Supplementary Information

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* - note that the Bayesian estimations reversed the signs of the loadings for deprivation. Therefore, I re-labelled deprivation from SOCDEP to SOCADV (advantage). Direct path coefficients for SOCADV in these analyses have the opposite sign for the expectation for deprivation.
Mplus commands to perform each analysis appear at the beginning of each Mplus output.

Introduction

The main report focuses on effects of ethnicity, deprivation and payment source on obstetric outcomes. Here, I present further details of the sample and analyses and discuss effects of other parental risk factors on each other and on outcomes.

Methods

Variables

The study used publicly-available natality data from the Centers for Disease Control (CDC).[1] I extracted the study variables from the CDC's file: "Nat2019PublicUS.c20200506.r20200915.txt". The CDC's User Guide ("UserGuide2019-508.pdf")[2] describes these data. Table S1 shows the User Guide's identifiers for the variables, their location in the data file and a brief description of each.

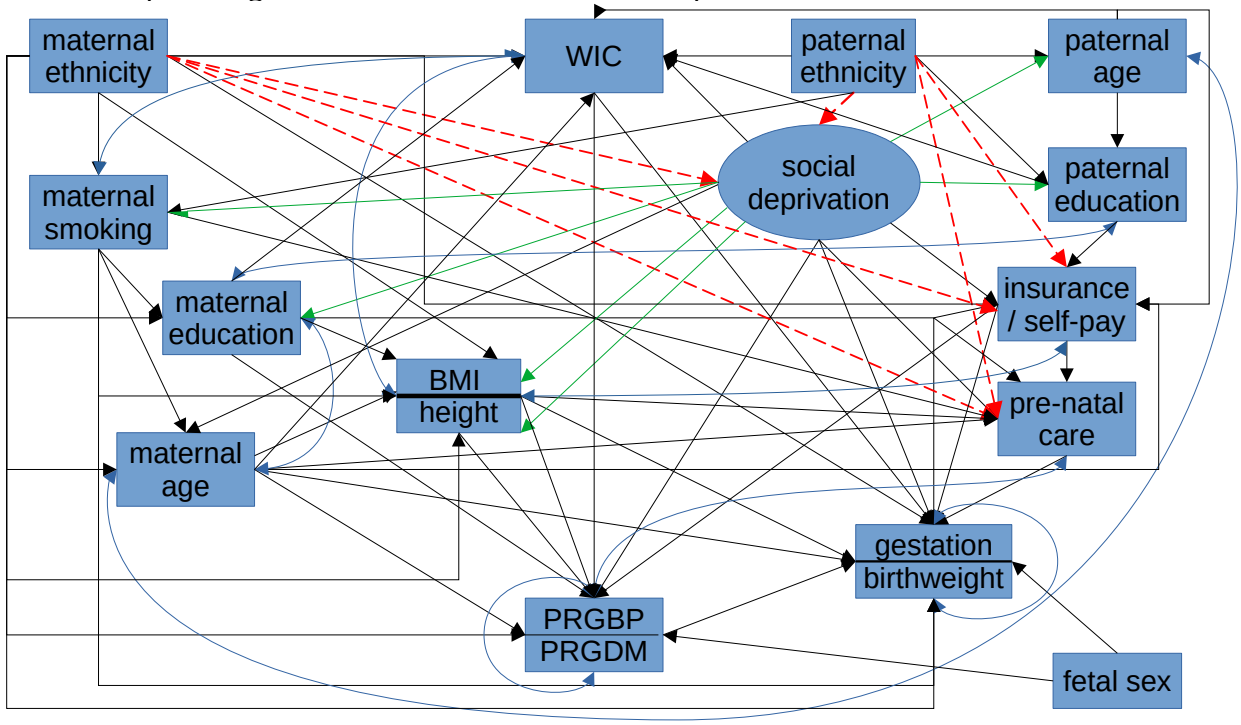
Table S1: correspondence between CDC identifiers and those in the present study

