Web Material

Associations of Maternal Educational Level, Proximity to Greenspace During Pregnancy, and Gestational Diabetes With Body Mass Index From Infancy to Early Adulthood: A Proof-of-Concept Federated Analysis in 18 Birth Cohorts

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Web appendix 2: Study specific information

ABCD

The Amsterdam Born Children and their Development cohort is a multi-ethnic birth cohort in the Netherlands focusing on maternal factors during pregnancy influencing offspring's health. Between January 2003 and March 2004 all pregnant women in Amsterdam (n=12,373) were invited for participation at their first pregnancy check-up at median 13 weeks' gestation. They were asked to fill out a pregnancy questionnaire. Of these 12,373 women, 8,266 filled out the pregnancy questionnaire (response 67 %) and 7050 granted permission for follow-up. More information can be found in the cohort profile [1].

The cohort was established with a significant funding from the Public Health Service and Municipal Council of Amsterdam. Additional funding was obtained from the Netherlands Organization for Health Research and Development (ZonMw), Amsterdam University Medical Center, Amsterdam, Dutch Heart Foundation and Sarphati Institute, Amsterdam.

Approval for the ABCD-study was obtained from the Central Committee on Research involving Human Subjects in the Netherlands, the Medical Ethical Committees of the participating hospitals, and from the Registration Committee of the Municipality of Amsterdam. Written informed consent was obtained from all participants.

The authors thank the participating mothers, fathers, their children, and all others who contributed to the ABCD-study: obstetric care providers, primary schools, students, and youth healthcare centers in Amsterdam, The Netherlands.

ALSPAC

Pregnant women resident in Avon, UK with expected dates of delivery 1st April 1991 to 31st December 1992 were invited to take part in the study. The initial number of pregnancies enrolled is 14,541 (for these at least one questionnaire has been returned or a "Children in Focus" clinic had been attended by 19/07/99). Of these initial pregnancies, there was a total of 14,676 foetuses, resulting in 14,062 live births and 13,988 children who were alive at 1 year of age.

When the oldest children were approximately 7 years of age, an attempt was made to bolster the initial sample with eligible cases who had failed to join the study originally. As a result, when considering variables collected from the age of seven onwards (and potentially abstracted from obstetric notes) there are data available for more than the 14,541 pregnancies mentioned above. The number of new pregnancies not in the initial sample (known as Phase I enrolment) that are currently represented on the built files and reflecting enrolment status at the age of 24 is 913 (456, 262 and 195 recruited during Phases II, III and IV respectively), resulting in an additional 913 children being enrolled. The phases of enrolment are described in more detail in the cohort profile paper and its update (see footnote 4 below). The total sample size for analyses using any data collected after the age of seven is therefore 15,454 pregnancies, resulting in 15,589 foetuses. Of these 14,901 were alive at 1 year of age.

A 10% sample of the ALSPAC cohort, known as the Children in Focus (CiF) group, attended clinics at the University of Bristol at various time intervals between 4 to 61 months of age. The CiF group were chosen at random from the last 6 months of ALSPAC births (1432 families attended at least one clinic). Excluded were those mothers who had moved out of the area or were lost to follow-up, and those partaking in another study of infant development in Avon.

Full details of the cohort can be provided in the cohort profiles [2, 3]. Please note that the study website contains details of all the data that is available through a fully searchable data dictionary and variable search tool: http://www.bristol.ac.uk/alspac/researchers/our-data/

The UK Medical Research Council and Wellcome (Grant ref: 217065/Z/19/Z) and the University of Bristol provide core support for ALSPAC. This publication is the work of the authors and Tim Cadman and Deborah Lawlor will serve as guarantors for the contents of this paper. A comprehensive list of grants funding is available on the ALSPAC website (http://www.bristol.ac.uk/alspac/external/documents/grant-acknowledgements.pdf); This research was specifically funded by H2020 LifeCycle project Grant Agreement No. 733206).

DAL and AK work in a unit that is supported by the University of Bristol and UK Medical Research Council (MC_UU_00011/6) and DAL holds a European Research Council Advanced Grant (ERC grant agreement no 669545) and is a NIHR Senior Investigator (NF-0616-10102). The funders had no role in the design of the study, the collection, analysis, or interpretation of the data; the writing of the manuscript, or the decision to submit the manuscript for publication. The views expressed in this paper are those of the authors and not necessarily those of any funder.

Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC Ethics and Law Committee at the time.

We are extremely grateful to all of the families who took part in ALSPAC, the midwives for their help in recruiting them, and the whole ALSPAC team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientists, volunteers, managers, receptionists and nurses.

BIB

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Ethics approval has been obtained for the main platform study and all of the individual substudies from the Bradford Research Ethics Committee. All participants gave written informed consent.

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CHOP

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The study was approved by the ethics committees of all study centers. Written informed parental consent was obtained for each infant.

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DNBC

The Danish National Birth Cohort was established with a significant grant from the Danish National Research Foundation. Additional support was obtained from the Danish Regional Committees, the Pharmacy Foundation, the Egmont Foundation, the March of Dimes Birth Defects Foundation, the Health Foundation and other minor grants. The DNBC Biobank has been supported by the Novo Nordisk Foundation and the Lundbeck Foundation. Follow-up of mothers and children have been supported by the Danish Medical Research Council (SSVF 0646, 271-08-0839/06-066023, O602-01042B, 0602-02738B), the Lundbeck Foundation (195/04, R100-A9193), The Innovation Fund Denmark 0603-00294B (09-067124), the Nordea Foundation (02-2013-2014), Aarhus Ideas (AU R9-A959-13-S804), University of Copenhagen Strategic Grant (IFSV 2012), and the Danish Council for Independent Research (DFF – 4183-00594 and DFF - 4183-00152). AP is funded by a Lundbeck Foundation fellowship (R264-2017-3099).

The DNBC complies with the Declaration of Helsinki and was approved by the Danish National Committee on Biomedical Research Ethics. Informed consent was obtained from participants upon enrolment.

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EDEN

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The study received approval from the ethics committee (CCPPRB) of Kremlin Bicêtre on 12 December 2002 and from CNIL (Commission Nationale Informatique et Liberté), the French data privacy institution. Women gave written informed consent for themselves and their child. Fathers gave written informed consent for themselves.

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ELFE

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Ethical approvals for data collection in maternity units and for each data collection wave during follow-up were obtained from the national advisory committee on information processing in health research (CCTIRS: Comité Consultatif sur le Traitement de l'Information en matière de Recherche dans le domaine de la Santé), the national data protection authority (CNIL: Comission Nationale Informatique et Liberté) and, in case of invasive data collection such as biological sampling, the committee for protection of persons engaged in research (CPP: Comité de Protection des Personnes). The ELFE study was also approved by the national committee for statistical

information (CNIS: Conseil National de l'Information Statistique). Informed consent was signed by the parents or the mother alone, with the father being informed of his right to deny consent for participation.

The Elfe cohort received funding from the National Research Agency Investment for the Future program [ANR-11-EQPX-0038]; French National Institute for Research in Public Health (IRESP TGIR 2009-2001 program); Ministry of Higher Education and Research; Ministry of Environment; Ministry of Health; French Agency for Public Health; Ministry of Culture; and National Family Allowance Fund.

GECKO Drenthe

The GECKO Drenthe birth cohort was funded by an unrestricted grant of Hutchison Whampoa Ld, Hong Kong and supported by the University of Groningen, Well Baby Clinic Foundation Icare, Noordlease, Paediatric Association Of The Netherlands and Youth Health Care Drenthe and the European Union's Horizon 2020 research and innovation programme (LIFECYCLE, grant agreement No 733206, 2016

This study was approved by the Medical Ethics Committee of the University Medical Center Groningen (UMCG). Parents of all participants in the study gave written informed consent.

The authors are grateful to the families who took part in the GECKO Drenthe study, the midwives, gyneacologists, nurses, and the general practitioners and all health professionals at the Preventive Child Healthcare Drenthe for their help in the recruitment and the measurements, and the GECKO Drenthe study team.

Generation R

The general design of the Generation R Study is made possible by financial support from the Erasmus MC, University Medical Center, Rotterdam, Erasmus University Rotterdam, Netherlands Organization for Health Research and Development (ZonMw), Netherlands Organisation for Scientific Research (NWO), Ministry of Health, Welfare and Sport and Ministry of Youth and Families. This project received funding from the European Union's Horizon 2020 research and innovation programme (LIFECYCLE, grant agreement No 733206, 2016; EUCAN-Connect grant agreement No 824989; ATHLETE, grant agreement No 874583). VJ received funding from a Consolidator Grant from the European Research Council (ERC-2014-CoG-648916). LD received funding from the European Union's Horizon 2020 co-funded programme ERA-Net on Biomarkers for Nutrition and Health (ERA HDHL) (ALPHABET project (no 696295; 2017), ZonMw The Netherlands (no 529051014; 2017)). JFF received received funding from the European Joint Programming Initiative "A Healthy Diet for a Healthy Life" (JPI HDHL, NutriPROGRAM project, ZonMw the Netherlands no.529051022 and PREcisE project ZonMw the Netherlands no.529051023). The study sponsors had no role in the study design, data analysis, interpretation of data, or writing of this report.

