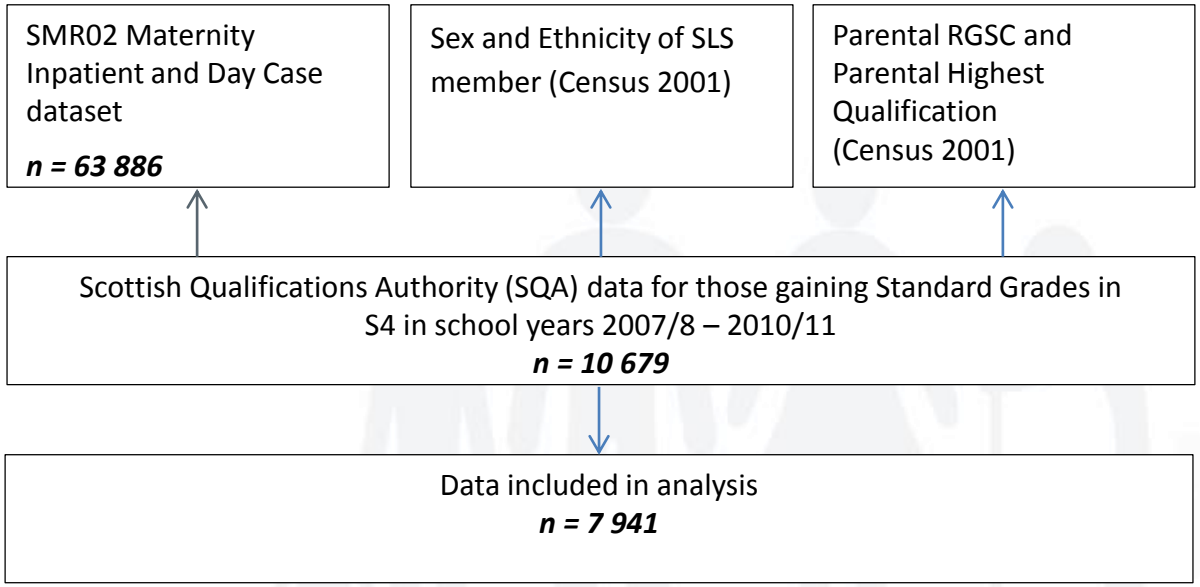
- There are 9,656 cases (90.4% of records) in H05 Qualifications Table which have linked records in SMR02.

- There are the same number of records are also present in the 2001 Census extract (Includes information on Sex and Ethnicity).

- 7,941 records are also present in Extract 6 (2001 Census Information on Parental Qualifications and Occupations)

- 7,028 records with complete cases
  - Inclusion of CHSP-PS measures reduces this to 5,201 cases
  - Further details provided

Sample construction (2)

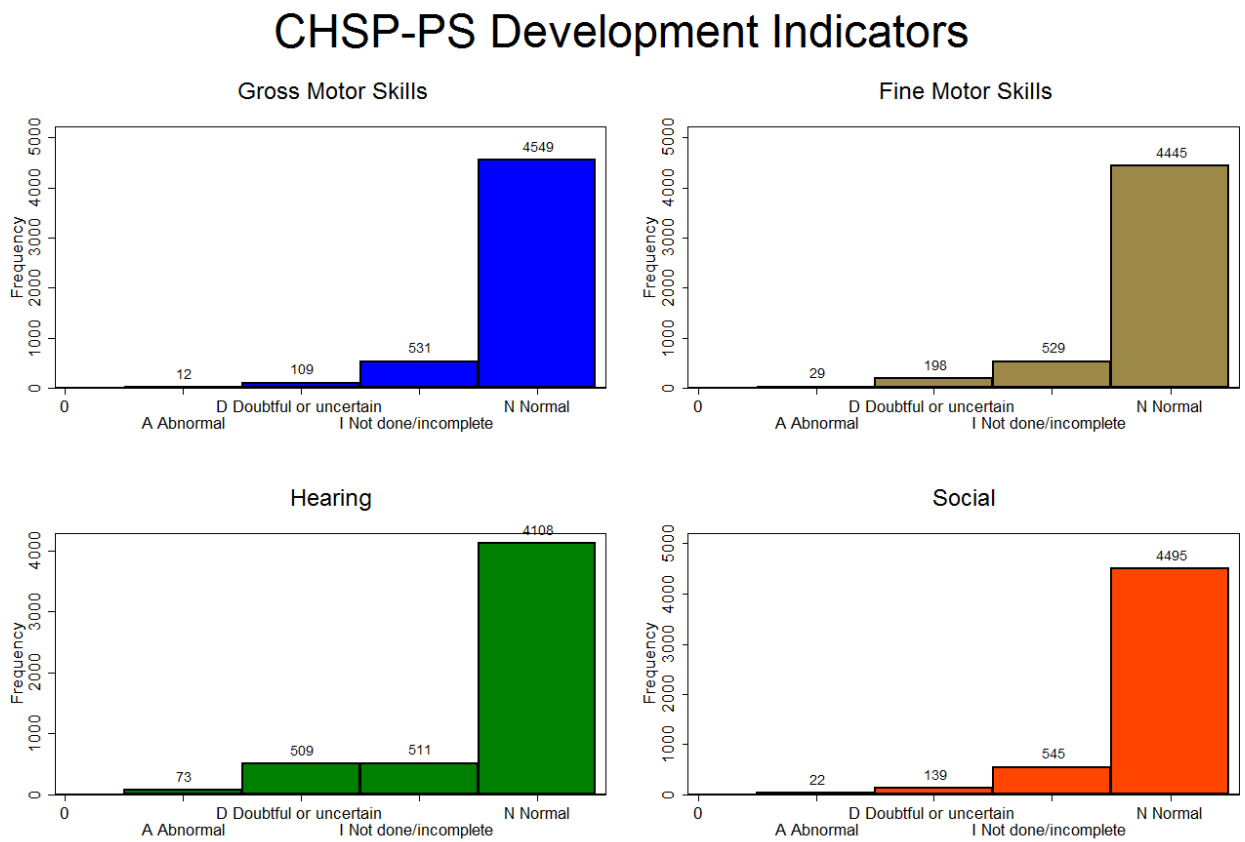


CHSP-PS Measures

- Different number of visits and assessments per individual

- Derived measures
  - Any Abnormality
  - Any Doubtful/Uncertain

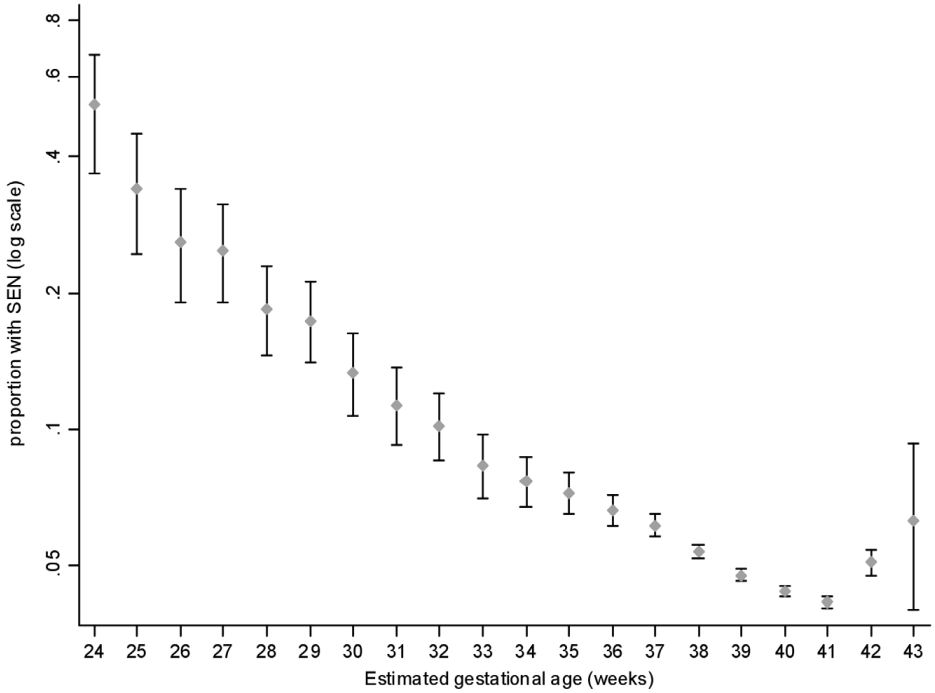
CHSP-PS Descriptive Statistics



Source: SLS, n=5,201

CHSP-PS and Estimated Gestation

- After MacKay et al. (2010)
  - Special Educational Needs and Gestational Age



Source: MacKay et al. (2010: 7) – Figure 1

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Estimated Gestation

Estimated Gestation

Priority
Conditional

Definition
The number of completed weeks of pregnancy, as judged by the clinician (doctor or midwife), usually on the basis of an ultrasound measurement.

Recording Rules
Enter the Estimated Gestation in the boxes provided. If the Estimated Gestation is not known enter 99.