Variable	CDC name	Position	Brief description	Analysis name
Maternal age	MAGER	75-76	Mother's single years of age	mage
Maternal ethnicity	MRACE31	105-106	Mother's race recode 31	AFRAMM, OTHM
Hispanic mother	MHISPX	117	Mother's race/Hispanic origin	MHISP
Maternal education	MEDUC	124	Mother's education	MEDUC
Paternal age	FAGECOMB	147-148	Father's combined age	FAGE
Paternal ethnicity	FRACE31	151-152	Father's race recode 31	AFRAMF, OTHF
Hispanic father	FHISPX	162	Father's race/Hispanic origin	FHISP
Paternal education	FEDUC	163	Father's education	FEDUC
Prior births alive	PRIORLIVE	171-172	Prior births now living	*to select primigravidae with singleton pregnancy*
Prior births dead	PRIORDEAD	173-174	Prior births now dead	
Prior terminations	PRIORTERM	175-176	Prior other terminations	
Plural pregnancy	DPLURAL	454	Plurality recode	
Beginning of care	PRECARE	224-225	Month prenatal care began	PRECAREM
Participation in WIC	WIC	251	WIC	WIC
Pre-pregncy smoking	CIG0	253-254	Cigarettes before pregnancy	*to compute overall smoking before and during pregnancy*
1st trimester smoking	CIG1	255-256	Cigarettes 1st trimester	
2nd trimester smoking	CIG2	257-258	Cigarettes before pregnancy	
3rd trimester smoking	CIG3	259-260	Cigarettes before pregnancy	
Mother's height	M_Ht_In	280-281	Mother's height in total inches	MHT
Mother's BMI	BMI	283-286	Body Mass Index	BMI
Pre-preg weight	Pwgt_R	292-294	Pre-pregnancy weight recode	*To compute BMI*
Pre-preg diabetes	RF_PDIAB	313	Pre-pregnancy diabetes	predm - *exclusion*
Gestational diabetes	RF_GDIAB	314	Gestational diabetes	PRGDM
Pre-preg hypertensn	RF_PHYPE	315	Pre-pregnancy hypertension	prebp - *exclusion*
Preg hypertension	RF_GHYPE	316	Gestational hypertension	PRGBP
Source of payment	PAY_REC	436	Payment source for delivery	PAYER
Sex of infant	SEX	475	Sex of infant	SEXINF
Length of gestation	OEGest_Comb	499-500	Combined gestation – weeks	OBGEST
Birth weight	DBWT	504-507	Birthweight – details in grams	BWT
Anencephaly	CA_ANEN	537	Anencephaly	*exclusion*

Legend: the CDC's names are from the "User Guide to the 2019 Natality Public Use File".[1] "Position" means the columns that the data occupy in the data file. "Brief Description" is the User Guide's brief description. "Analysis name" is the name in my Mplus analysis (see output). I downloaded some variables in order to exclude them from the model.

Figure 1 in the Main Report shows a schematic diagram of the path model for disentangling effects of ethnicity, deprivation and source of payment. Figure S1 shows the model in detail:

Figure S1: the path diagram for the model in the Main Report



Legend: The path diagram shows the causal paths, factor loadings and non-causal associations between ethnicity, deprivation, payment source (insurance/self-pay) and other variables in the model. Manifest variables are in rectangular boxes, the latent deprivation factor is an oval. Causal paths are straight, single-ended arrows (sometimes with right-angles). Factor loadings are in green; red, dashed arrows are the causal paths that I omitted from the 'no-racism' model; other causal paths that are common to both the 'realistic' and 'no racism' models are black. Non-causal associations are blue, curved double-ended arrows. I combined some factors into horizontally-split boxes, to simplify the diagram. Note that some causal paths partly obscure others – for example, the path from maternal ethnicity to PRGBP overlies the path from maternal age to PRGBP. Figure 2 and Tables 2-5 in the Main Report show the path coefficients for each path on the diagram. Abbreviations: WIC – participation in Supplemental Nutrition Program for Women, Infants and Children; BMI – Body Mass Index; PRGBP – pregnancy hypertension; PRGDM – gestational diabetes mellitus. Note: ethnicity comprises 4 groups – non-Hispanic White (baseline), African American, Hispanic and Other (mostly Asian) ethnicities. The Mplus output in the Supplementary Information may be easier to read and understand than the above path diagram.

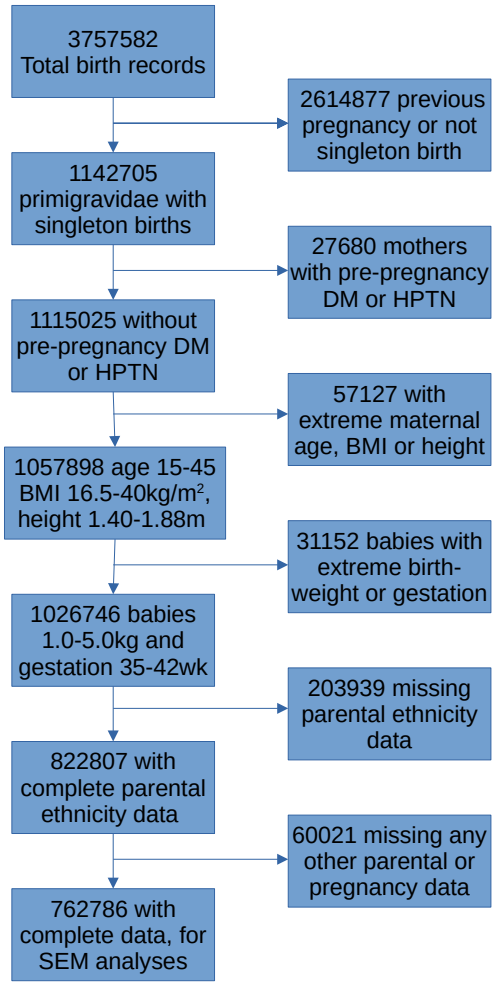
The "no racism" model and separate 'reatlistic' models for each ethnicity

I assessed the importance of racism by comparing the 'realistic' model with a 'no racism' model that eliminates *direct* effects of parental ethnicity on deprivation and on engagement with obstetric health services (Figure 1 in Main Report and Figure S1, above). Note, however, that the model still allows *in*direct effects of parental ethnicity *via* its (direct) causal effects on parental risk factors. I assessed the adequacy of the realistic model by re-estimating it for each ethnicity separately. In effect, this allows assessment of ethnicity's interactions with other predictors in the realistic model.