The general design, all research aims and the specific measurements in the Generation R Study have been approved by the Medical Ethical Committee of the Erasmus Medical Center, Rotterdam. New measurements will only be embedded in the study after approval of the Medical Ethical Committee. Participants are asked for their written informed consent for the four consecutive phases of the study (prenatally, birth to 4 years, 4–12 years, and from 12 years onwards). At the start of each phase, mothers and their partners receive written and oral information about the study. Even with consent of the parents, when the child is not willing to participate actively, no measurements are performed. From the age of 12 years, children are asked for written informed consent.

The authors gratefully acknowledge the contribution of participants, research collaborators, general practitioners, hospitals, midwives, and pharmacies in Rotterdam.

HGS

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Approval to conduct the study was granted by the Greek Ministry of National Education and the Ethics Committee of Harokopio University of Athens, and the study was conducted in accordance with the ethical standards specified in the 1964 Declaration of Helsinki. Parents who agreed to the participation of their children in the study had to sign the consent form and provide their contact details.

INMA

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The INMA project was approved by the ethics committee in each area. All participants provided written informed consent before enrolment to the study.

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MoBa

The Norwegian Mother, Father and Child Cohort Study is supported by the Norwegian Ministry of Health and Care Services and the Ministry of Education and Research.

The establishment and data collection in MoBa was previously based on a license from the Norwegian Data protection agency and approval from The Regional Committee for Medical Research Ethics, and it is now based on regulations related to the Norwegian Health Registry Act. MoBa is conducted according to the guidelines laid down in the declaration of Helsinki, and written informed consent was obtained from all participants. A detailed protocol of the study including the consent can be found elsewhere (http://www.fhi.no/morogbarn).

The current study is based on version 12 of the quality-assured data files released for research. The establishment of MoBa and initial data collection were based on a license from the Norwegian Data Protection Agency and approval from The Regional Committees for Medical and Health Research Ethics. The MoBa cohort is based on regulations of the Norwegian Health Registry Act. The current study was approved by The Regional Committees for Medical and Health Research Ethics (2018/427).

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NFBC1966 and NFBC1986

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These studies was conducted following the principles of the Declaration of Helsinki and was approved by the Ethical Committee of Northern Ostrobothnia Hospital District. Written informed consent was obtained from all participants.

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NINFEA

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The Ethical Committee of the San Giovanni Battista Hospital and CTO/CRF/Maria Adelaide Hospital of Turin approved the NINFEA study (approval N. 0048362, and subsequent amendments). Informed consent was obtained from all the participants.

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RAINE Study

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Ethics approval was obtained from the Human Ethics Committees at King Edward Memorial Hospital, Princess Margaret Hospital, The University of Western Australia and Curtin University. All participants and guardians provided written consent.

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RHEA

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The study was approved by the corresponding ethical committees. All participants provided written, informed consent.

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SWS

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The study had full approval from the Southampton and Southwest Hampshire Local Research Ethics Committee. All participants gave written informed consent.

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Missing data

Complete case analysis is unbiased by missing data if the chance of being a complete case is not associated with the outcome after adjusting for covariates. However, it is not possible to test this within one model, as including all covariates from a given analysis as predictors of being a complete case in that analysis would leave no variation in the variable indicating missingness. We therefore regressed a variable indicating complete cases on BMI at each age and covariates with no missingness (sex, exact age in days, cohort; Figure S2). For maternal education and pregnancy diabetes all odds ratios for the association between BMI and being a complete case were null. For area deprivation and NDVI odds ratios were close to 1 at younger ages, however at older ages higher BMI was associated with a lower chance of being a complete case.

Web Table 1: Information sources for gestational diabetes

Cohort	Source	Universal screening?
ABCD	Questionnaire, linkage with perinatal registration, and info from medical files	No
ALSPAC	Clinical records	No
BiB	OGTT	Yes
DNBC	Clinical records	No
EDEN	OGTT during study clinic and clinical record	Yes
ELFE	Clinical record	No
GECKO	Clinical records	No
Gen-R	Clinical records	No
INMA	Clinical records	No
MoBa	Questionnaire	No
NINFEA	Questionnaire	No
Raine	Questionnaire	No
Rhea	Questionnaire	No
SWS	Clinical records	No

Web Table 2: Cohort-specific methods of data collection for height and weight

Cohort	Method of height and weight measurement
ABCD	Clinical measurement
ALSPAC	Clinical measurement & parent/self-report
BiB	Clinical measurement
CHOP	Clinical measurement & parent-report
DNBC	Clinical measurement & parent-report
EDEN	Clinical measurement & parent-report
ELFE	Clinical measurement & parent-report
GECKO	Clinical measurement & parent-report
Gen-R	Clinical measurement
HGS	Clinical measurement
INMA	Clinical measurement & parent-report
MoBa	Parent and self-report
NFBC66	Medical records
NFBC86	Medical records
NINFEA	Self-report
Raine	Self-report
Rhea	Clinical measurement
SWS	Clinical measurement

Web Table 3: Numbers of observations provided by each child for each exposure

Exposure	Observations per child	N
Maternal education	1	3639
	2	4670
	3	4740
	4	3569
	5	10653
NDVI	1	1611
	2	2932
	3	3070
	4	224
	5	714
GDM	1	1372
	2	2798
	3	3354
	4	1182
	5	979

Web Table 4: Descriptive statistics for analysis dataset vs excluded participants

	Analysis sample (N = 258568)		**Excluded sample N = (62220)**	
	Median (IQR) / n (%)	**Missing, N (%)**	**Median (IQR) / n (%)**	**Missing, N (%)**
Maternal age at birth (years)	29.8 (26.6,33)	1944 (0.8)	29 (25.4,32.7)	6644 (10.7)
Area deprivation		199758 (77.3)		51592 (82.9)
Low	15055 (5.8)		2933 (4.7)	
Medium	13912 (5.4)		2589 (4.2)	
High	29843 (11.5)		5106 (8.2)	
BMI z-score age 0-1 years (KG)	-0.1 (-0.8,0.5)	38511 (14.9)	-0.1 (-0.8,0.5)	60331 (97)
BMI z-score age 2-3 years (KG)	0.4 (-0.3,1.1)	162789 (63)	0.4 (-0.2,1)	61166 (98.3)
BMI z-score age 4-7 years (KG)	0.1 (-0.5,0.8)	97235 (37.6)	0.2 (-0.4,0.9)	60741 (97.6)
BMI z-score age 8-13 years (KG)	0.1 (-0.6,0.8)	128976 (49.9)	0.3 (-0.4,1)	60813 (97.7)
BMI z-score age 14-17 years (KG)	0.1 (-0.6,0.8)	229955 (88.9)	0 (-0.6,0.7)	60962 (98)
Maternal education		17782 (6.9)		16690 (26.8)
Low	122592 (47.4)		18578 (29.9)	
Medium	73389 (28.4)		14580 (23.4)	
High	44805 (17.3)		12372 (19.9)	
Maternal ethnicity		200,673 (77.6)		55491 (89.2)
Western	41538 (65)		4460 (31.1)	
Other	16357 (25.6)		2269 (15.8)	
Gestational age (days)	280.7 (273.1,286.8)	11088 (4.3)	279.4 (271,286.2)	10870 (17.5)
Maternal height (m)	166.9 (162.8,171.2)	9725 (3.8)	166.5 (162.8,171)	12940 (20.8)
NDVI	0.4 (0.3,0.5)	198412 (76.7)	0.4 (0.3,0.5)	51335 (82.5)
Parity (Nulliparous)	138908 (53.7)	2483 (1)	30428 (48.9)	9349 (15)
Gestational diabetes (yes)	4482 (1.7)	18876 (7.3)	433 (0.7)	17369 (28)
Smoking in pregnancy (yes)	56800 (22)	6622 (2.6)	15188 (24.4)	10484 (16.8)
Maternal pre-pregnancy BMI (KG)		22107 (8.5)		15069 (24.2)
Underweight	10918 (4.2)		15188 (24.4)	
Overweight	66471 (25.7)		13601 (21.9)	
Child sex (male)	131983 (51)	0 (0)	22369 (36)	15069 (24.2)

Note: The analysis sample is defined as participants with minimum one exposure and BMI at one time point.