Points to Note

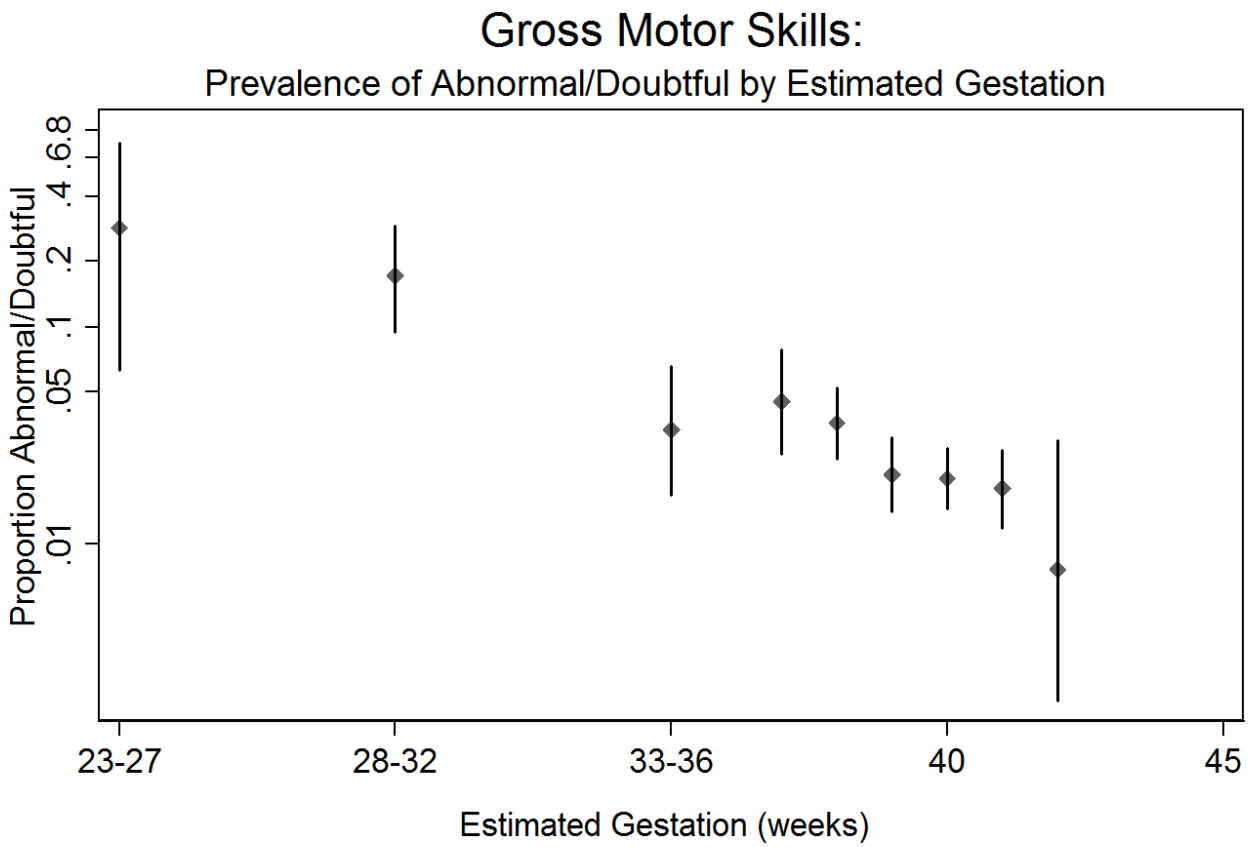
1. This field should be completed for Delivery and Abortion episodes and may be completed for Other (includes missed abortion) episodes, otherwise it should be left blank.
2. Records staff must not base this Estimated Gestation simply on the interval between the dates of LMP and delivery. The clinician's estimate will take account of other factors, including scans.

Cross-Checks

1. Estimated Gestation MUST be present if Certainty of Gestation is present.
2. The record will be queried if the Estimated Gestation falls outwith the range 01-45 weeks.
3. Gestation is cross-checked with Birthweight.
4. Gestation is cross-checked with Outcome of Pregnancy.
5. Gestation is cross-checked with Condition on Discharge and MUST be completed if Condition on Discharge = 2 or 3 (Abortion or Delivery episode).

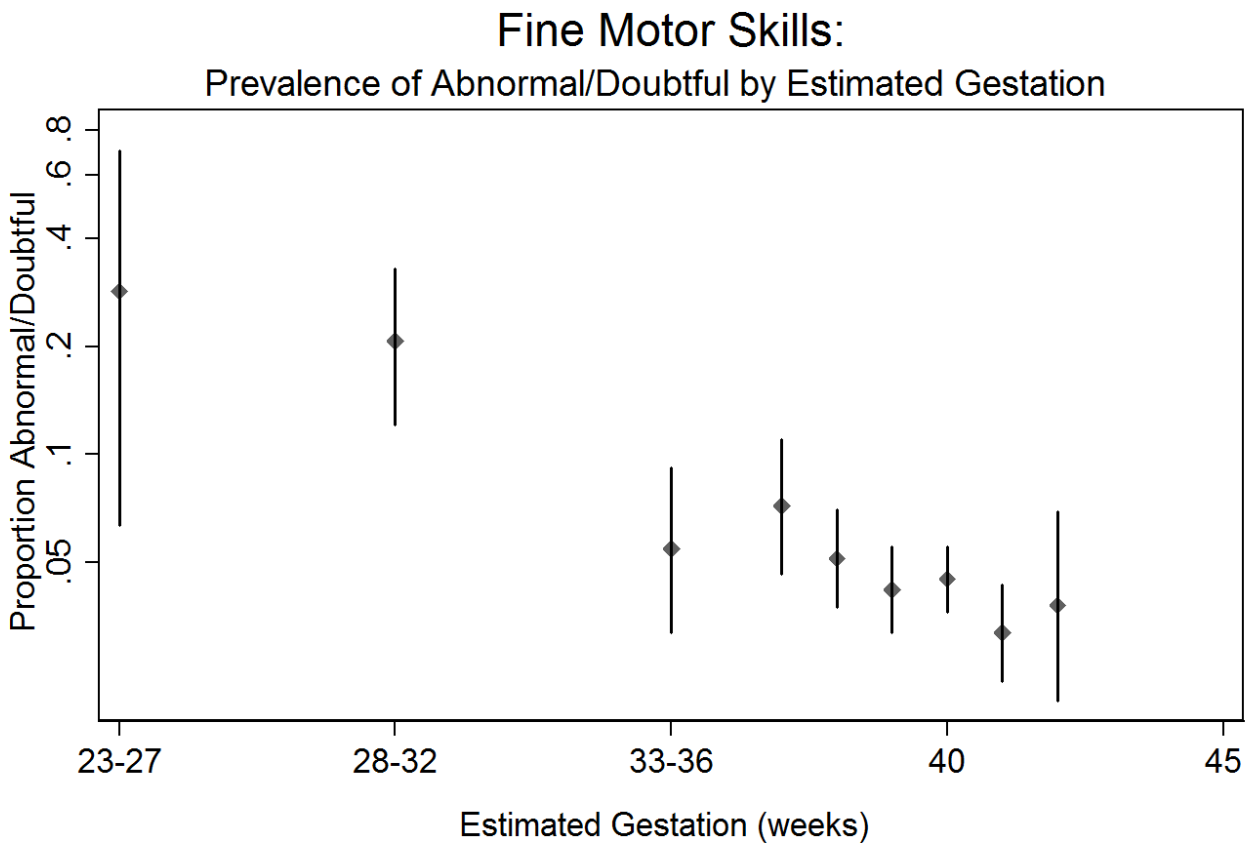
Source: http://www.ndc.scot.nhs.uk/Dictionary-A-Z/Definitions/index.asp?Search=E&ID=242&Title=Estimated%20Gestation