Sample

I analysed only primigravidae, because prior pregnancy may affect obstetric outcomes.[3–5] I excluded births with incomplete data for any of the study variables. I also excluded: mothers with pre-pregnancy diabetes or hypertension or with extreme values of age (<14 or >45), height (<1.44m or >1.88m), or BMI (<16.5 or >40); babies with extreme values of weight (<1000g or >5000g), or anencephaly, or extreme values of gestational age (<35 weeks or >42 weeks) (see Methods in Main Report and Figure S2). The analyses of each individual ethnicity used only births where both parents were of the same ethnicity.

Figure S2: selection of cases for the analysis



Note: Paternal variables are ethnicity, age and education; maternal variables are ethnicity, age, education, any smoking, participation in WIC, source of payment and gestational month of starting prenatal care. Abbreviations: BMI = body mass index; DM = diabetes mellitus; HPTN = hypertension; wk = weeks; SEM = structural equation modelling.

Statistical methods

Simple comparisons between ethnic groups, or between included and excluded cases, used Wilcoxon-Mann-Whitney tests, t-tests, Fisher exact probabilities and χ^2 tests.

Model estimation and assessment of fit

Model estimation used Mplus.[6–8] Initial model estimation used the Weighted Least Squares for Mean and Variance (WLSMV) algorithm with 'theta' parameterization. I then used the path coefficients from the WLSMV models as starting values for Bayesian re-estimation. These Bayesian analyses used weakly-informative priors centred on zero for most path coefficients, except intercepts, thresholds for categorical variables and residual variances; they used 3 MonteCarlo Markov chains and set the convergence criterion (potential scale reduction) to p=0.005.

I initially assessed the absolute fit of the WLSMV models via their χ^2, Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR).[9] However, all these fit indices are imperfect.[10] Therefore, I re-analysed the models using Bayesian estimation of a random 1% sample of the data (N~7800) and assessed this fit using χ^2. I also estimated a "no racism" model (see Figure 1 in Main Report and Supplementary Figure 1) and compared it formally with the 'realistic' model using the Satorra-Bentler χ^2 test[6] (see Main Report).

Results

Exclusions

The excluded cases differed from the study sample for *every* variable in the analysis (Table S2; all ps<10^{-10} via Wilcoxon-Mann-Whitney or Kolmogorov-Smirnov 2-sample tests or Fisher exact probability) including variables which appear identical in Table S2. Note that almost all risk factors and all outcomes were worse in the excluded cases. The most commonly missing variables were paternal ethnicity, education and age (Table S2).

Table S2: the characteristics of the study sample and of excluded cases

Variable	% missing	Included in study sample	Excluded from study sample
Number of mothers	0	762786	263960
Maternal ethnicity	2.4	977636	24555
Paternal ethnicity	19.3	828279	198467
Smoking mothers (%)	2.7	4.9	8.0
Cigs/day (smokers only)	-	5 (2 – 10)	5 (2.5 – 10)
Maternal Education*	3.6	5 (3 – 6)	3 (3 – 4)
Paternal Education*	15.4	4 (3 – 6)	3 (3 – 5)
Maternal age (y)	2.4	27 (23 – 31)	23 (20 – 28)
Paternal age (y)	13.3	29 (25 – 33)	28 (23 – 33)
Maternal height (m)	2.4	1.63 (1.57 – 1.68)	1.63 (1.57 – 1.68)
Maternal BMI (kg/m^2)	2.4	24.4 (21.6 – 28.5)	24.8 (21.7 – 29.1.0)
WIC participant (%)	3.4	26.0	49.2
Privately insured/self-payer (%)	4.3	67.8	39.2
Pre-natal care (month)	6.0	2 (2 – 3)	3 (2 – 5)
Pregnancy high BP (%)	2.4	8.5	8.8
Gestational diabetes (%)	2.4	4.3	5.4
Gestation (weeks)	2.4	39 (38 – 40)	39 (38 – 40)
Birthweight (kg)	2.4	3.31 (3.01 – 3.60)	3.24 (2.94 – 3.54)

Legend: the values are counts (numbers of parents), percentages, or medians – with inter-quartile ranges in brackets).

Missing data (apart from ethnicity) were more common for AA and Other-ethnicity mothers:

Table S3: Missingness of any other variable, in relation to non-missing maternal ethnicity

Other data	Maternal ethnicity	nHEA	African American	Hispanic	Other
Not missing		451267	89356	136847	85316
Missing		112091	57475	77535	16859
Odds ratio		1 (Reference)	**2.59**	**2.28**	**0.80**

Variables apart from maternal ethnicity showed different patterns of missingness in relation to non-missing maternal ethnicity. Compared with nHEA mothers, paternal variables were missing more frequently for African American and Hispanic mothers (Table S4), but less frequently for Other-ethnicity mothers. In contrast, missingness of maternal variables, participation in WIC and source of payment was *apparently* less prevalent in mothers of all ethnic-minorities (Table S4). This is probably because electronic birth records that had missing maternal ethnicity also had missing data for paternal variables, so that missingness for maternal variables was only a small proportion of total missingness for those cases.