Web Table 5: Numbers of complete cases for each exposure-outcome combination

Exposure	BMI age period (years)	N (%) complete cases
Maternal education	0-1	206180 (64.91)
	2-3	91556 (41.46)
	4-7	151286 (47.63)
	8-13	121020 (37.78)
	14-17	27253 (19.94)
NDVI	0-2	39690 (14.85)
	3-4	22658 (13.29)
	4-7	36040 (13.48)
	8-13	29566 (11.06)
	14-17	7096 (6.31)
Gestational diabetes	0-2	177600 (60.28)
	3-4	72610 (36.71)
	4-7	124004 (42.09)
	8-13	96972 (32.91)
	14-17	12530 (10.86)

Note: denominator is the maximum n of the cohorts which contained any data for the exposure at that time poin

Web Table 6: Cohort-specific information on covariates

	Sex, n(%)		Parity, n(%)		Maternal ethnicity, n(%)			Maternal smoking in pregnancy, n(%)	
Cohort	Male	Missing	Nulliparous	Missing	Western	Other	Missing	Yes	Missing
ABCD (n = 6152)	3063 (49.8)	0 (0)	3302 (53.7)	45 (0.7)	3463 (56.3)	2644 (43)	45 (0.7)	670 (10.9)	3 (0)
ALSPAC (n=10499)	5279 (50.3)	0 (0)*	4521 (43.1)	544 (5.2)	9628 (91.7)	155 (1.5)	716 (6.8)	2332 (22.2)	1283 (12.2)
BiB (n=13400)	6920 (51.6)	0 (0)	4985 (37.2)	766 (5.7)	4685 (35)	6411 (47.8)	2304 (17.2)	1822 (13.6)	2313 (17.3)
CHOP (n=1669)	843 (50.5)	0 (0)	817 (49)	6 (0.4)	-	-	-	580 (34.8)	3 (0.2)
DNBC (n=77534)	39297 (50.7)	0 (0)	36799 (47.5)	0 (0)	-	-	-	19237 (24.8)	1068 (1.4)
EDEN (n=1765)	918 (52)	0 (0)	798 (45.2)	3 (0.2)	-	-	-	449 (25.4)	5 (0.3)
ELFE (n=17926)	9223 (51.5)	0 (0)	8120 (45.3)	250 (1.4)	12550 (70)	3141 (17.5)	2235 (12.5)	3563 (19.9)	207 (1.2)
GECKO (n=2748)	1384 (50.4)	0 (0)	1107 (40.3)	12 (0.4)	2489 (90.6)	113 (4.1)	146 (5.3)	427 (15.5)	3 (0.1)
GENR (n=8680)	4376 (50.4)	0 (0)	4660 (53.7)	251 (2.9)	4664 (53.7)	3544 (40.8)	472 (5.4)	1933 (22.3)	1231 (14.2)
HGS (n=2570)	1299 (50.5)	0 (0)	0 (0)	81 (3.2)	-	-	-	671 (26.1)	0 (0)
INMA (n=1918)	989 (51.6)	0 (0)	1030 (53.7)	62 (3.2)	1826 (95.2)	86 (4.5)	6 (0.3)	597 (31.1)	27 (1.4)
MoBa (n=85589)	43849 (51.2)	0 (0)	40826 (47.7)	71 (0.1)	-	-	-	19181 (22.4)	1 (0)
NINFEA (n=6532)	3312 (50.7)	0 (0)	4520 (69.2)	316 (4.8)	-	-	-	516 (7.9)	74 (1.1)
NFBC66 (n=7709)	4125 (53.5)	0 (0)	7 (0.1)	0 (0)	-	-	-	1602 (20.8)	122 (1.6)
NFBC86 (n=7315)	3716 (50.8)	0 (0)	2494 (34.1)	10 (0.1)	-	-	-	1779 (24.3)	8 (0.1)
Raine (n=2548)	1300 (51)	0 (0)	1191 (46.7)	52 (2)	2233 (87.6)	263 (10.3)	52 (2)	688 (27)	52 (2)
RHEA (n=1002)	526 (52.5)	0 (0)	450 (44.9)	11 (1.1)	-	-	-	302 (30.1)	84 (8.4)
SWS (n=3012)	1564 (51.9)	0 (0)	1550 (51.5)	3 (0.1)	-	-	-	451 (15)	138 (4.6)
Combined (n=258568)	131983 (51)	0 (0)	117177 (45.3)	2483 (1)	41538 (65)	16357 (25.6)	5976 (9.4)	56800 (22)	6622 (2.6)

Note: cohort ns refer to number of participants in the analysis sample (minimum one exposure and BMI at one time point)
*This may include zero.

Web Table 6: Cohort-specific information on covariates (continued)

	Maternal pre-pregnancy BMI, n(%)			Maternal age at child's birth	
Cohort	**Underweight**	**Overweight**	**Missing**	**Median (IQR)**	**Missing**
ABCD (n = 6152)	276 (4.5)	1274 (20.7)	485 (7.9)	32 (28, 35)	310 (5)
ALSPAC (n=10499)	993 (9.5)	1808 (17.2)	1685 (16)	29 (26, 32)	996 (9.5)
BiB (n=13400)	206 (1.5)	2333 (17.4)	8750 (65.3)	27 (23, 31)	0 (0)
CHOP (n=1669)	116 (7)	398 (23.8)	151 (9)	30 (26, 33)	9 (0.5)
DNBC (n=77534)	3132 (4)	19833 (25.6)	4817 (6.2)	30 (27, 33)	0 (0)
EDEN (n=1765)	143 (8.1)	448 (25.4)	36 (2)	29 (26, 33)	0 (0)
ELFE (n=17926)	1377 (7.7)	4799 (26.8)	296 (1.7)	30 (27, 34)	78 (0.4)
GECKO (n=2748)	50 (1.8)	956 (34.8)	191 (7)	31 (28, 34)	4 (0.1)
GENR (n=8680)	276 (3.2)	1844 (21.2)	2053 (23.7)	31 (27, 34)	0 (0)
HGS (n=2570)	154 (6)	418 (16.3)	359 (14)	28 (25, 32)	351 (13.7)
INMA (n=1918)	82 (4.3)	475 (24.8)	12 (0.6)	32 (29, 35)	8 (0.4)
MoBa (n=85589)	2487 (2.9)	25852 (30.2)	2154 (2.5)	30 (27, 33)	121 (0.1)
NINFEA (n=6532)	540 (8.3)	1218 (18.6)	143 (2.2)	33 (30, 36)	1 (0)
NFBC66 (n=7709)	201 (2.6)	1586 (20.6)	668 (8.7)	27 (22, 32)	0 (0)
NFBC86 (n=7315)	529 (7.2)	1226 (16.8)	121 (1.7)	27 (24, 31)	0 (0)
Raine (n=2548)	272 (10.7)	434 (17)	130 (5.1)	28 (24, 32)	62 (2.4)
RHEA (n=1002)	35 (3.5)	336 (33.5)	29 (2.9)	30 (26, 33)	4 (0.4)
SWS (n=3012)	49 (1.6)	1233 (40.9)	27 (0.9)	30 (27, 33)	0 (0)
Combined (n=258568)	10918 (4.2)	66471 (25.7)	22107 (8.5)	29.8 (26.6, 33)	1944 (0.8)

Note: cohort ns refer to number of participants in the analysis sample (minimum one exposure and BMI at one time point)

Web Table 7: Child BMI z-scores by cohort

	0-1 years		2-3 years		4-7 years		8-13 years		14-17 years	
Cohort	**n**	**BMI z-score, median (IQR)**	**n**	**BMI z-score, median (IQR)**	**n**	**BMI z-score, median (IQR)**	**n**	**BMI z-score, median (IQR)**	**n**	**BMI z-score, median (IQR)**
ABCD (n = 6152)	5669	-0.1 (-0.7, 0.6)	4763	0.3 (-0.3, 1)	4754	0.2 (-0.5, 0.8)	3603	0 (-0.7, 0.9)	-	-
ALSPAC (n=10499)	1420	0.1 (-0.6, 0.7)	1221	0.7 (0, 1.3)	5682	0.3 (-0.4, 1)	9585	0.3 (-0.4, 1.1)	7675	0.1 (-0.5, 0.9)
BiB (n=13400)	12959	-0.6 (-1.3, 0.1)	6225	0.5 (-0.2, 1.2)	10539	0.4 (-0.3, 1.1)	5592	0.2 (-0.7, 1.3)	-	-
CHOP (n=1669)	1668	-0.5 (-1.1, 0.1)	938	0.1 (-0.5, 0.8)	1092	0.3 (-0.3, 0.9)	755	0.3 (-0.4, 1.2)	-	-
DNBC (n=77534)	56821	-0.3 (-1, 0.4)	-	-	43164	0 (-0.6, 0.6)	44177	-0.2 (-0.9, 0.6)	6508	0.2 (-0.4, 0.9)
EDEN (n=1765)	1760	-1.4 (-2.6, -0.2)	1521	0.1 (-0.6, 0.7)	1278	0 (-0.5, 0.7)	904	-0.1 (-0.8, 0.7)	-	-
ELFE (n=17926)	17795	0 (-0.7, 0.7)	10773	0 (-0.7, 0.7)	10192	0 (-0.6, 0.6)	3360	-0.1 (-0.8, 0.6)	-	-
GECKO (n=2748)	2738	0 (-0.6, 0.6)	2212	0.4 (-0.3, 0.9)	2309	0.4 (-0.2, 0.9)	2180	0.2 (-0.5, 1)	-	-
GENR (n=8680)	7230	0 (-0.7, 0.7)	6466	0.5 (-0.2, 1.1)	6572	0.3 (-0.2, 1)	5723	0.3 (-0.4, 1.1)	-	-
HGS (n=2570)	-	-	-	-	-	-	2568	1 (0.1, 1.8)	-	-
INMA (n=1918)	1910	-0.2 (-0.9, 0.3)	1177	0.4 (-0.3, 1.1)	1634	0.5 (-0.1, 1.2)	1043	0.8 (-0.1, 1.7)	-	-
MoBa (n=85589)	85079	0 (-0.7, 0.7)	45673	0.4 (-0.3, 1.1)	49728	0.1 (-0.5, 0.8)	33473	0.1 (-0.6, 0.9)	-	-
NINFEA (n=6532)	6269	-0.4 (-1.3, 0.4)	255	0.3 (-0.6, 0.9)	4870	0.1 (-0.7, 0.9)	1109	0.1 (-0.7, 0.9)	-	-
NFBC66 (n=7709)	7379	-0.2 (-0.9, 0.6)	5809	0.6 (-0.1, 1.2)	7268	0.1 (-0.5, 0.7)	7239	0 (-0.6, 0.6)	7035	-0.1 (-0.8, 0.5)
NFBC86 (n=7315)	5141	-0.1 (-0.8, 0.4)	4739	0.5 (-0.1, 1.1)	7110	0.3 (-0.3, 0.9)	4750	0.2 (-0.4, 1)	5760	0 (-0.6, 0.7)
Raine (n=2548)	2303	0.4 (-0.2, 1.1)	614	0 (-0.6, 0.7)	2088	0.2 (-0.4, 0.8)	1988	0.3 (-0.3, 1.2)	1623	0.4 (-0.3, 1.2)
RHEA (n=1002)	974	-0.6 (-1.3, 0.1)	684	0 (-0.7, 0.9)	887	0.6 (-0.1, 1.3)	334	1.1 (0.2, 1.9)	-	-
SWS (n=3012)	2942	0.4 (-0.3, 1)	2701	0.7 (0, 1.3)	2166	0.3 (-0.2, 1)	1209	0.1 (-0.7, 1)	-	-
Combined (n=258568)	220057	-0.1 (-0.8, 0.5)	95779	0.4 (-0.3, 1.1)	161333	0.1 (-0.5, 0.8)	129592	0.1 (-0.6, 0.8)	28613	0.1 (-0.6, 0.8)