CHSP-PS: Gross Motor Skills



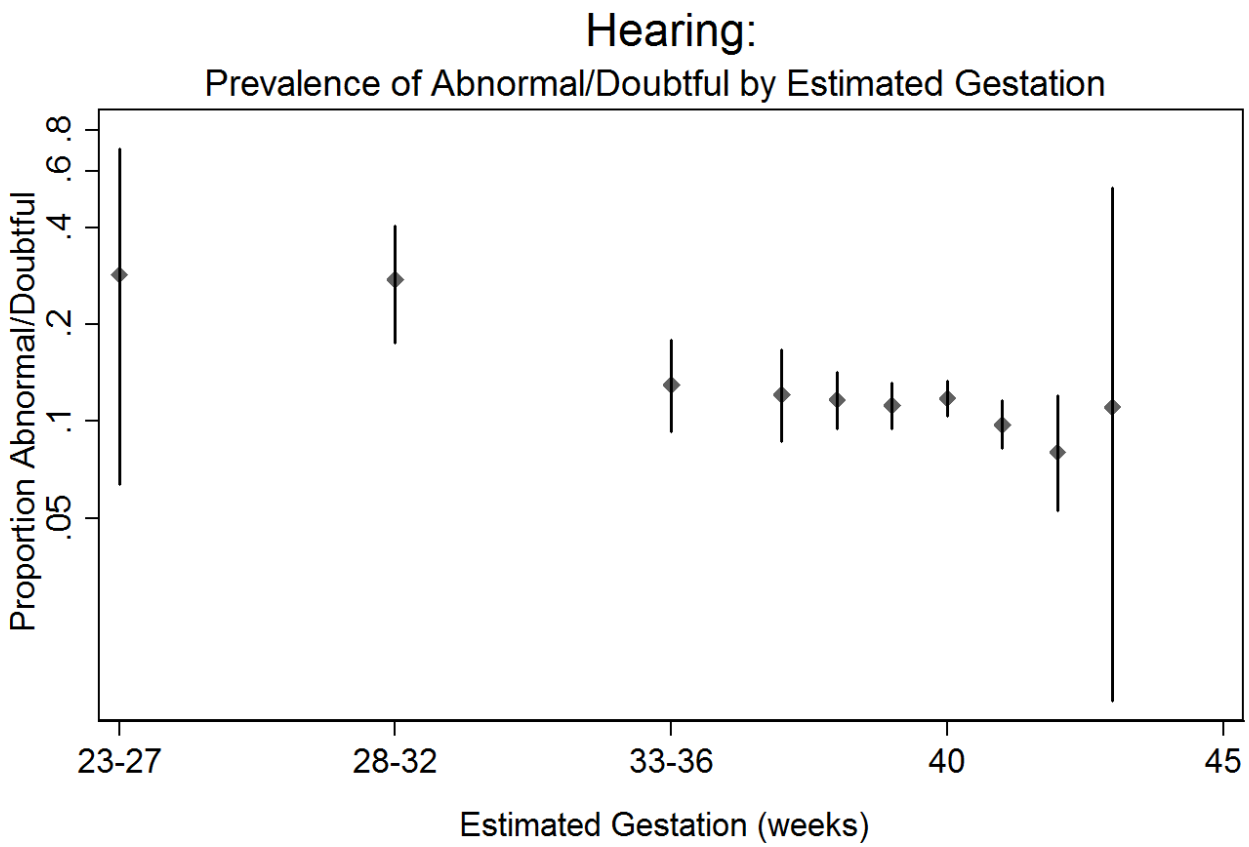
Source: SLS, n=5,768

CHSP-PS: Fine Motor Skills



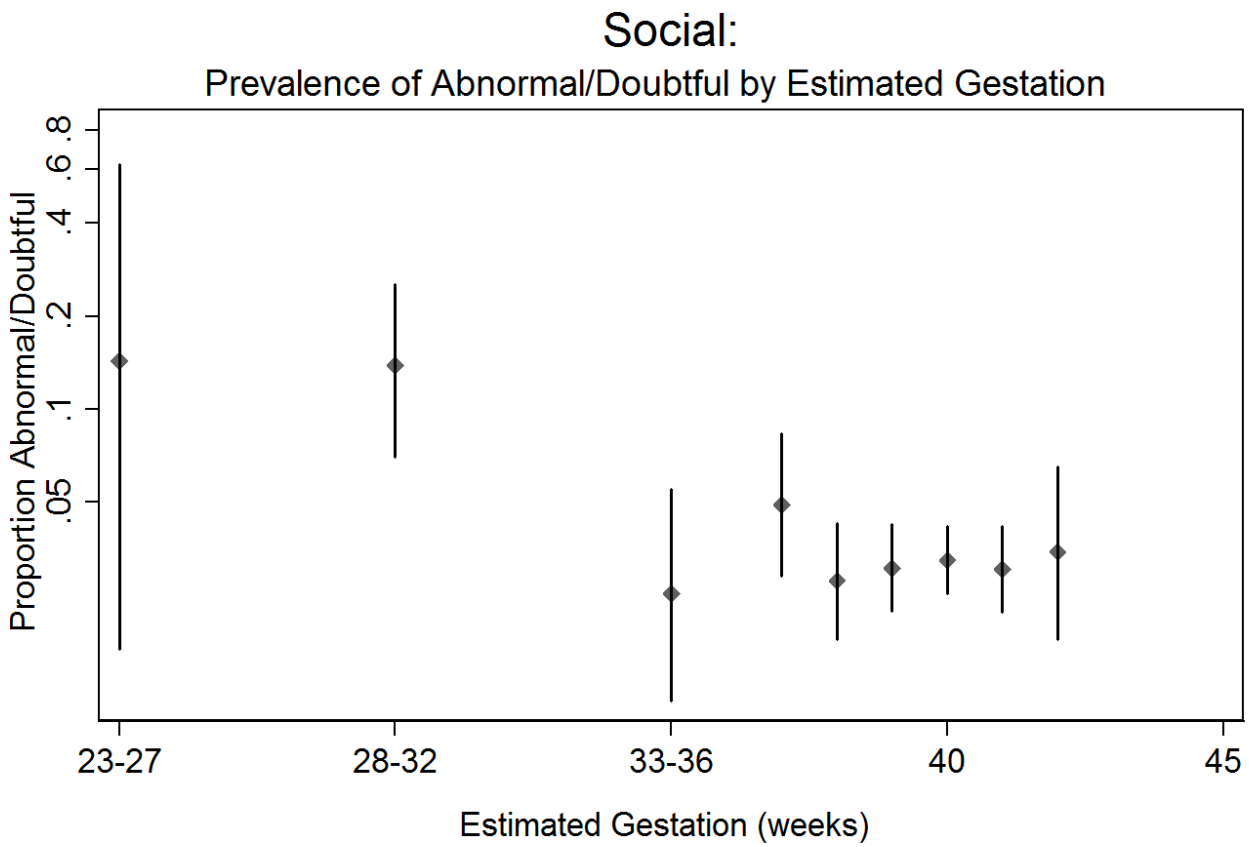
Source: SLS, n=5,768

CHSP-PS: Hearing



Source: SLS, n=5,768

CHSP-PS: Social



Source: SLS, n=5,768

Education Data in the SLS

- Education data linked from ScotXed (2007-2011)
  - Schools Census
  - **SQA Attainment**
  - Absences
  - Exclusions

http://sls.lscs.ac.uk/guides-resources/what-data-are-included/education-data/

- See Raab (2013)

- Focused on Standard Grade attainment.

Table 18: Variables in Table H05 Qualification data

Variable	Description
CREDITVAL	Credit value of course/qualification
EDATE	Course end date
LCODE	Level code
QCODE	Qualification code
QTITLE	Name of course/qualification
QTYPE	Type of course/qualification
RECID	Unique record identifier
SDATE	Course start date

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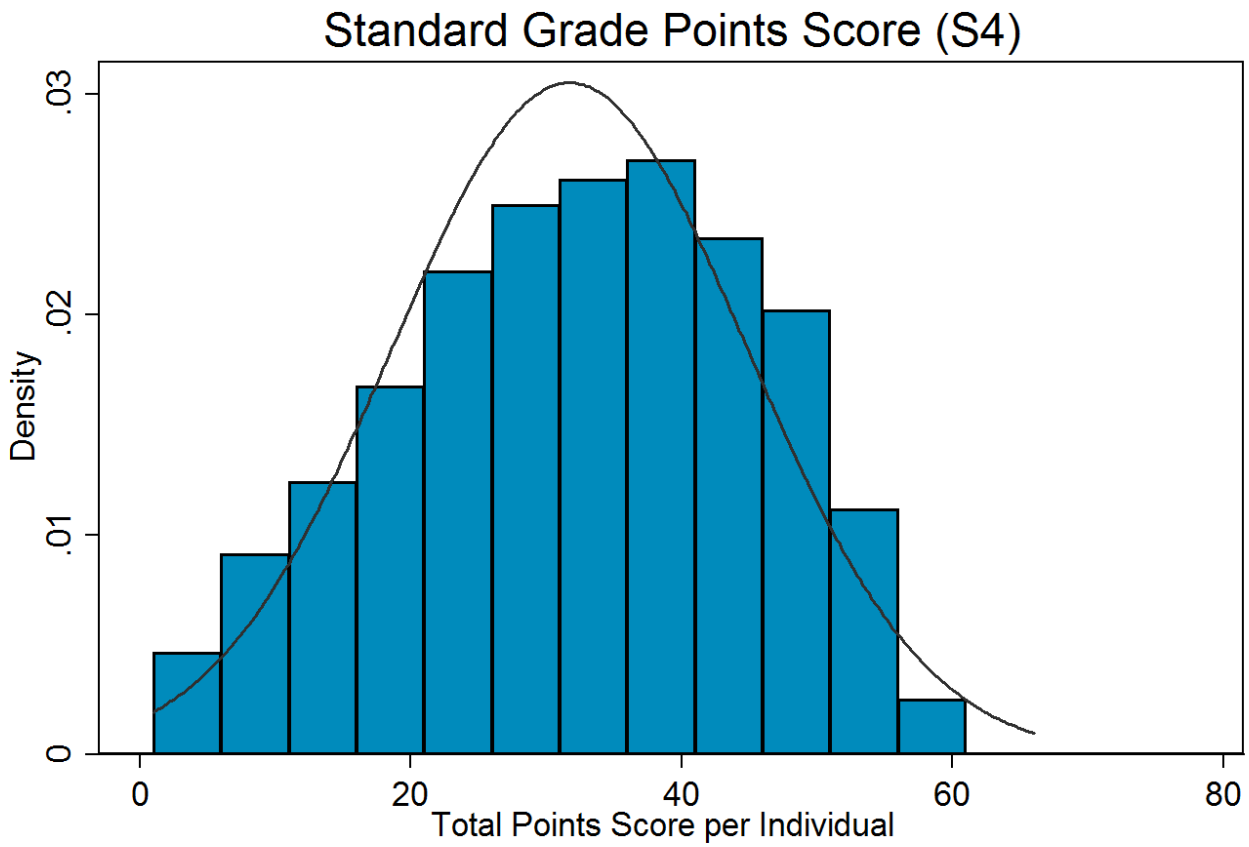
Source: Raab (2013: 23)

Standard Grade Attainment

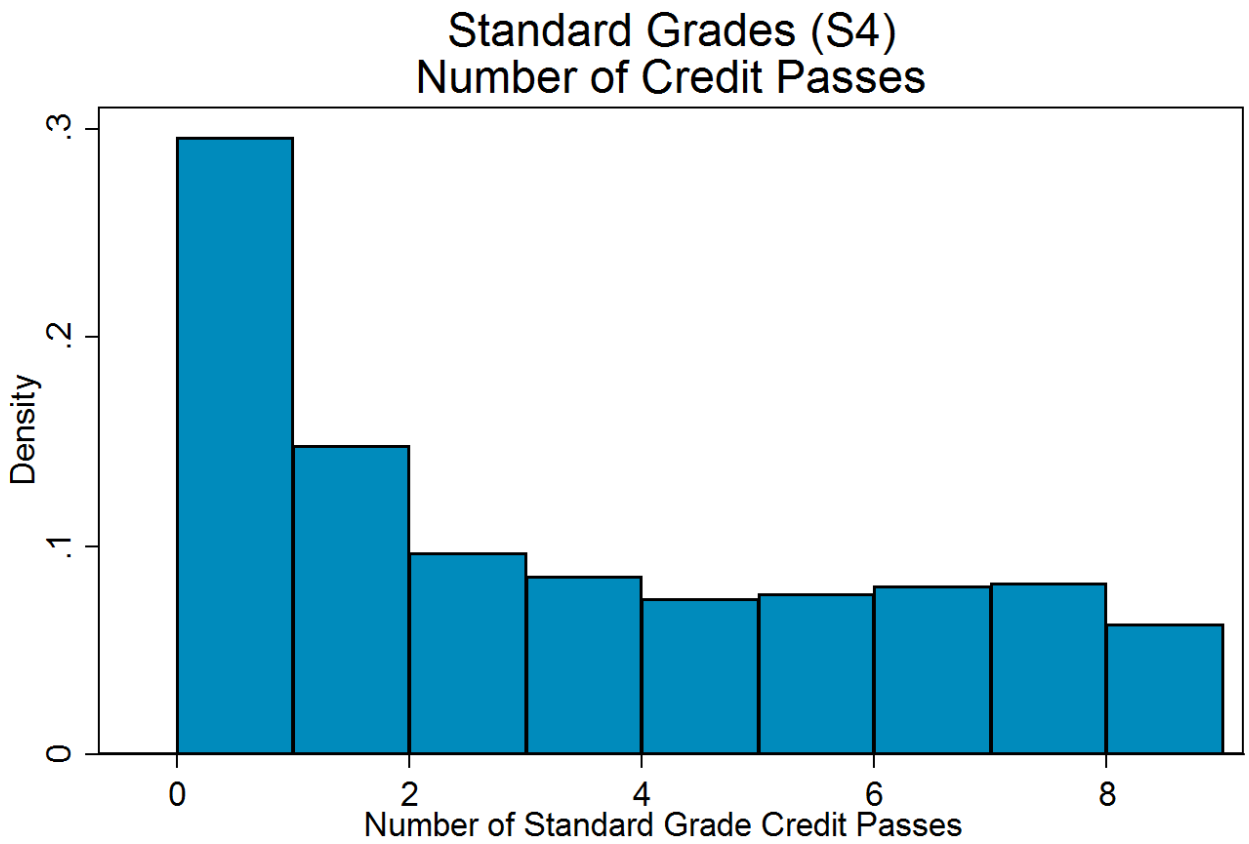
- Standard Grades: central qualifications undertaken by pupils in secondary schools in Scotland (historically).
- No single recognised measure of school attainment at Standard Grade level.
- Number of Credit Passes (Standard Grades 1 & 2)
- Standard Grade Points Score (inverted)
  - 7 points = Grade 1 (Highest)
  - 1 point = Grade 7 (Lowest)
  - See Croxford et al. (2007)