Table S4: numbers of missing values of different variables, broken down by maternal ethnicity

Variable	Missing /OR	nHEA	AA	Hispanic	Other	χ^2 (3df)
Paternal age	No	499600	107679	214382	97428	20692
	Yes	63758	39152	28723	4747	
	OR	Ref.	**2.85**	**1.21**	**0.38**	
Paternal education	No	489909	103909	181197	94059	28402
	Yes	73449	42922	33185	8116	
	OR	Ref.	**2.75**	**1.22**	**0.58**	
Maternal education	No	533012	145332	211891	99150	11663
	Yes	30346	1499	2491	3025	
	OR	Ref.	**0.18**	**0.21**	**0.54**	
Maternal smoking	No	536893	146039	213852	101793	17893
	Yes	26465	792	530	382	
	OR	Ref.	**0.11**	**0.05**	**0.08**	
Participation in WIC	No	533892	145231	212675	100418	13575
	Yes	29466	1600	1707	1757	
	OR	Ref.	**0.20**	**0.15**	**0.32**	
Source of payment	No	529024	143752	209510	100160	9596
	Yes	34334	3079	4872	2015	
	OR	Ref.	**0.33**	**0.36**	**0.31**	

Legend: The table shows three rows for each variable, broken down by maternal ethnicity. For each variable, the first row shows the numbers of cases with no missing values; the second row shows the number of cases with missing values and the third row shows the odds ratio for comparing each minority ethnicity with non-Hispanic European American (nHEA) mothers. Abbreviations: AA = African American; BMI = body mass index; WIC = Supplemental Food Program for Women Infants and Children; OR = odds ratio; Ref. = reference. Bold values differ significantly from nHEA

The above comparisons (Tables S2 – S3) indicate clearly that the missing data are “not missing at random” (NMAR). In fact, maternal ethnicity is a strong predictor of missingness. Note, however, that these results are uncertain, because they depend on missingness of both maternal ethnicity and the other variables, which may be inter-dependent. The reasons for this missingness are unknown.

Recorded maternal and paternal ethnicities tend to be concordant (Cohen’s kappa = 0.72, Table S5).

Table S5: Concordance between maternal and paternal ethnicities

Maternal ethnicity	Paternal ethnicity:	nHEA	African American	Hispanic	Other
nHEA		500423	19092	31432	12411
African American		50840	87292	7678	1021
Hispanic		61547	8060	140839	3936
Other		26631	2584	4847	68113

The table coarsens values for AA and Other ethnicities, and recodes parents reporting only two ‘races’ (CDC ‘mrace’ codes 6-10, 13 and 15) as AA or Other.

This concordance means there is some collinearity in parental ethnicities. Potentially, parental ethnicities could interact when causing other risk factors or outcomes. The present analyses do not attempt to define or quantify such interactions.

The “no racism” model

The 'no-racism' model did not fit the data well (see Main Report). Therefore, I only contrast it with the ‘realistic’ model, and with the raw data. The realistic and no-racism models showed different direct effects of parental ethnicities on obstetric risk factors – especially age and education (see Table S6a-S6b and Mplus outputs). Specifically, *direct* effects of ethnicity tended to be more detrimental for AA and Hispanic parents, but *total* effects of ethnicity were generally similar in the two models (Table S6c and Mplus outputs).

Table S6a: Direct and total effects of parental ethnicity on parental age and education in the realistic and no-racism models

Variable	Maternal age				Paternal age				Maternal Education				Paternal Education			
Effect type	Direct		Total		Direct		Total		Direct		Total		Direct		Total	
model	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism
AFAMM	-0.1	-3.3	-4.5	-4.4	-	-	-3.4	-	0.6	-2.1	-3.4	-3.5	-	-	-4.7	-
MHISP	1.2	-1.9	-8.5	-3.8	-	-	-7.6	-	-4.0	-6.6	-13.9	-9	-	-	-10.4	-
OTHM	-0.2	9.5	9.8	5.5	-	-	8.2	-	-3.9	10.4	8.8	5.4	-	-	11.2	-
AFAMF	-	-	-14	-2.7	1.5	-3.6	-9.8	-3.6	-	-	-16.4	-3.3	2.2	-	-13.2	-1.4
FHISP	-	-	-13.5	-4.4	0.3	-6.1	-10.4	-6.1	-	-	-15.1	-5.4	-4.2	-	-18.8	-3
OTHF	-	-	0.3	0.9	2.7	7.3	3.0	7.3	-	-	0.7	1.1	2.6	-	2.9	2.2

Table S6b: Direct and total effects of parental ethnicity on maternal smoking, BMI, source of payment and WIC in the realistic and no-racism models