Note: cohort ns refer to number of participants in the analysis sample (minimum one exposure and BMI at one time point)

Web Table 8: Child height measurements (cm) by cohort

	0-1 years		2-3 years		4-7 years		8-13 years		14-17 years	
Cohort	**n**	**Height, median (IQR)**	**n**	**Height, median (IQR)**	**n**	**Height, median (IQR)**	**n**	**Height, median (IQR)**	**n**	**Height, median (IQR)**
ABCD (n = 6152)	5669	55.5 (53.9, 57.6)	4763	91.5 (88.5, 95.5)	4754	112 (107, 117.4)	3603	146.5 (141.2, 151.8)	-	-
ALSPAC (n=10499)	1420	63.5 (61.7, 67.8)	1221	87.5 (85.2, 90)	5682	114 (109, 119)	9585	132.4 (128, 137.9)	7675	168 (162, 173.3)
BiB (n=13400)	12959	53 (51, 56)	6225	89 (86, 94)	10539	106.9 (103.4, 110.6)	5592	130.5 (126.3, 135)	-	-
CHOP (n=1669)	1668	51.6 (50, 54)	938	89 (86.6, 91.6)	1092	107 (103, 115)	755	137.2 (128.9, 147.8)	-	-
DNBC (n=77534)	56821	68 (66.5, 70)	-	-	43164	125.5 (122, 129)	44177	151 (145, 156)	6508	172 (167, 179)
EDEN (n=1765)	1760	54 (52, 56)	1521	89.5 (86.5, 93)	1278	107.5 (104, 112)	904	134 (128, 142.6)	-	-
ELFE (n=17926)	17795	50 (48, 51)	10773	90 (87, 96)	10192	108 (104, 113)	3360	131 (127, 135)	-	-
GECKO (n=2748)	2738	55 (53.5, 57)	2212	91 (88, 95)	2309	117.5 (112.5, 121.5)	2180	148 (143, 152.5)	-	-
GENR (n=8680)	7230	56 (53.5, 61)	6466	90 (87, 93.5)	6572	118.5 (114.8, 122.7)	5723	141.1 (136.8, 145.7)	-	-
HGS (n=2570)	-	-	-	-	-	-	2568	148.5 (143.2, 153.9)	-	-
INMA (n=1918)	1910	51.5 (50, 53)	1177	89.5 (86.5, 93.5)	1634	104.5 (101.5, 107.5)	1043	135.1 (130.5, 140.1)	-	-
MoBa (n=85589)	85079	58 (56, 61)	45673	92 (88, 96)	49728	116 (111, 124)	33473	132 (128, 136)	-	-
NINFEA (n=6532)	6269	61 (59, 65)	255	91 (88, 98)	4870	104 (100, 106)	1109	140 (135, 147)	-	-
NFBC66 (n=7709)	7379	60 (56, 65)	5809	89 (86, 93)	7268	110 (104, 117)	7239	133 (127.5, 140)	7035	163 (158, 168.5)
NFBC86 (n=7315)	5141	56.6 (54.5, 59)	4739	89 (86.5, 93)	7110	109.5 (104, 120)	4750	133.5 (129, 138.1)	5760	166 (160.8, 172)
Raine (n=2548)	2303	77.5 (75.6, 79.5)	614	90 (87.6, 92.2)	2088	116.2 (112.8, 119.5)	1988	134.5 (129, 141.8)	1623	165 (160, 172)
RHEA (n=1002)	974	53 (51, 55)	684	92 (89, 95)	887	105.1 (102, 108)	334	144.6 (140.2, 150.5)	-	-
SWS (n=3012)	2942	68.4 (66.3, 71.5)	2701	88.3 (85.4, 92.6)	2166	109.7 (103.5, 120.4)	1209	135.1 (131, 139.3)	-	-
Combined (n=258568)	220057	59.8 (57.9, 62.5)	95779	90.8 (87.4, 95)	161333	116.1 (111.7, 121.8)	129592	140.2 (135.2, 145.1)	28613	167.1 (161.8, 173.1)

Note: cohort ns refer to number of participants in the analysis sample (minimum one exposure and BMI at one time point)

Web Table 9: Child weight measurements (kg) by cohort

	0-1 years		2-3 years		4-7 years		8-13 years		14-17 years	
Cohort	**n**	**Weight, median (IQR)**	**n**	**Weight, median (IQR)**	**n**	**Weight, median (IQR)**	**n**	**Weight, median (IQR)**	**n**	**Weight, median (IQR)**
ABCD (n = 6152)	5669	4.7 (4.2, 5.2)	4763	13.6 (12.5, 15)	4754	19.5 (17.5, 21.7)	3603	36.6 (32.5, 42)	-	-
ALSPAC (n=10499)	1420	7 (6.3, 8)	1221	12.8 (11.9, 13.9)	5682	20 (18.1, 22)	9585	29 (26, 34)	7675	58 (51.3, 65.3)
BiB (n=13400)	12959	3.6 (3.2, 4.3)	6225	13.2 (12, 14.8)	10539	18.1 (16.4, 20)	5592	27.7 (24.3, 32.9)	-	-
CHOP (n=1669)	1668	3.5 (3.1, 4)	938	12.7 (11.7, 13.7)	1092	18.2 (16.4, 21)	755	32.4 (27, 40.6)	-	-
DNBC (n=77534)	56821	7.8 (7.1, 8.5)	-	-	43164	24.2 (22, 27)	44177	39 (34, 45)	6508	65 (58, 75)
EDEN (n=1765)	1760	3.6 (3.1, 4.4)	1521	12.8 (11.8, 14)	1278	18 (16.2, 19.8)	904	29 (25, 35)	-	-
ELFE (n=17926)	17795	3.4 (3, 3.7)	10773	13 (11.8, 14.5)	10192	18 (16.3, 20)	3360	27 (24.6, 30.4)	-	-
GECKO (n=2748)	2738	4.6 (4.2, 5.2)	2212	13.5 (12.5, 14.9)	2309	21.6 (19.5, 23.9)	2180	37.6 (33.7, 43.2)	-	-
GENR (n=8680)	7230	4.8 (4.2, 6.1)	6466	13.3 (12.2, 14.6)	6572	22.2 (20.2, 24.8)	5723	33.8 (30.2, 38.8)	-	-
HGS (n=2570)	-	-	-	-	-	-	2568	43.5 (37.1, 52)	-	-
INMA (n=1918)	1910	3.6 (3.2, 4)	1177	13.1 (11.9, 14.5)	1634	17.4 (16, 19.2)	1043	32.4 (27.6, 38.8)	-	-
MoBa (n=85589)	85079	5.4 (4.8, 6.1)	45673	13.8 (12.5, 15)	49728	21 (19, 24)	33473	28 (25, 31)	-	-
NINFEA (n=6532)	6269	6 (5.4, 7)	255	13.5 (12, 15)	4870	16 (15, 18)	1109	34 (29.3, 40)	-	-
NFBC66 (n=7709)	7379	5.7 (4.6, 7.3)	5809	13.1 (12, 14.5)	7268	18.5 (16.6, 21.2)	7239	29 (25, 33.5)	7035	52 (46.3, 58)
NFBC86 (n=7315)	5141	4.9 (4.3, 5.6)	4739	13.1 (12, 14.4)	7110	19 (16.8, 23)	4750	29.6 (26.1, 34)	5760	56 (50, 63.2)
Raine (n=2548)	2303	10.2 (9.4, 11.1)	614	12.8 (11.8, 14)	2088	21 (19.1, 23.2)	1988	30.8 (26.5, 36.9)	1623	57.9 (50.9, 67.5)
RHEA (n=1002)	974	3.7 (3.3, 4.2)	684	13.3 (12.2, 14.6)	887	17.8 (16.2, 19.8)	334	41.5 (35.3, 49.4)	-	-
SWS (n=3012)	2942	8.3 (7.5, 9.3)	2701	13.1 (12, 14.4)	2166	19.5 (16.8, 22.9)	1209	29.7 (26.7, 34.3)	-	-
Combined (n=258568)	214388	5.8 (5.2, 6.5)	91016	13.5 (12.2, 14.8)	156579	21 (19, 23.7)	125989	33 (29, 37.9)	28613	57.7 (51.3, 65.4)