Standard Grade Score 1



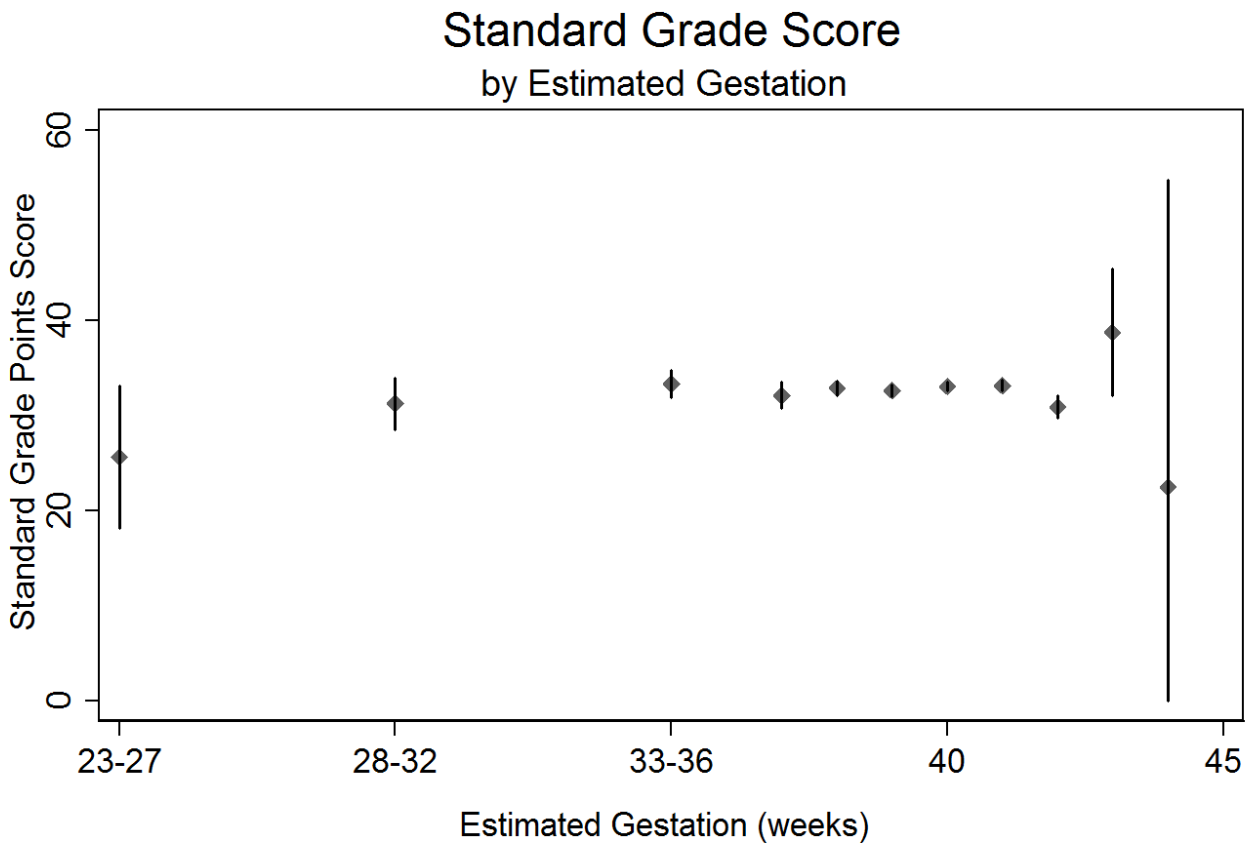
Source: SLS, n=9,656

Standard Grade Score 2



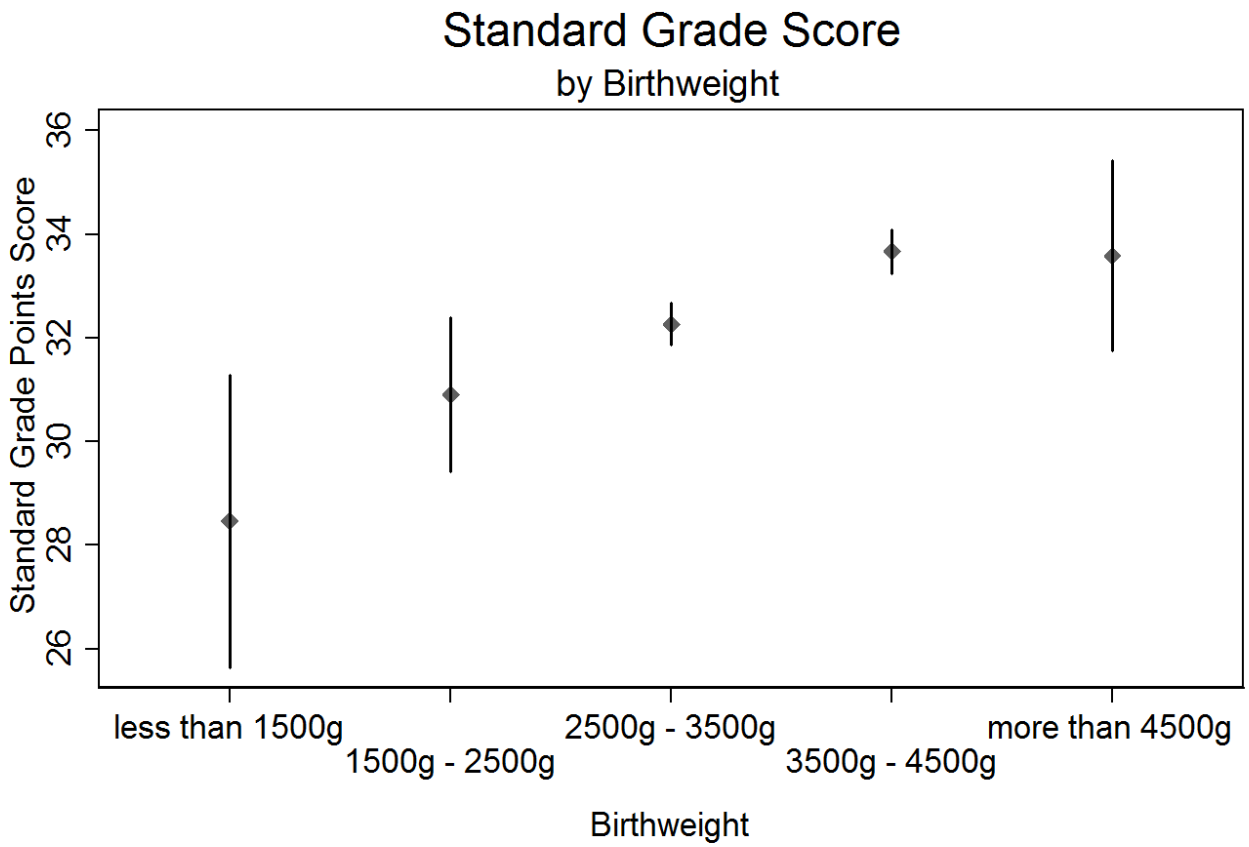
Source: SLS, n=9,656

Standard Grade by Estimated Gestation



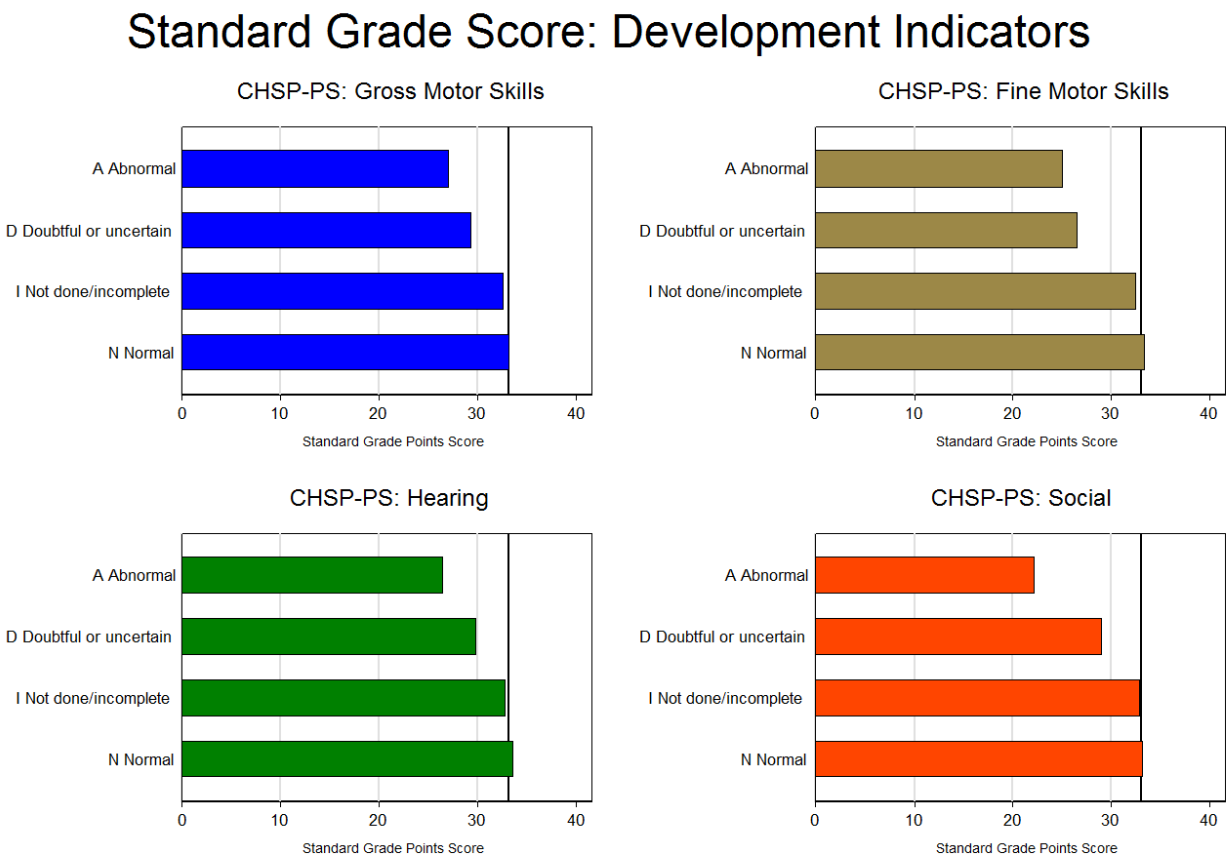
Source: SLS, n=7,941

Standard Grade by Low Birthweight



Source: SLS, n=7,941

Descriptive Statistics (2)