Variable	Maternal smoking				Pre-pregnancy BMI				Source of payment				Participation in WIC			
Effect type	Direct		Total		Direct		Total		Direct		Total		Direct		Total	
model	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism
AFAMM	-17.0	-6.6	-13.9	-6.6	0.8	4.9	2.6	3.4	-6.8	-	-11.3	-	7.1	9.3	11.5	7.6
MHISP	-22.8	-11.0	-15.8	-11.0	-0.6	4.9	1.9	1.3	-4.6	-	-14.6	-	5.4	11.9	14.9	7.7
OTHM	-8.5	-22.6	-16.1	-22.6	-8.3	-25.1	-11.8	-10.8	-9.2	-	1.7	-	7.0	-3.5	-3.5	-1.0
AFAMF	-6.1	-15	4.3	-15.0	-	-	4.0	2.5	-3.2	-	-18.3	-1.4	4.7	9.4	19.0	7.9
FHISP	-15.2	-24.8	-5.3	-24.8	-	-	4.1	4.1	-2.7	-	-16.6	-3.0	4.8	12.5	18.5	10.0
OTHF	-6.0	5.1	-6.3	5.1	-	-	0.1	-0.9	-3.1	-	-3.0	2.2	4.7	1.7	4.4	2.3

Table S6c: Direct and total effects of parental ethnicity on pregnancy and birth outcomes in the realistic and no-racism models

Variable	Pregnancy hypertension				Gestational diabetes				Duration of gestation				Birth weight			
Effect type	Direct		Total		Direct		Total		Direct		Total		Direct		Total	
model	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism	realistic	noracism
AFAMM	1.7	7.4	1.7	1.6	-0.3	-0.7	-1.1	-0.9	-2.1	-2.8	-2.2	-2.3	-9.8	-8.8	-8.9	-8.9
MHISP	-4.7	3.0	-4.8	-5.5	0.9	0.5	0.9	1.2	-1.4	-2.3	-0.9	-0.6	-0.4	0.7	-2.0	-1.8
OTHM	-1.6	-22.8	-5.9	-5.1	11.5	11.8	11.0	10.6	-3.2	-0.6	-3.3	-3.7	-2.6	-5.1	-5.7	-5.8
AFAMF	-3.0	-0.4	-1.7	-1.9	-3.5	-2.7	-4.1	-3.5	-2.7	-3.4	-2.1	-1.7	-4.4	-5.5	-4.5	-3.5
FHISP	-2.6	-0.6	-1.3	-1.1	-1.2	-0.2	-2.3	-1.5	-1.6	-2.4	-1.4	-1.1	-4.2	-5.7	-3.6	-2.6
OTHF	-4.3	-2.5	-4.8	-5.4	3.0	2.2	2.8	2.7	-0.7	-0.7	0.6	0.8	-7.9	-6.7	-6.5	-6.5
SOCDEP	17.3	17.4	8.5	14.1	4.1	1.1	1.4	0.5	-9.0	-20.2	-6.2	-7.2	-6.9	16.2	-6.2	-5.3

Legend: the values in tables 6a-6c are doubly-standardised path coefficients from the realistic and no-racism models for direct and total effects of parental ethnicities and social deprivation on risk factors, financial indicators and obstetric outcomes. Values in green or red show where the no-racism model predicts better or worse outcomes than the realistic model.