Note: cohort ns refer to number of participants in the analysis sample (minimum one exposure and BMI at one time point)

Web Table 10: Age at height and weight measurement (months) by cohort

	0-1 years		2-3 years		4-7 years		8-13 years		14-17 years	
Cohort	**n**	**Child age, median (IQR)**	**n**	**Child age, median (IQR)**	**n**	**Child age, median (IQR)**	**n**	**Child age, median (IQR)**	**n**	**Child age, median (IQR)**
ABCD (n = 6152)	5669	1.1 (1.1, 1.5)	4763	28 (25.8, 33)	4754	63.2 (50.9, 68.4)	3603	127.9 (123.9, 132.5)	-	-
ALSPAC (n=10499)	1420	3.9 (3.7, 8)	1221	24.8 (24.8, 25.1)	5682	69 (69, 70)	9585	102 (98, 109)	7675	177 (175, 186)
BiB (n=13400)	12959	0.3 (0.2, 1.4)	6225	25.7 (24.6, 36)	10539	55.8 (51.8, 59.6)	5592	100.7 (98.3, 103.2)	-	-
CHOP (n=1669)	1668	0.5 (0.1, 0.9)	938	24.2 (24.1, 29.5)	1092	53.9 (48.4, 72.1)	755	99 (96.7, 133.9)	-	-
DNBC (n=77534)	56821	5.2 (5, 5.5)	-	-	43164	84 (84, 85.2)	44177	133.2 (132, 135.6)	6508	210.3 (210, 210.7)
EDEN (n=1765)	1760	1 (0.9, 1.1)	1521	24.8 (24.2, 29.8)	1278	55.1 (49.5, 64.7)	904	100.3 (96.8, 125.8)	-	-
ELFE (n=17926)	17795	0 (0, 0)	10773	25.2 (24.2, 37.4)	10192	56.1 (50.9, 63.3)	3360	103.1 (101.1, 106.1)	-	-
GECKO (n=2748)	2738	1.2 (1, 1.5)	2212	25.9 (24.9, 28.6)	2309	69.5 (65.3, 72.6)	2180	127.3 (123.7, 131)	-	-
GENR (n=8680)	7230	1.2 (1, 3.3)	6466	25.8 (24.7, 30.2)	6572	72.1 (70.2, 74.9)	5723	116.7 (115.3, 118.3)	-	-
HGS (n=2570)	-	-	-	-	-	-	2568	133.9 (127.2, 139.6)	-	-
INMA (n=1918)	1910	0.4 (0.3, 0.6)	1177	24.9 (24.1, 32.9)	1634	50.4 (48.8, 52.6)	1043	109.1 (105.2, 113.3)	-	-
MoBa (n=85589)	85079	1.6 (1.4, 3)	45673	27.7 (25, 36.2)	49728	63 (61, 84)	33473	97 (97, 98)	-	-
NINFEA (n=6532)	6269	3 (3, 3)	255	28.6 (25.4, 46.7)	4870	48 (48, 48.7)	1109	121.9 (120.6, 124.9)	-	-
NFBC66 (n=7709)	7379	2.4 (1.2, 4.8)	5809	26.4 (24, 33.6)	7268	60 (52.8, 78)	7239	106.8 (100.8, 127.2)	7035	174 (170.4, 177.6)
NFBC86 (n=7315)	5141	1.5 (1.1, 2)	4739	24.9 (24.3, 35.4)	7110	60 (48.9, 83)	4750	106.4 (100.8, 113.2)	5760	180.2 (174.1, 189)
Raine (n=2548)	2303	13.7 (12.9, 14.5)	614	25.8 (25.2, 26.8)	2088	71 (70.1, 72.4)	1988	102.2 (98.5, 125.5)	1623	170 (169.1, 172.1)
RHEA (n=1002)	974	0.6 (0.4, 1)	684	25.9 (24.6, 29.2)	887	49.7 (49.1, 50.7)	334	131.4 (130.1, 134.2)	-	-
SWS (n=3012)	2942	6.3 (6, 8)	2701	24.8 (24.3, 35.7)	2166	50.6 (49.2, 81)	1209	109.8 (107.8, 111.9)	-	-
Combined (n=258568)	220057	2.5 (2.3, 3.5)	95779	26.7 (24.7, 34.9)	161333	67.3 (64.6, 77.6)	129592	114.5 (112.6, 118.9)	28613	184.1 (181.3, 189.4)

Note: cohort ns refer to number of participants in the analysis sample (minimum one exposure and BMI at one time point)

Web Table 11: GDM analysis stratified by test type

	Questionnaire or non-universal test				Universal blood-based test			
Age	N cohorts	N unexposed	N exposed	Estimate	N cohorts	N unexposed	N exposed	Estimate
0-1	12	169073	2754	0.07 (-0.02, 0.17)	2	5328	445	-0.19 (-0.42, 0.04)
2-3	11	67856	1160	0.04 (-0.02, 0.1)	2	3317	277	-0.04 (-0.17, 0.09)
4-7	12	117624	1836	0.06 (-0.03, 0.14)	2	4183	361	0.03 (-0.17, 0.23)
8-13	12	93535	966	0.19 (0.11, 0.27)	2	2275	196	0.10 (-0.09, 0.28)

*Note: no cohorts with data available at 14-17 assessed GDM via universal blood-based test. Models adjusted for child sex, exact age at measurement, maternal education, parity and pre-pregnancy BMI.

Web Table 12: Analysis on subgroup with ethnicity data

Exposure	Age	N	n	Original model	Additionally adjusting for ethnicity
Maternal education (ref = high)					
Medium	0-1	8	45601	0.02 (0,0.04)	0.03 (0.01,0.05)
	2-3	8	30752	0.09 (0.06,0.12)	0.08 (0.06,0.11)
	4-7	8	39718	0.15 (0.12,0.17)	0.15 (0.12,0.17)
	8-13	8	30214	0.32 (0.29,0.35)	0.32 (0.29,0.35)
	14-17	2	8717	0.06 (0,0.12)	0.06 (0,0.12)
Low	0-1	8	45601	-0.19 (-0.22,-0.17)	-0.15 (-0.17,-0.12)
	2-3	8	30752	0.24 (0.21,0.27)	0.21 (0.17,0.24)
	4-7	8	39718	0.31 (0.28,0.33)	0.29 (0.26,0.31)
	8-13	8	30214	0.38 (0.34,0.41)	0.36 (0.32,0.39)
	14-17	2	8717	0.29 (0.21,0.36)	0.29 (0.21,0.36)
NDVI	0-1	5	23248	-0.01 (-0.02,0.01)	-0.01 (-0.03,0)
	2-3	5	16267	0.05 (0.03,0.07)	0.05 (0.03,0.07)
	4-7	5	23403	0.03 (0.01,0.05)	0.03 (0.01,0.05)
	8-13	5	20466	-0.02 (-0.05,0)	-0.02 (-0.05,0)
	14-17	1	6189	0.03 (-0.01,0.08)	0.03 (-0.01,0.08)
GDM	0-1	8	35661	-0.04 (-0.1,0.01)	-0.03 (-0.09,0.02)
	2-3	8	24635	-0.09 (-0.16,-0.03)	-0.1 (-0.17,-0.04)
	4-7	8	30755	-0.08 (-0.14,-0.02)	-0.09 (-0.16,-0.03)
	8-13	8	23205	0.06 (-0.04,0.16)	0.05 (-0.05,0.14)
	14-17	2	6965	0.18 (-0.11,0.47)	0.18 (-0.11,0.47)