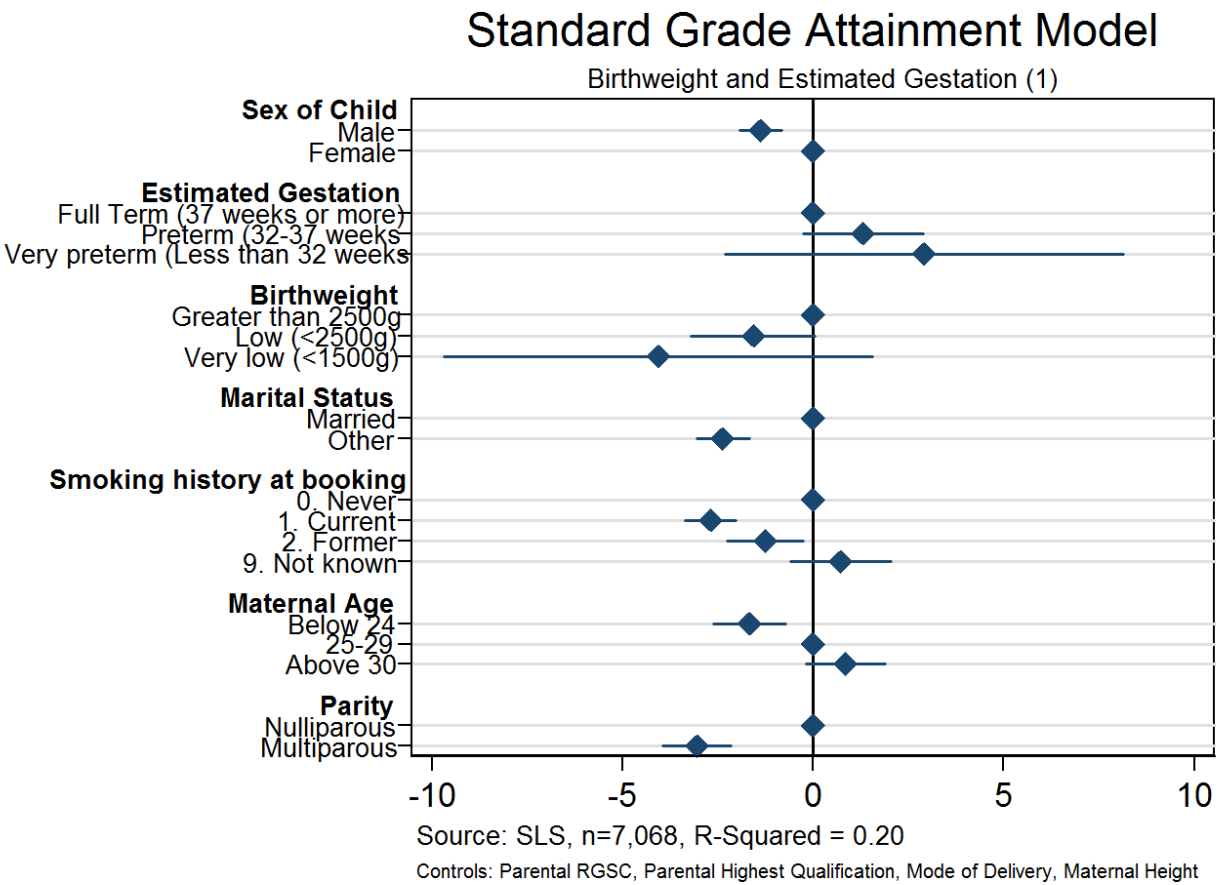


Source: SLS, n=5,201

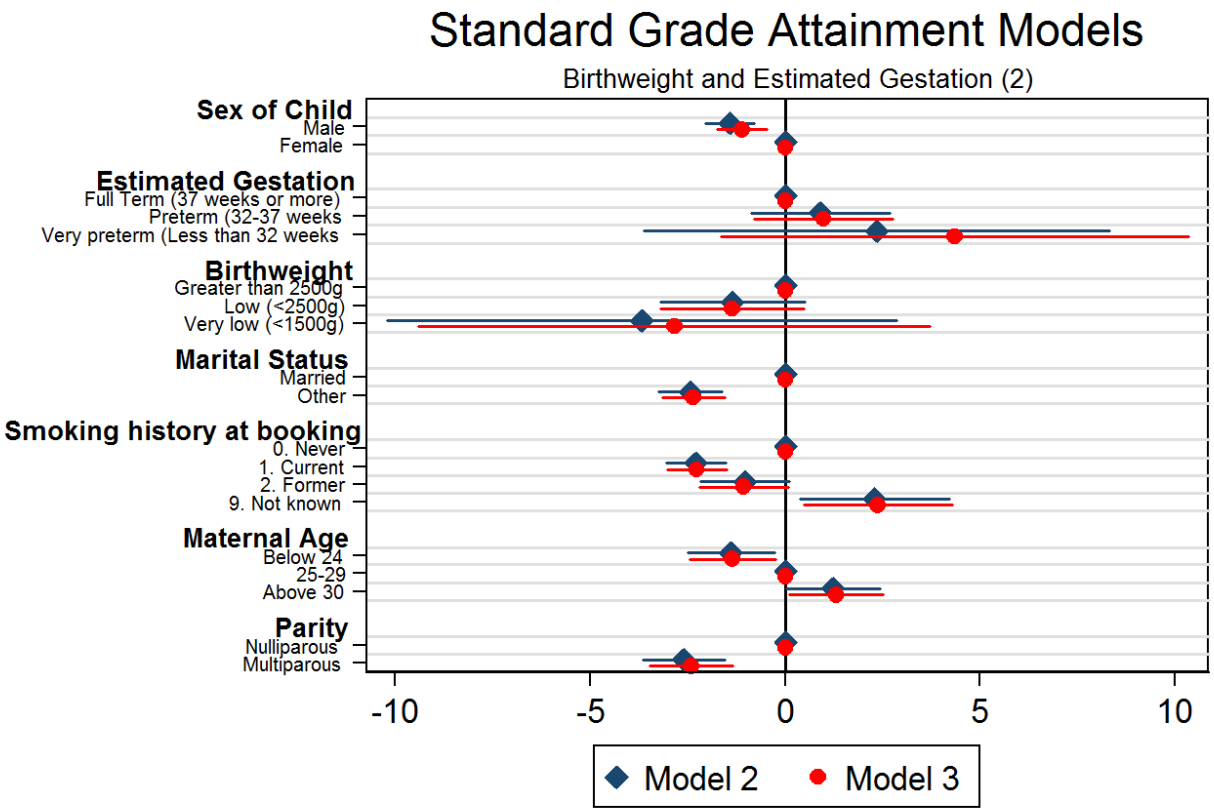
Models

- LBW Models
- SGA Models
- LBW Models with interaction between birthweight and estimated gestation (Appendix)

LBW Models (1)


Standard Grade Attainment Model
Birthweight and Estimated Gestation (1)
Sex of Child
Male
Female
Estimated Gestation
Full Term (37 weeks or more)
Preterm (32-37 weeks
Very preterm (Less than 32 weeks
Birthweight
Greater than 2500g
Low (<2500g)
Very low (<1500g)
Marital Status
Married
Other
Smoking history at booking
0. Never
1. Current
2. Former
9. Not known
Maternal Age
Below 24
25-29
Above 30
Parity
Nulliparous
Multiparous
-10
-5
0
5
10
Source: SLS, n=7,068, R-Squared = 0.20
Controls: Parental RGSC, Parental Highest Qualification, Mode of Delivery, Maternal Height

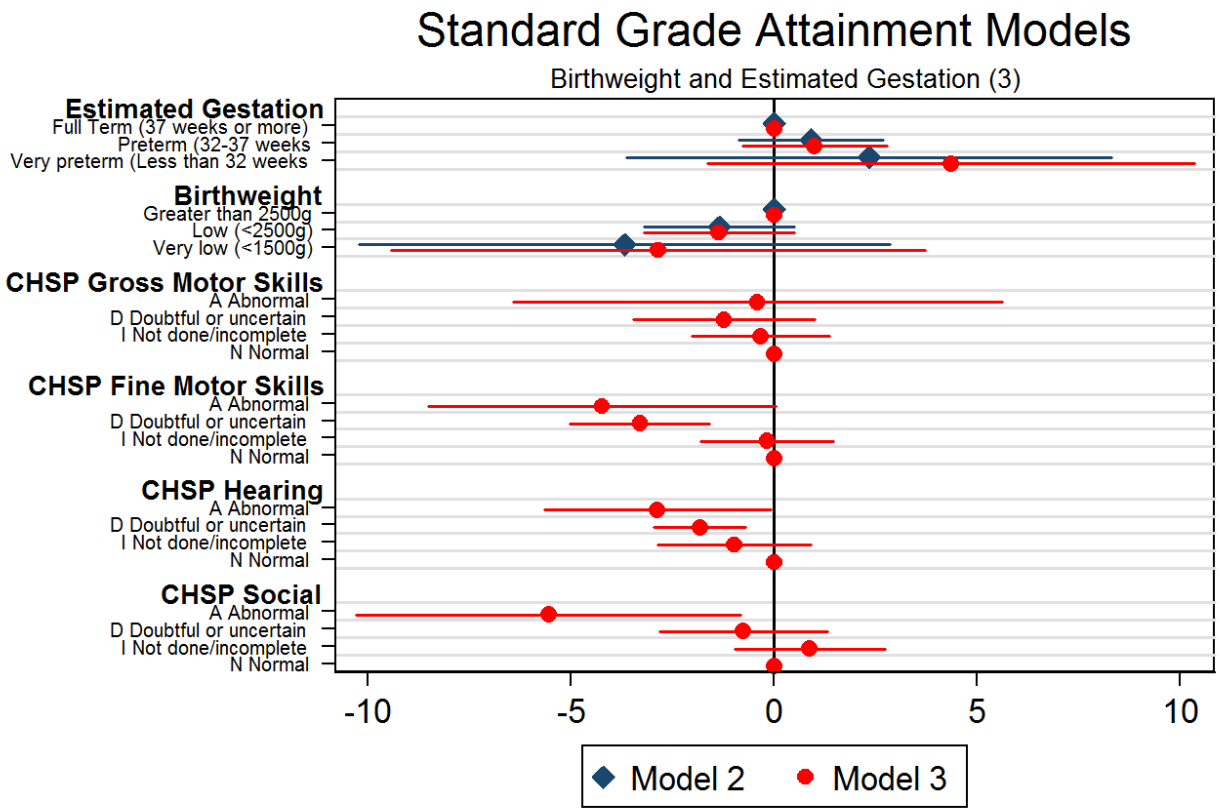
LBW Models (2)



Source: SLS, n=5,229, R-Squared: Model 2 = 0.20, Model 3 = 0.21

Controls: Parental RGSC, Parental Highest Qualification, Mode of Delivery, Maternal Height