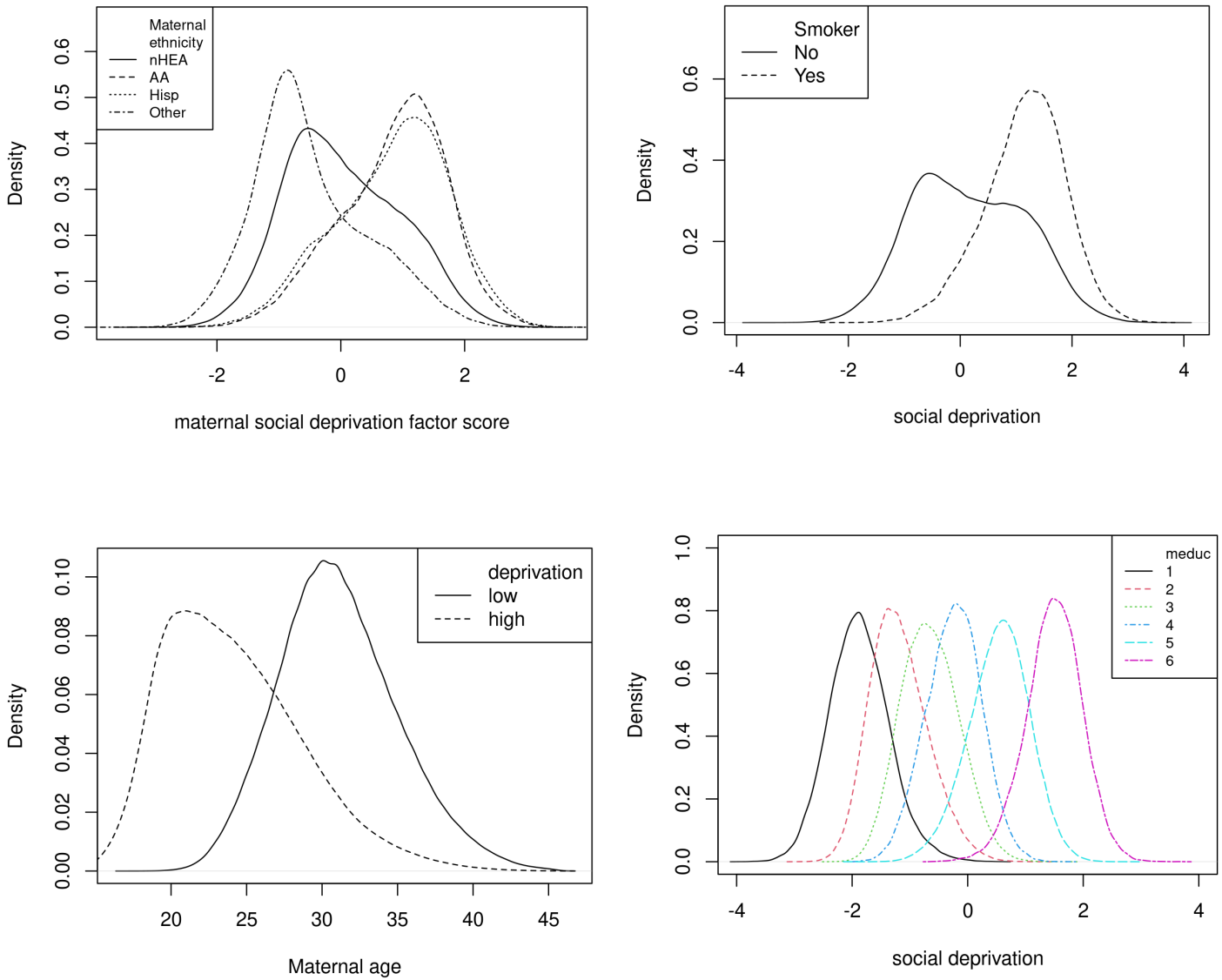


Figure S3 (a-d): Associations between factor scores of social deprivation and maternal demographic characteristics.

(a) (top left): distributions of deprivation factor scores in 4 ethnic groups – non-Hispanic European American (nHEA), African American (AA), Hispanic (Hisp) and Other (mostly Asian).

(b) (top right) distributions of deprivation factor scores in non-smokers and smokers

(c) (bottom left) distributions of maternal age in mothers whose deprivation scores were low (<0) or high (>0).

(d) (bottom right) distributions of deprivation scores in relation to maternal educational level (recoded from CDC categorisation: 1 = none through 12th grade; 2 = high school graduate; 3 = some college credit, but not a degree; 4 = Associate degree; 5 = Bachelor's degree or Master's degree; 6 = Doctorate or Professional degree.

Table S7a: Loadings of parental demographic variables on the social deprivation factor, separately for each ethnic group

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
loading	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI
FAGE	-0.645	-0.650	-0.640	-0.773	-0.787	-0.759	-0.712	-0.724	-0.700	-0.333	-0.345	-0.321
FEDUC	-1.213	-1.241	-1.186	-0.822	-0.860	-0.790	-0.987	-1.030	-0.943	-1.097	-1.183	-1.027
MEDUC	-1.407	-1.438	-1.377	-1.258	-1.304	-1.214	-1.003	-1.029	-0.977	-1.198	-1.261	-1.136
MHT	-0.117	-0.120	-0.115	-0.088	-0.094	-0.082	-0.133	-0.137	-0.128	-0.092	-0.098	-0.087
CIG0	0.645	0.633	0.657	0.204	0.170	0.240	0.071	0.036	0.106	0.607	0.540	0.675
BMI	0.577	0.543	0.611	0.607	0.494	0.730	0.287	0.254	0.320	0.258	0.197	0.327

Legend: Values are mean loadings from Bayesian estimation, together with their lower and upper 95% credibility intervals (CI). Key: FAGE = paternal age; FEDUC = paternal education; MEDUC = maternal education; MHT = maternal height; CIG0 = any previous maternal smoking; BMI = pre-pregnancy maternal BMI. For ethnic minorities, loadings in red are stronger than those in the non-Hispanic European American (nHEA) group (their 95% CIs do not overlap); loadings in green are weaker.

Table S7b: effects of social deprivation on maternal age, indicators of obstetric care and obstetric outcomes, separately for each ethnic group

Ethnicity	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
SOCDEP →	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI
MAGE	-0.699	-0.705	-0.693	-0.788	-0.800	-0.775	-0.704	-0.714	-0.695	-0.440	-0.458	-0.422
PAYER	-1.209	-1.260	-1.168	-0.941	-1.000	-0.886	-1.112	-1.209	-1.023	-1.429	-1.674	-1.208
WIC	0.970	0.911	1.033	1.335	1.036	1.653	0.635	0.573	0.701	1.376	1.040	1.808
PRECAREM	0.030	0.005	0.054	-0.511	-0.769	-0.300	0.097	0.043	0.154	-0.240	-0.442	-0.072
PRGBP	0.165	0.123	0.206	0.218	-0.015	0.475	0.086	0.011	0.161	0.244	-0.03	0.586
PRGDM	0.023	-0.027	0.071	-0.216	-0.563	0.089	0.166	0.079	0.256	-0.072	-0.292	0.131
OBGEST	-0.077	-0.108	-0.044	**-0.700**	**-1.074**	**-0.438**	0.018	-0.034	0.070	-0.153	-0.361	0.015
BWT	-0.018	-0.029	-0.008	**-0.315**	**-0.464**	**-0.205**	-0.018	-0.036	0.000	-0.027	-0.089	0.029