Web Table 13: Analyses with DNBC & MoBa removed

		Full model			Excluding DNBC & MoBa		
Exposure	Age	N	n	Estimate	N	n	Estimate
Maternal education (ref = high)							
Medium	0-1	17	206180	0.01 (0, 0.02)	15	73949	0.03 (0.01, 0.05)
	2-3	16	91556	-0.02 (-0.04, -0.01)	15	47945	0.01 (-0.01, 0.04)
	4-7	17	151286	0.09 (0.08, 0.1)	15	64934	0.10 (0.08, 0.12)
	8-13	18	121020	0.15 (0.13, 0.16)	16	49297	0.19 (0.17, 0.22)
Low	0-1	17	206180	0.02 (0, 0.03)	15	73949	0.04 (0.02, 0.06)
	2-3	16	91556	0.03 (0, 0.05)	15	47945	0.06 (0.03, 0.08)
	4-7	17	151286	0.16 (0.14, 0.17)	15	64934	0.14 (0.11, 0.16)
	8-13	18	121020	0.24 (0.22, 0.26)	16	49297	0.25 (0.22, 0.28)
NDVI	0-1	10	39690	0.05 (0.03, 0.06)	8	27330	0.05 (0.03, 0.07)
	2-3	9	22658	0.02 (0, 0.04)	8	18118	0.03 (0.01, 0.05)
	4-7	10	36040	0.04 (0.02, 0.05)	8	26632	0.05 (0.03, 0.07)
	8-13	10	29566	0.04 (0.01, 0.06)	8	21982	0.04 (0.02, 0.07)
GDM	0-1	14	177600	0 (-0.04, 0.04)	12	48452	0 (-0.04, 0.05)
	2-3	13	72610	0.03 (-0.03, 0.08)	12	29923	0.02 (-0.04, 0.08)
	4-7	14	124004	0.01 (-0.03, 0.06)	12	39506	-0.02 (-0.08, 0.03)
	8-13	14	96972	0.18 (0.12, 0.25)	12	26700	0.15 (0.06, 0.24)

Note: N = number of studies, n = number of participants. Ages 14-17 not shown because MoBa did not contribute to these analysis

Web Figure 1: Directed acyclic graphs

Figure S1a: Maternal education

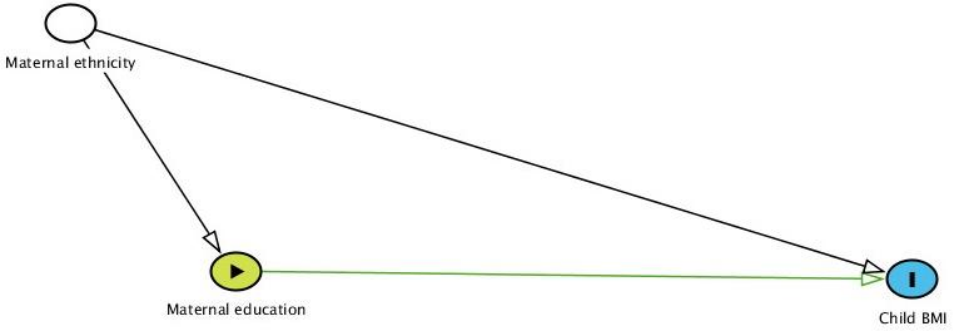

Figure S1b: Green spaces (NDVI)

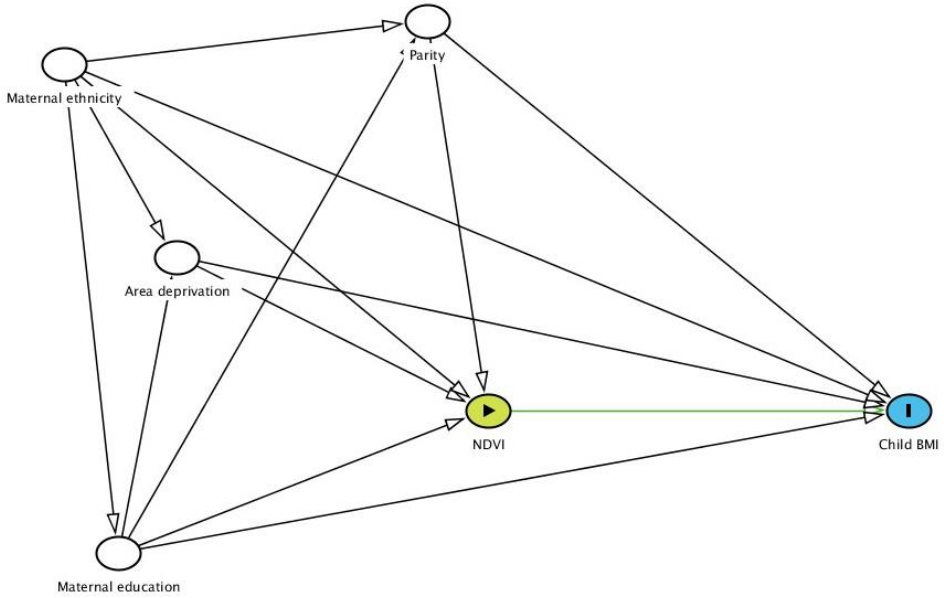

Figure S1c: Gestational Diabetes

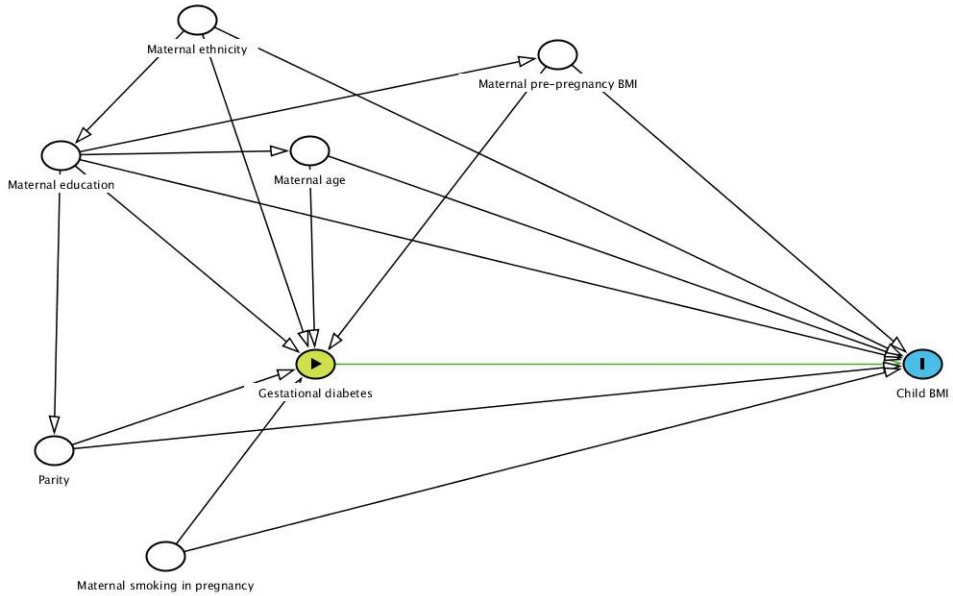

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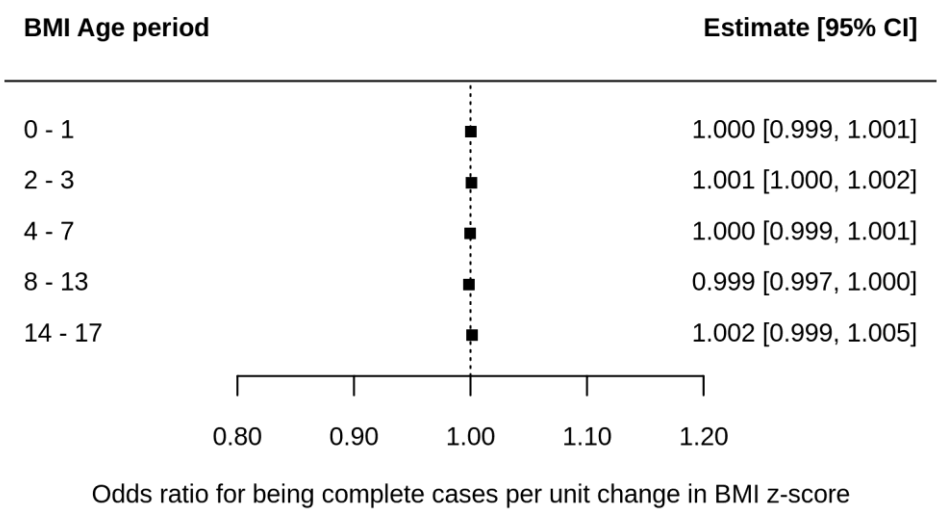
Figure S2b: NDVI