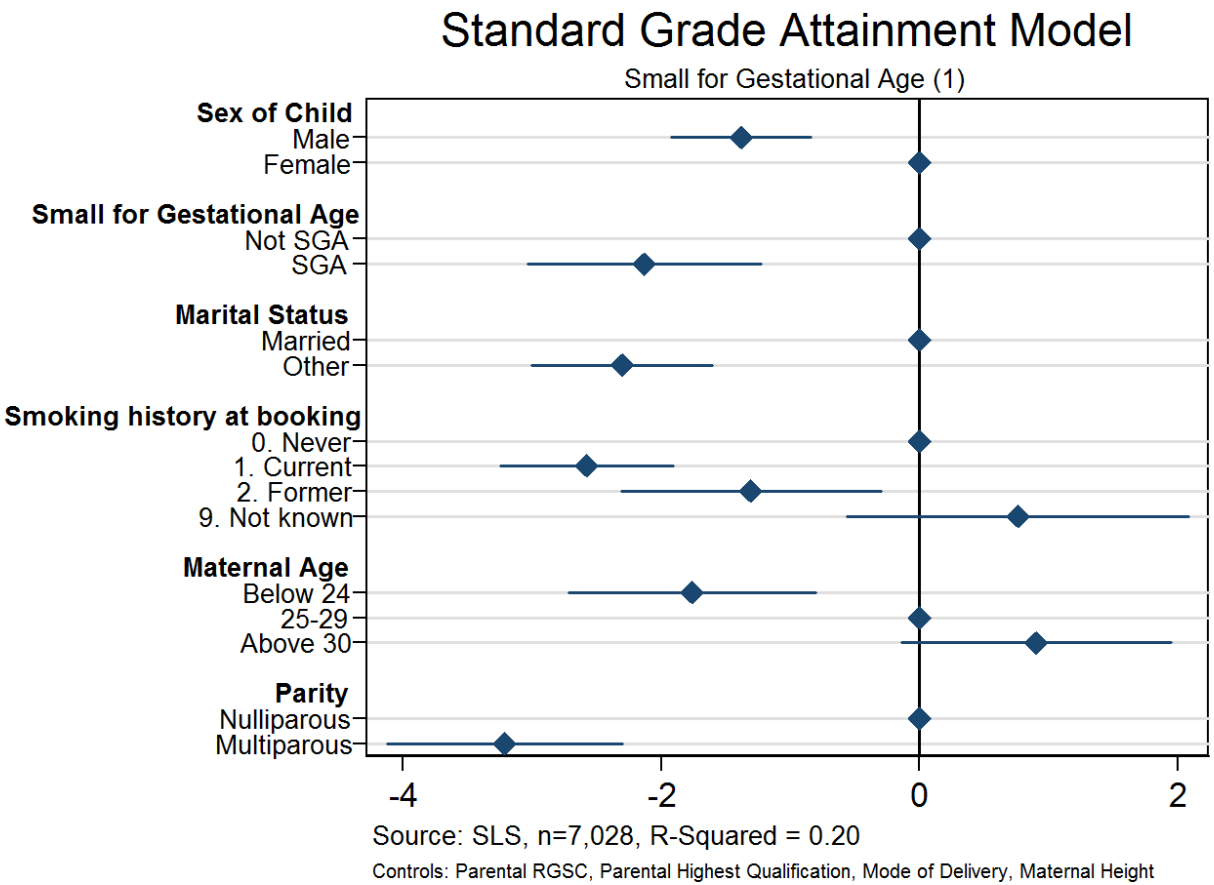
LBW Models (3)



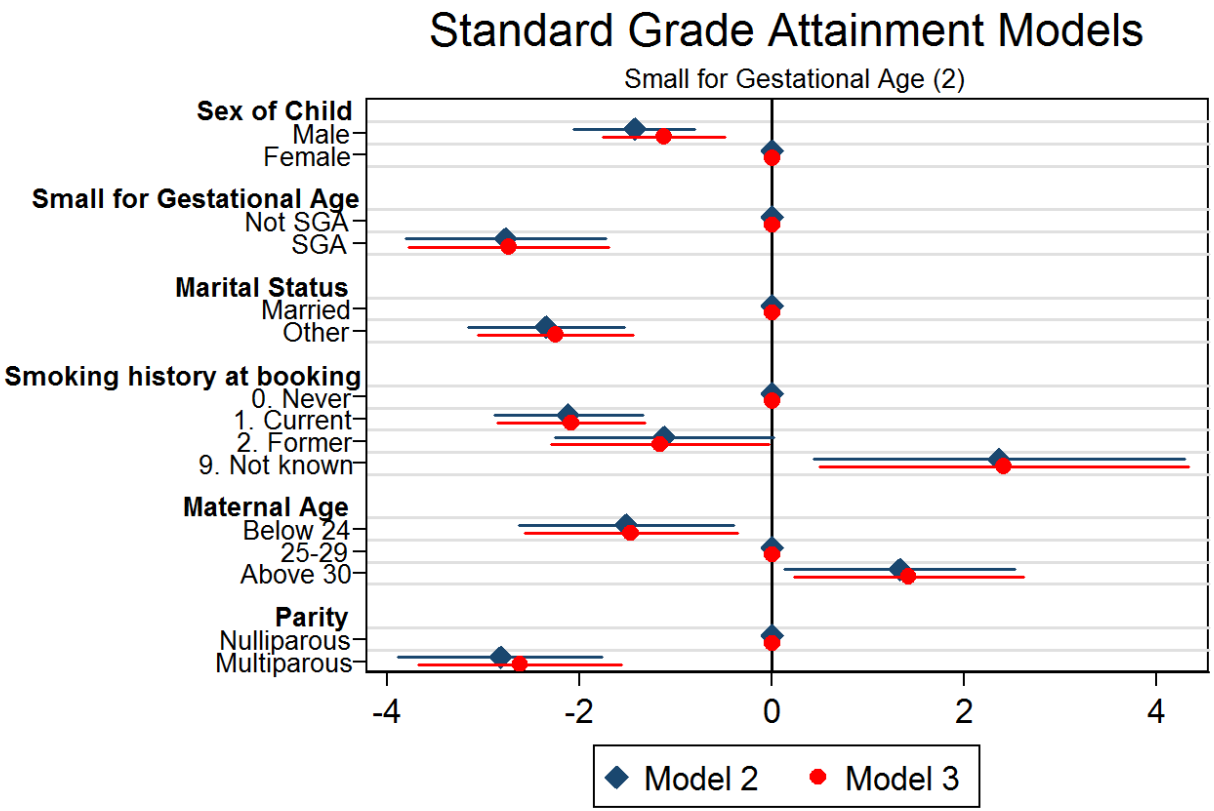
Source: SLS, n=5,229, R-Squared: Model 2 = 0.20, Model 3 = 0.21

Controls: Parental RGSC, Parental Highest Qualification, Mode of Delivery, Maternal Height

SGA Models (1)


Standard Grade Attainment Model
Small for Gestational Age (1)
Sex of Child
Male
Female
Small for Gestational Age
Not SGA
SGA
Marital Status
Married
Other
Smoking history at booking
0. Never
1. Current
2. Former
9. Not known
Maternal Age
Below 24
25-29
Above 30
Parity
Nulliparous
Multiparous
-4
-2
0
2
Source: SLS, n=7,028, R-Squared = 0.20
Controls: Parental RGSC, Parental Highest Qualification, Mode of Delivery, Maternal Height

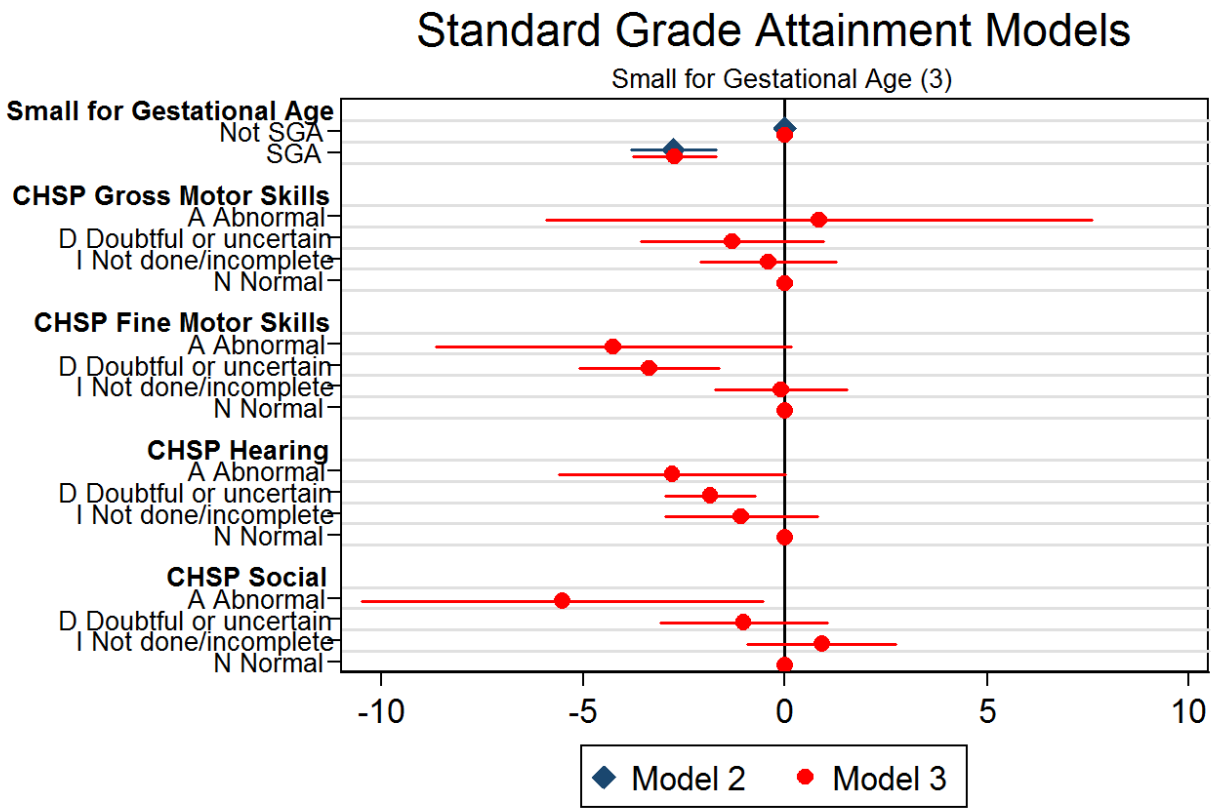
SGA Models (2)



Source: SLS, n=5,021, R-Squared: Model 2 = 0.20, Model 3 = 0.21

Controls: Parental RGSC, Parental Highest Qualification, Mode of Delivery, Maternal Height

SGA Models (3)



Source: SLS, n=5,021, R-Squared: Model 2 = 0.20, Model 3 = 0.21

Controls: Parental RGSC, Parental Highest Qualification, Mode of Delivery, Maternal Height

Research Questions Revisited

- Is LBW/SGA associated with lower standard grade attainment?
  - Independent of other known correlates (such as parental occupation, parental education and other family background factors).
  - Is this also the case for Small for Gestational Age (SGA) infants?

- Are Child Development measures associated with standard grade attainment?
  - Do these indicators act as potential mediators of any supposed relationship between LBW and standard grade attainment?

Conclusions

- This presentation has demonstrated potential use of the CHSP-PS measures to model Standard Grade attainment using the Scottish Longitudinal Study.