Legend: Values are mean path coefficients from Bayesian estimation, together with their lower and upper 95% credibility intervals (CI). Key: MAGE = maternal age; PAYER = insured or private payer; WIC = participation in WIC; PRECAREM = month of gestation when pre-natal care began; PRGBP = pregnancy hypertension; PRGDM = gestational diabetes; OBGEST = duration of gestation; BWT = birthweight. For ethnic minorities, loadings in red are more adverse than those in the non-Hispanic European American (nHEA) group (their 95% CIs do not overlap); loadings in green are more beneficial. Note that deprivation causes much worse birth outcomes for AA parents than in nHEA parents (highlighted in bold), but deprivation's effects on birth outcomes in Hispanic and Other parents are similar to those for nHEA parents..

Table S7a: Variances of continuous variables for each of ethnic groupings

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
Variable	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI
FAGE	1.028	1.021	1.035	1.425	1.404	1.447	1.19	1.173	1.207	1.071	1.058	1.085
MAGE	0.591	0.586	0.596	0.598	0.583	0.614	0.666	0.654	0.677	0.641	0.631	0.651
MHT	0.443	0.441	0.445	0.461	0.456	0.466	0.379	0.376	0.383	0.339	0.335	0.343
BMI	0.907	0.898	0.916	1.049	1.007	1.087	0.969	0.958	0.980	0.623	0.609	0.635
PRECAREM	1.275	1.27	1.281	2.206	2.161	2.244	2.278	2.257	2.299	1.949	1.921	1.975
OBGEST	1.423	1.416	1.431	1.438	1.368	1.483	1.425	1.409	1.440	1.381	1.359	1.402
BWT	0.186	0.185	0.187	0.180	0.169	0.188	0.181	0.179	0.183	0.173	0.171	0.175

Legend: Intercepts are variances from Bayesian estimation, together with their lower and upper 95% credibility intervals. Variances that are greater in ethnic minorities (95%CIs do not overlap those of nHEA) are in red; those that are smaller are in green. Key: FAGE = paternal age; MAGE = maternal age; MHT = maternal height; BMI = pre-pregnancy maternal BMI; PRECAREM = month of gestation when pre-natal care began; OBGEST = duration of gestation (obstetric estimate); BWT = birthweight.

Table S7b: Miscellaneous effects of different demographic variables on each other

Ethnicity		Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
Cause	effect	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI
FAGE	FEDUC	0.003	-0.006	0.011	0.071	0.059	0.082	-0.063	-0.079	-0.048	0.012	-0.002	0.025
CIG0	MAGE	0.011	0.006	0.017	0.019	0.002	0.036	-0.027	-0.047	-0.007	0.021	-0.004	0.046
CIG0	MEDUC	-0.120	-0.134	-0.107	-0.113	-0.146	-0.079	-0.069	-0.099	-0.039	-0.001	-0.055	0.053
MEDUC	BMI	0.126	0.114	0.138	0.226	0.187	0.268	0.084	0.070	0.098	0.088	0.064	0.114
MAGE	BMI	0.216	0.207	0.226	0.354	0.311	0.398	0.199	0.185	0.213	0.047	0.032	0.063
CIG0	BMI	-0.035	-0.043	-0.026	0.040	0.014	0.067	0.023	-0.003	0.050	0.059	0.027	0.090

Legend: Intercepts are path coefficients from causal factors to effects, from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients that are higher in ethnic minorities (95%CIs do not overlap those of nHEA) are in red; those that are lower are in green. Key: as in Table S7a-b..

Table S7c: effects of paternal and maternal age and education on source of payment and participation in WIC

Ethnicity	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
path	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI
FAGE→ PAYER	-0.010	-0.020	0.000	-0.016	-0.030	-0.003	-0.030	-0.052	-0.009	0.056	0.036	0.074
FEDUC → PAYER	-0.092	-0.112	-0.074	-0.002	-0.030	0.023	-0.094	-0.132	-0.058	0.010	-0.082	0.092
MAGE → WIC	0.008	-0.013	0.028	0.169	0.085	0.259	-0.039	-0.061	-0.016	0.071	-0.027	0.199
MEDUC → WIC	-0.146	-0.160	-0.131	0.123	0.039	0.214	-0.064	-0.086	-0.040	-0.035	-0.087	0.024

Legend: Intercepts are path coefficients from causal factors to effects, from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients that are higher in ethnic minorities (compared with nHEA) are in red; those that are lower are in green. Key: as in Tables S7a-b.