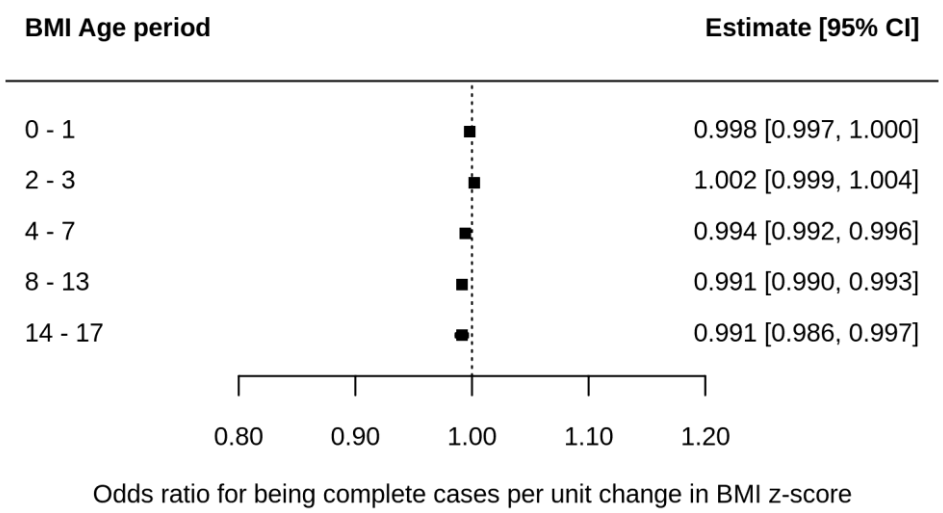
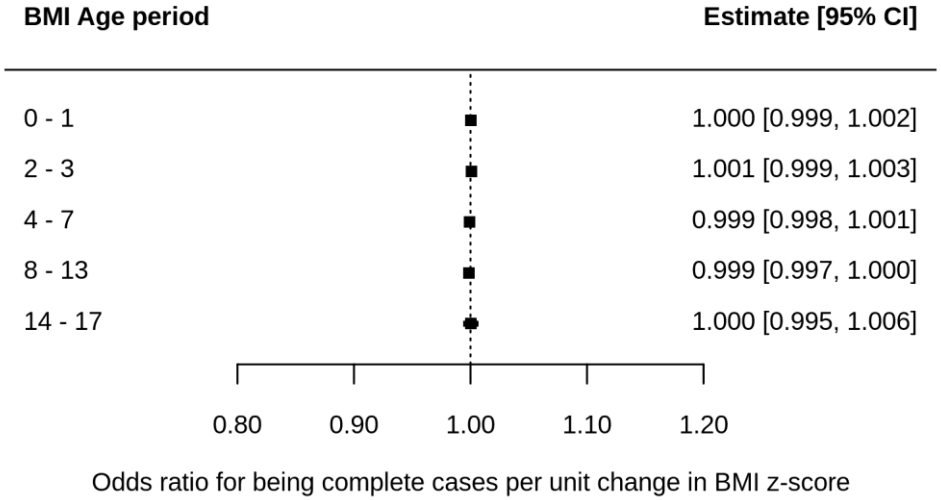
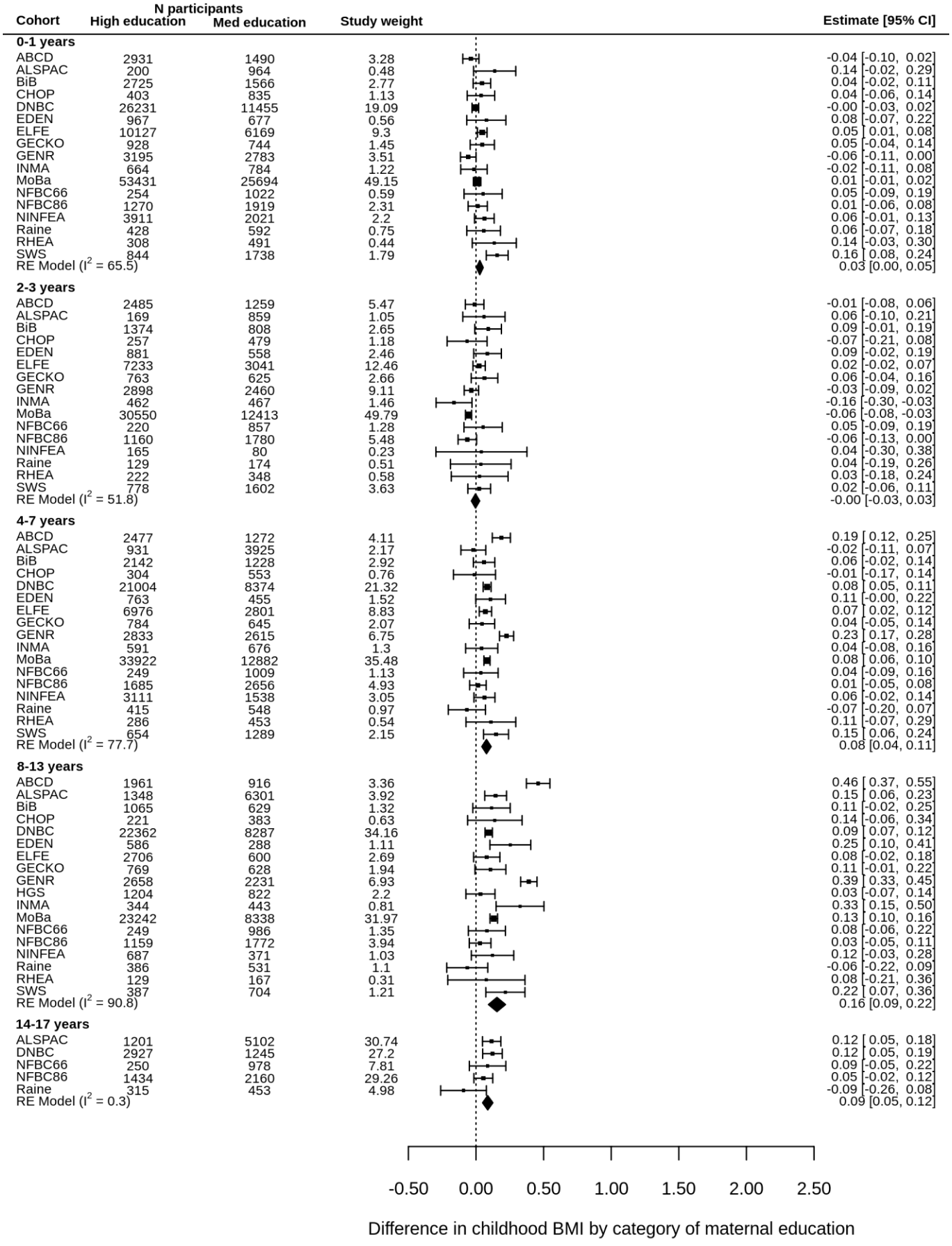


Figure S2c: Gestational diabetes

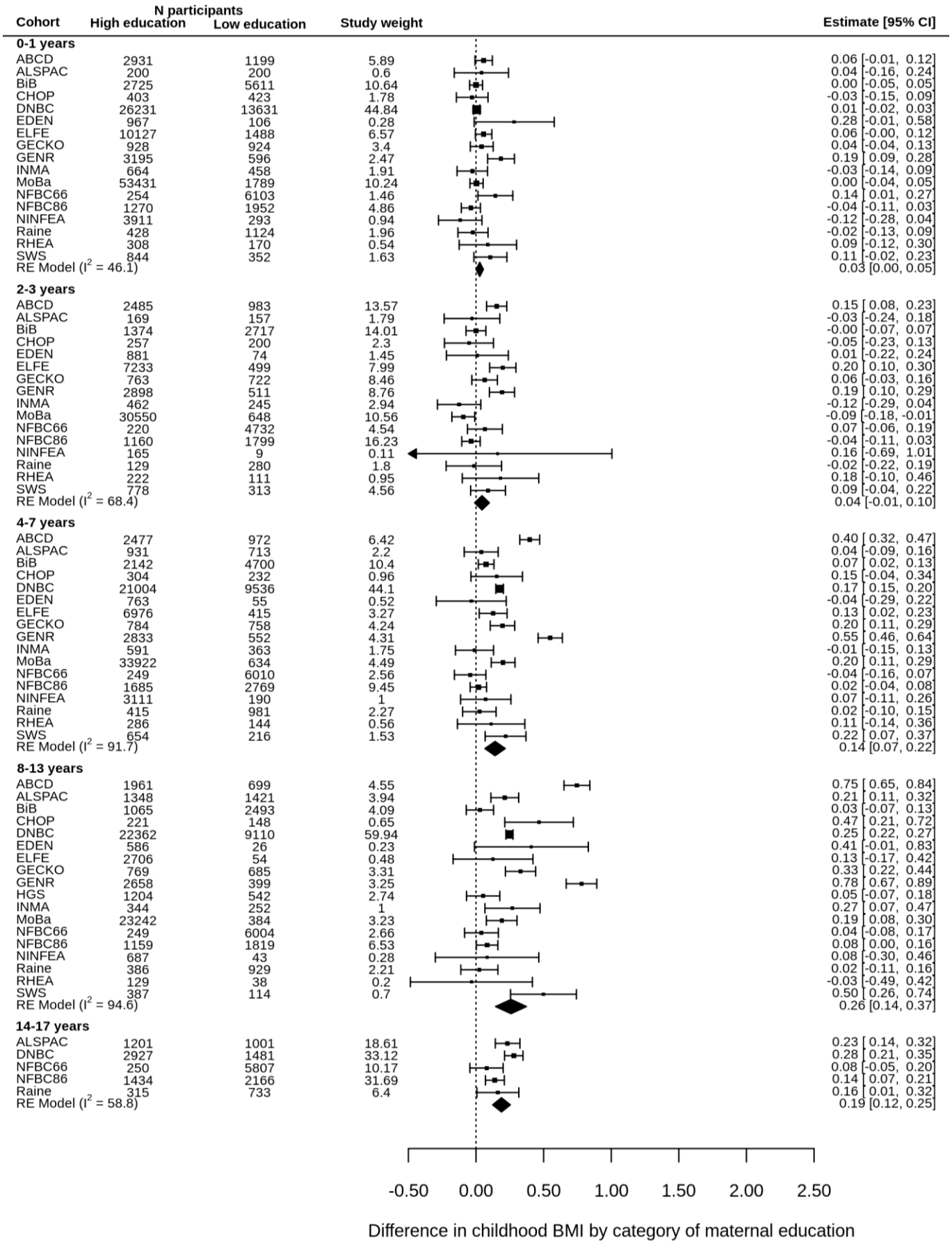


Web Figure 3a: Associations between maternal education and child BMI z-scores using 2-stage IPD meta-analysis (medium education vs high)