- LBW has a weaker association with standard grade attainment (controlling for estimated gestation).
  - Borderline statistical significance (at $p<0.05$)
  - Larger standard error of the estimate.

- SGA is associated with lower Standard Grade attainment (age 15/16).
  - Independent of Parental RGSC, Parental Education, Sex of Child, Marital Status of Mother, Smoking History at Booking, Maternal Age at Birth, Parity, Mode of Delivery, Maternal Height, and CHSP-PS measures of development.

- CHSP-PS measures have weaker association due to small sub-sample sizes
- Little mediation of SGA effect on Standard Grade attainment (age 15/16).

- Requires further investigation

LBW Paradox

- Different distribution of birthweights by groups (e.g. smokers and non-smokers).
- Effect of birthweight is not, therefore uniform. What is a “Low” birthweight for one group is not “Low” for another.
- See Wilcox (2001, 2006)
- SGA makes an attempt to correct for the lowest birthweights for each week of gestational age.
- However, still an imperfect measure:
  - Z-Scores? (Schisterman et al. 2009)
  - Using a model-based definition to identify thresholds? (Juarez 2014)

Next Steps

- Sensitivity Analysis
  - Revisit LBW & VLBW
  - Number of Standard Grade credit passes

- Random effects model (see Goldstein et al. 1994)
  - Repeated measures data (CHSP-PS Assessments)
  - Unbalanced design (not recorded at every time point)

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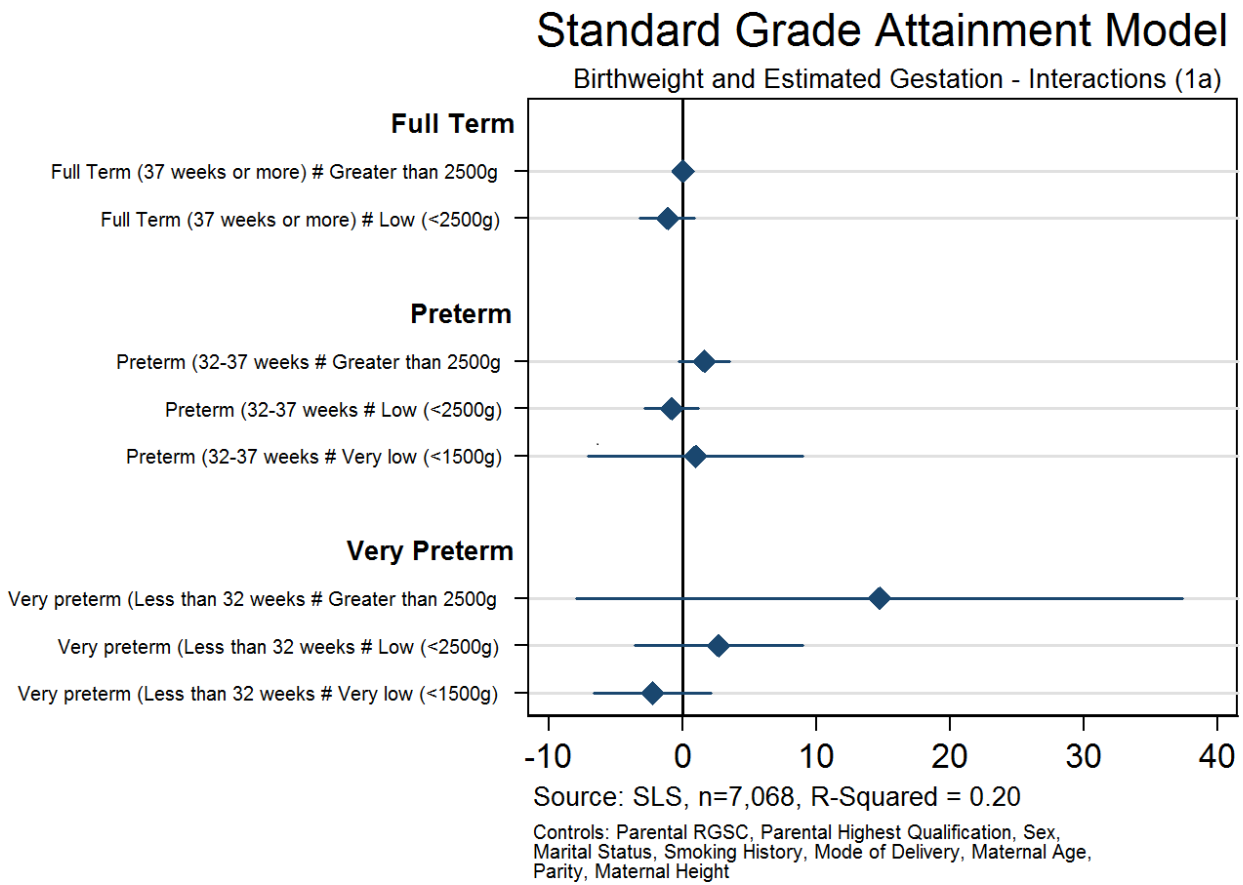
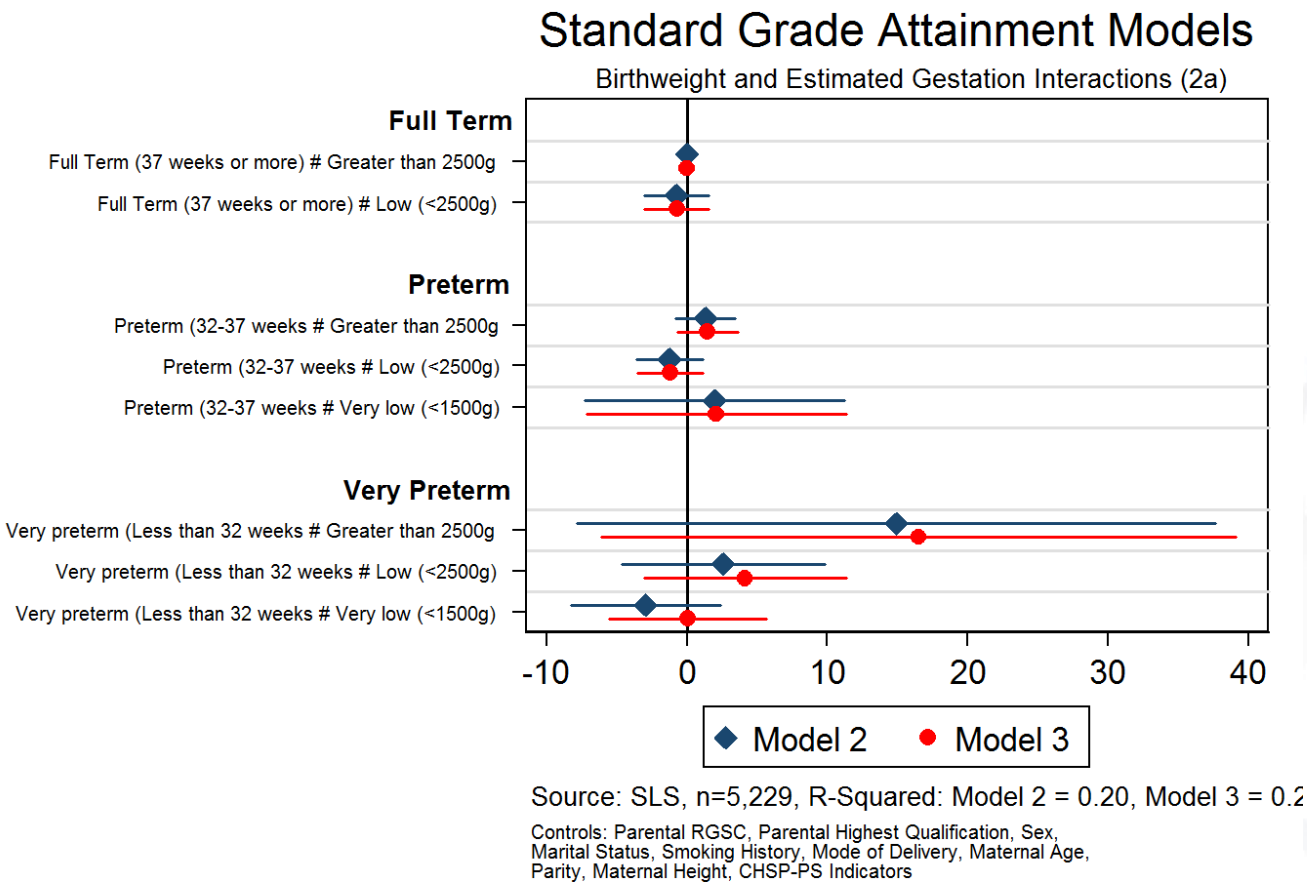
Appendix

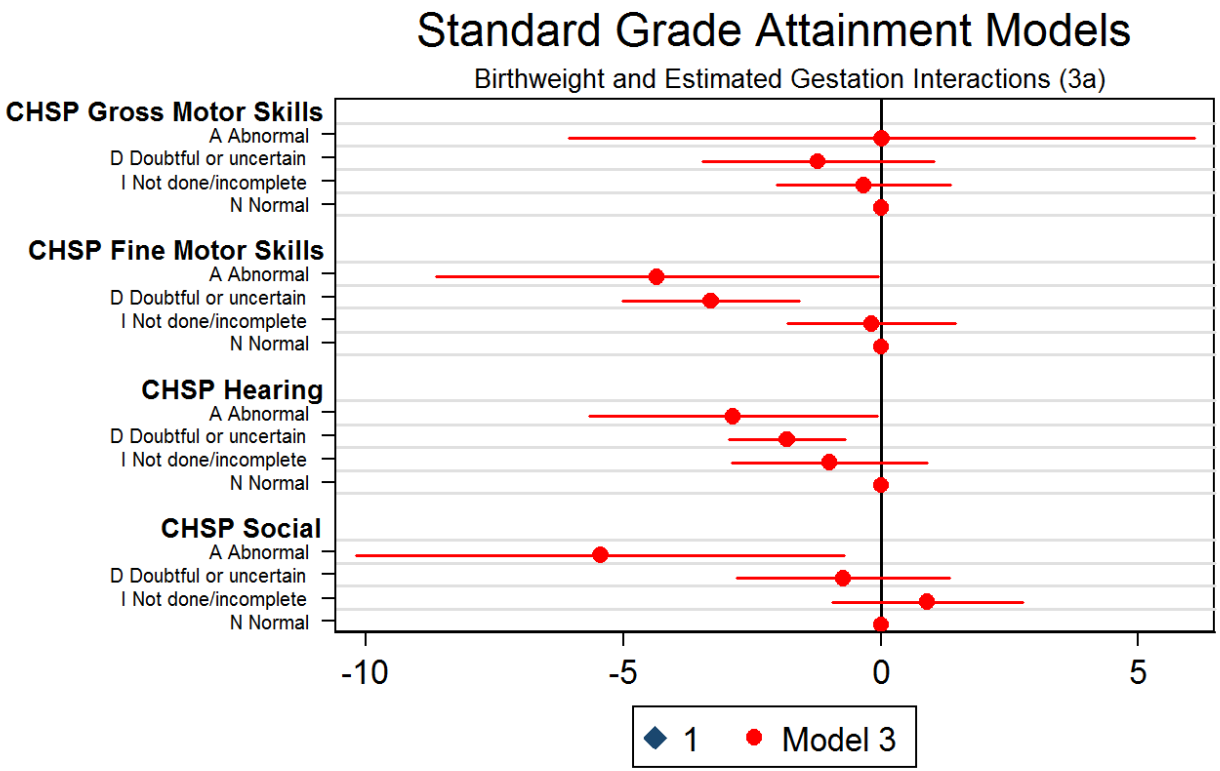
LBW Models Interaction (1a)



LBW Models Interaction (2a)



LBW Models Interaction (3a)



Source: SLS, n=5,229, R-Squared: Model 2 = 0.20, Model 3 = 0.21

Controls: Parental RGSC, Parental Highest Qualification, Sex, Marital Status, Smoking History, Mode of Delivery, Maternal Age, Parity, Maternal Height, Birthweight, Estimated Gestation

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The Scottish Low Birthweight Study

The Scottish low birthweight study: I. Survival, growth, neuromotor and sensory impairment

The Scottish Low Birthweight Study Group*

Abstract

Of all 908 livebirths weighing less than 1750 g at birth who were born in Scotland in 1984, 896 (99%) were enrolled in a prospective study to document survival and determine the prevalence of neuromotor and sensory impairments and disability.

At the age of 4·5 years, 636 (71%) had survived and 611 (96%) were assessed. Overall 16% were disabled; 47 had cerebral palsy (52·5/1000 livebirths), seven were blind (7·8/1000 livebirths), and 11 were deaf and using aids (12·3/1000 livebirths). Among those not overtly disabled, the prevalence of poor neuromotor competence was high and related to birth weight.

All growth measures had mean values below the standard population mean indicating a downward shift in the distribution which was related to birth weight. In addition the height distribution was negatively skewed.

The Scottish low birthweight study: II. Language attainment, cognitive status, and behavioural problems

The Scottish Low Birthweight Study Group*

Abstract

Of the 636 survivors of a total geographically based population born in Scotland in 1984, who weighed less than 1750 g at birth, 611 (96%) were assessed at 4·5 years to determine the prevalence of language, cognitive, and behavioural problems.

Language development was significantly related to birth weight, gestational age, and social class for comprehension, less so for expressive language.

Mean (SD) intelligence quotient (IQ) on the British ability scales was 92·9 (14·7). Within this population there were no signficant differences between birthweight groups. Overall they peformed poorly on visual recognition, verbal comprehension and number skills subscales—in the latter those with birth weights <1000 g were significantly worse than the heavier children. Only 5% had IQs <70, but a further 3% could not be tested because of other physical disability. Among those with normal IQs were groups of children who exhibited patterns of skill deficits in different subscales raising the possibility of specific learning difficulties.

Poor attention span was reported in 47%, and parents said the study children had more behavioural problems than their siblings.

References (1)

Almond, D., & Currie, J. (2011). Killing Me Softly: The Fetal Origins Hypothesis. Journal of Economic Perspectives, 25(3), 153-172. doi: 10.1257/jep.25.3.153

Anderson, S., Biggart, A., Deacon, K., Furlong, A., Given, L., & Hinds, K. (2004). 17 in 2003 - Scotland's Young People: Findings from the Scottish School Leavers Survey. Edinburgh: Scottish Executive Education Department.

Björklund, A., & Salvanes, K. G. (2011). Education and Family Background: Mechanisms and Policies. In S. M. Eric A. Hanushek & W. Ludger (Eds.), Handbook of the Economics of Education (Vol. Volume 3, pp. 201-247): Elsevier.

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2007). From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes. The Quarterly Journal of Economics, 122(1), 409-439. doi: 10.1162/qjec.122.1.409

Blumenshine, P., Egerter, S., Barclay, C. J., Cubbin, C., & Braveman, P. A. (2010). Socioeconomic disparities in adverse birth outcomes: a systematic review. Am J Prev Med, 39(3), 263-272. doi: 10.1016/j.amepre.2010.05.012

Boyle, P. J., Feijten, P., Feng, Z., Hattersley, L., Huang, Z., Nolan, J., & Raab, G. (2009). Cohort Profile: The Scottish Longitudinal Study (SLS). *International Journal of Epidemiology, 38*(2), 385-392. doi: 10.1093/ije/dyn087

Bradshaw, P. (2011). GROWING UP IN SCOTLAND: Changes in child cognitive ability in the pre-school years. Edinburgh: The Scottish Government.

References (2)

Breen, R. (Ed.). (2004). Social Mobility in Europe. Oxford: Oxford University Press.

Bukodi, E., & Goldthorpe, J. H. (2012). Decomposing ‘Social Origins’: The Effects of Parents’ Class, Status, and Education on the Educational Attainment of Their Children. European Sociological Review. doi: 10.1093/esr/jcs079

Chevalier, A., Harmon, C., O' Sullivan, V., & Walker, I. (2013). The impact of parental income and education on the schooling of their children. IZA Journal of Labor Economics, 2(1), 8.

Croxford, L., Tinklin, T., Frame, B., & Ducklin, A. (2003). Gender and pupil performance: where do the problems lie? Scottish Educational Review, 35, 135-147.

Croxford, L., Ianelli, C., & Shapira, M. (2007). Documentation of the Youth Cohort Time-Series Datasets. In Centre for Educational Sociology (Ed.), UK Data Archive Study Number 5765 - Youth Cohort Time Series for England, Wales and Scotland, 1984-2002. Edinburgh: UK Data Archive.

Currie, J., & Hyson, R. (1999). Is the Impact of Health Shocks Cushioned by Socioeconomic Status? The Case of Low Birthweight. American Economic Review, 89(2), 245-250.

Dibben, C., Sigala, M., & Macfarlane, A. (2006). Area deprivation, individual factors and low birth weight in England: is there evidence of an “area effect”? *Journal of Epidemiology and Community Health, 60*(12), 1053-1059. doi: 10.1136/jech.2005.042853

References (3)

Eu, B. S. (1986). Evaluation of a developmental screening system for use by child health nurses. *Arch Dis Child, 61*(1), 34-41.

Fairley, L. (2005). Changing patterns of inequality in birthweight and its determinants: a population-based study, Scotland 1980–2000. *Paediatric & Perinatal Epidemiology, 19*(5), 342-351. doi: 10.1111/j.1365-3016.2005.00665.x

Gayle, V., Lambert, P. S., & Murray, S. (2009). School-To-Work in the 1990s: Modelling Transitions with large-scale datasets. In R. Brooks (Ed.), Transitions from Education to Work: New Perspectives from Europe and Beyond (pp. 17-41). Basingstoke: Palgrave Macmillan.

Goldstein, H., Healy, M. J., & Rasbash, J. (1994). Multilevel time series models with applications to repeated measures data. Stat Med, 13(16), 1643-1655.

Juarez, S., Ploubidis, G. B., & Clarke, L. (2014). Revisiting the 'Low Birth Weight paradox' using a model-based definition. Gac Sanit, 28(2), 160-162. doi: 10.1016/j.gaceta.2013.08.001

Kirkegaard, I., Obel, C., Hedegaard, M., & Henriksen, T. B. (2006). Gestational age and birth weight in relation to school performance of 10-year-old children: a follow-up study of children born after 32 completed weeks. Pediatrics, 118(4), 1600-1606. doi: 10.1542/peds.2005-2700

Macfarlane, A., & Mugford, M. (2000). Birth Counts: Statistics of Pregnancy and Childbirth 2nd edn. London: The Stationary Office.

References (4)

Macfarlane, A., Stafford, M., & Moser, K. (2004). Social inequalities. In Office for National Statistics (Ed.), The health of children and young people. London: Office for National Statistics.

MacKay, D. F., Smith, G. C., Dobbie, R., & Pell, J. P. (2010). Gestational age at delivery and special educational need: retrospective cohort study of 407,503 schoolchildren. PLoS Med, 7(6), e1000289. doi: 10.1371/journal.pmed.1000289

Maher, J., & Macfarlane, A. (2004). Trends in live births and birthweight by social class, marital status and mother's age, 1976-2000. Health Stat Q(23), 34-42.

Moser, K., Li, L., & Power, C. (2003). Social inequalities in low birth weight in England and Wales: trends and implications for future population health. Journal of Epidemiology and Community Health, 57(9), 687-691. doi: 10.1136/jech.57.9.687

Raab, G. M. (2013). Education data available within the Scottish Longitudinal Study *Scottish Longitudinal Development & Support Unit Technical Working Paper* (Vol. 6).

Royer, H. (2009). Separated at Girth: US Twin Estimates of the Effects of Birth Weight. American Economic Journal: Applied Economics, 1(1), 49-85.

Schisterman, E. F., Whitcomb, B. W., Mumford, S. L., & Platt, R. W. (2009). Z-scores and the birthweight paradox. Paediatr Perinat Epidemiol, 23(5), 403-413. doi: 10.1111/j.1365-3016.2009.01054.x

References (5)

Shenkin, S. D., Starr, J. M., Pattie, A., Rush, M. A., Whalley, L. J., & Deary, I. J. (2001). Birth weight and cognitive function at age 11 years: the Scottish Mental Survey 1932. Archives of Disease in Childhood, 85(3), 189-196. doi: 10.1136/adc.85.3.189

The Scottish Low Birthweight Study Group. (1992). The Scottish low birthweight study: I. Survival, growth, neuromotor and sensory impairment. Archives of Disease in Childhood, 67(6), 675-681.

The Scottish Low Birthweight Study Group. (1992). The Scottish low birthweight study: II. Language attainment, cognitive status, and behavioural problems. Archives of Disease in Childhood, 67(6), 682-686.

Shenkin, S. D., Starr, J. M., & Deary, I. J. (2004). Birth Weight and Cognitive Ability in Childhood: A Systematic Review. Psychological Bulletin, 130(6), 989-1013.

Wilcox, A. J. (2001). On the importance—and the unimportance— of birthweight. International Journal of Epidemiology, 30(6), 1233-1241. doi: 10.1093/ije/30.6.1233

Wilcox, A. J. (2006). Invited commentary: the perils of birth weight--a lesson from directed acyclic graphs. American Journal of Epidemiology, 164(11), 1121-1123; discussion 1124-1125. doi: 10.1093/aje/kwj276

Younger, M., & Warrington, M. (2005). Raising boys' achievement (Vol. Research report 636). London: Department for Education and Skills.