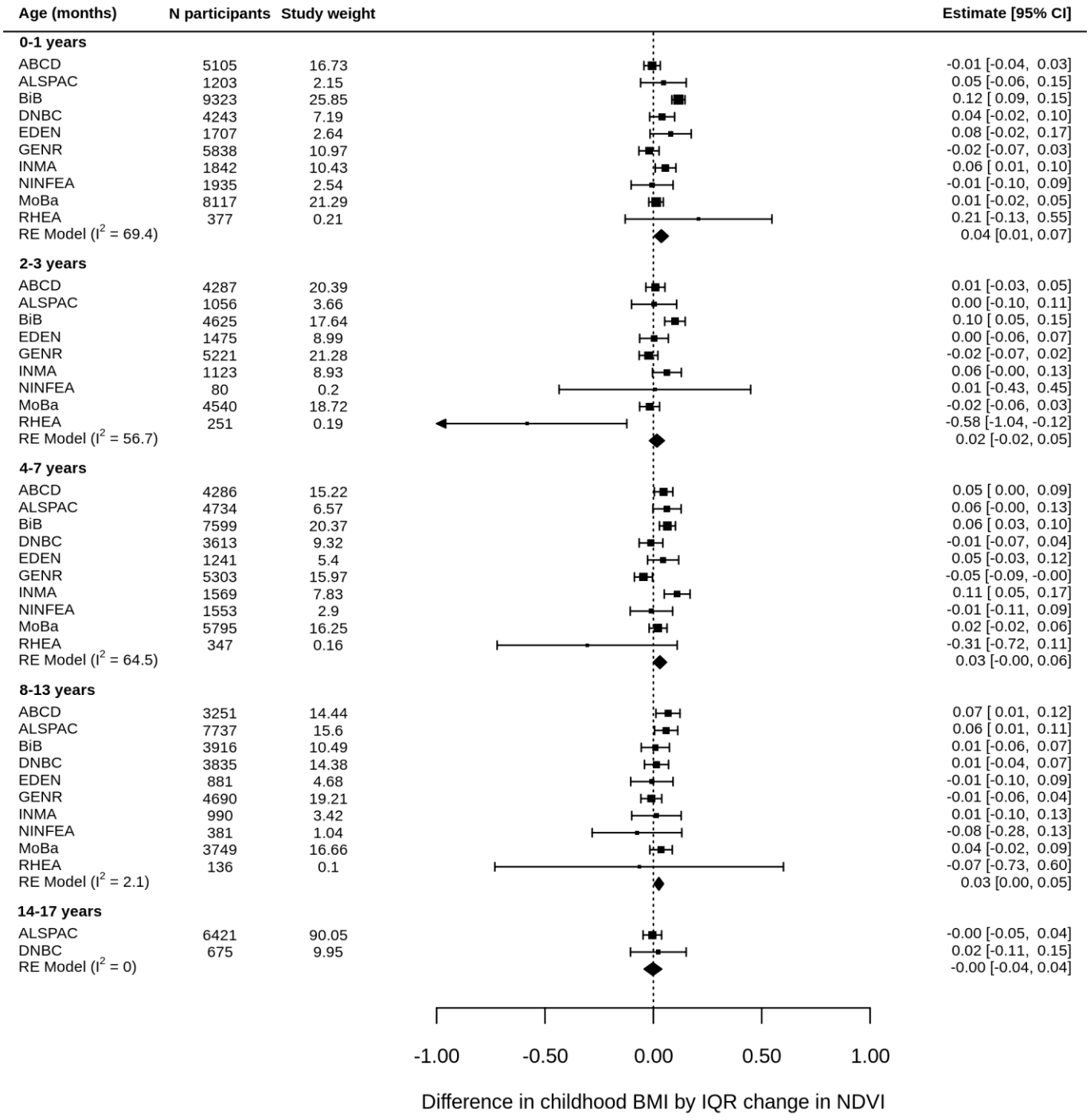
Note: models adjusted for child sex and exact age at measurement.

Web Figure 3b: Associations between maternal education and child BMI z-scores using 2-stage IPD meta-analysis (low education vs high)



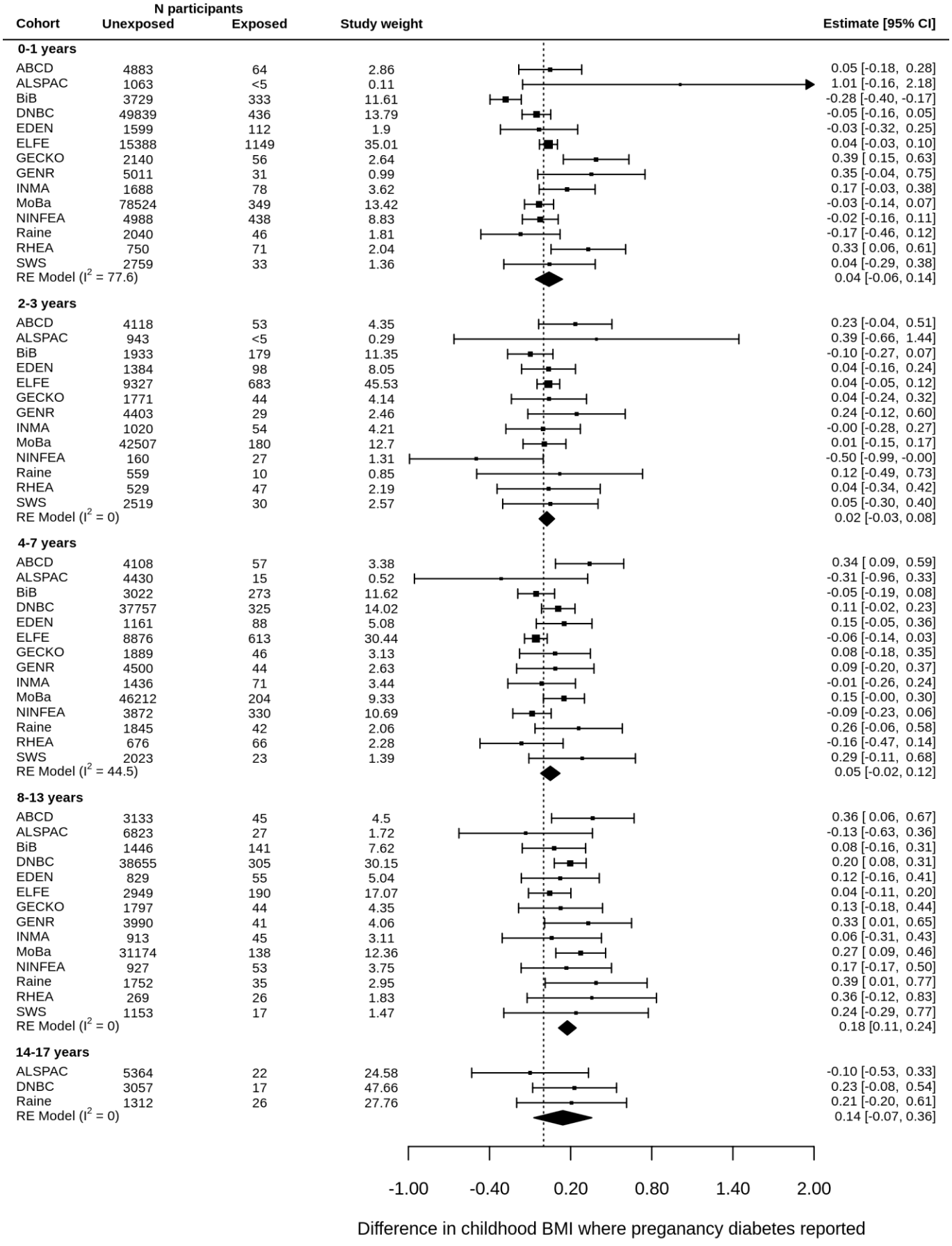
Note: models adjusted for child sex and exact age at measurement.

Web Figure 4: Associations between Normalised Difference Vegetation Index and child BMI z-scores using 2-stage IPD meta-analysis



Note: models adjusted for child sex, exact age at measurement, maternal education, parity and area deprivation.

Web Figure 5: Associations between gestational diabetes and child BMI z-scores using 2-stage IPD meta-analysis



Note: models adjusted for child sex, exact age at measurement, maternal education, parity and pre-pregnancy BMI.

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