Table S7d: effects of demographic factors, payment source and participation in WIC on initiation of pre-natal care (PNC)

Ethnicity	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
x → PNC	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI
MAGE	-0.019	-0.026	-0.013	-0.170	-0.239	-0.111	-0.050	-0.068	-0.031	-0.096	-0.116	-0.078
MEDUC	-0.034	-0.041	-0.027	-0.189	-0.254	-0.135	-0.061	-0.079	-0.043	-0.09	-0.130	-0.054
PAYER	-0.102	-0.110	-0.094	-0.183	-0.210	-0.155	-0.068	-0.090	-0.045	-0.169	-0.206	-0.133
CIG0	0.023	0.016	0.031	-0.032	-0.068	0.004	0.028	-0.009	0.066	0.034	-0.024	0.093
BMI	-0.027	-0.032	-0.022	0.059	0.021	0.108	-0.051	-0.063	-0.040	0.061	0.032	0.096
WIC	-0.036	-0.045	-0.028	0.034	-0.026	0.106	-0.110	-0.128	-0.092	-0.012	-0.060	0.050

Legend: Intercepts are path coefficients for causes of pre-natal care (PNC), from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients that delay beginning PNC in ethnic minorities (95%CIs do not overlap those of nHEA) are in red; those that are cause earlier initiation of PNC are in green. Key: as in Tables S7a-b.

Table S7e: effects of demographic and care variables and fetal sex on pregnancy hypertension, separately in each ethnic group.

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
x → PRGBP	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI
CIG0	0.017	0.005	0.029	0.010	-0.029	0.049	-0.026	-0.077	0.024	0.008	-0.084	0.096
FAGE	-0.020	-0.028	-0.013	-0.006	-0.021	0.009	-0.002	-0.018	0.013	-0.044	-0.067	-0.021
MAGE	0.031	0.019	0.042	0.072	0.009	0.141	0.029	0.005	0.053	0.121	0.086	0.158
MEDUC	0.032	0.021	0.044	0.038	-0.024	0.104	0.005	-0.019	0.027	0.020	-0.037	0.090
MHT	0.037	0.029	0.045	0.017	-0.003	0.038	0.013	-0.008	0.034	-0.022	-0.055	0.011
BMI	0.211	0.203	0.218	0.121	0.080	0.158	0.158	0.144	0.172	0.235	0.184	0.278
PAYER	0.044	0.030	0.058	0.020	-0.013	0.052	-0.004	-0.032	0.026	0.000	-0.061	0.063
WIC	-0.036	-0.051	-0.022	-0.022	-0.084	0.031	-0.004	-0.026	0.018	-0.062	-0.148	0.004
SEXINF	0.025	0.014	0.036	0.025	-0.001	0.052	0.037	0.013	0.062	0.008	-0.029	0.045

Legend: Intercepts are path coefficients from causal factors to pregnancy hypertension (PRGBP), from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients that show more PRGBP in ethnic minorities (95%CIs do not overlap those of nHEA) are in red; those that show less PRGBP are in green. Key: as in Tables S7a-b.

Table S7f: effects of demographic and care variables and fetal sex on gestational diabetes, separately in each ethnic group.

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
x → PRGDM	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI
CIG0	0.054	0.040	0.069	0.033	-0.021	0.086	0.051	-0.005	0.106	-0.002	-0.078	0.074
FAGE	0.011	0.002	0.020	0.024	0.004	0.043	0.005	-0.013	0.022	0.011	-0.006	0.028
MAGE	0.155	0.142	0.169	0.114	0.024	0.193	0.235	0.208	0.263	0.173	0.147	0.198
MEDUC	-0.008	-0.022	0.005	-0.066	-0.155	0.016	0.025	-0.002	0.052	-0.018	-0.062	0.024
MHT	-0.124	-0.134	-0.113	-0.046	-0.075	-0.017	-0.044	-0.068	-0.020	-0.158	-0.183	-0.134
BMI	0.201	0.191	0.210	0.186	0.136	0.246	0.194	0.177	0.210	0.241	0.208	0.276
PAYER	0.026	0.009	0.043	-0.040	-0.086	0.005	0.036	0.002	0.070	-0.051	-0.098	-0.006
WIC	0.021	0.002	0.039	0.060	-0.011	0.141	0.000	-0.027	0.027	0.017	-0.030	0.067
SEXINF	0.020	0.007	0.034	0.032	-0.006	0.068	0.002	-0.026	0.031	0.019	-0.007	0.046

Legend: Intercepts are path coefficients from causal factors to gestational diabetes (PRGDM), from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients that show more PRGDM in ethnic minorities (95%CIs do not overlap those of nHEA) are in red; those that show less PRGDM are in green. Key: as in Tables S7a-b.

Table S7g: effects of demographic and care variables and fetal sex on birthweight, separately in each ethnic group.

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
x → BWT	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI
CIG0	-0.030	-0.034	-0.027	-0.050	-0.064	-0.036	-0.013	-0.025	-0.002	0.019	0.000	0.037
FAGE	-0.009	-0.011	-0.008	0.000	-0.004	0.005	0.001	-0.003	0.005	-0.005	-0.010	-0.001
MAGE	-0.019	-0.022	-0.016	-0.084	-0.123	-0.054	-0.006	-0.012	0.000	0.004	-0.004	0.011
MEDUC	-0.005	-0.008	-0.002	-0.073	-0.110	-0.045	-0.005	-0.010	0.001	-0.010	-0.022	0.002
MHT	0.135	0.133	0.137	0.097	0.091	0.103	0.119	0.114	0.124	0.138	0.131	0.144
BMI	0.072	0.070	0.074	0.095	0.074	0.125	0.068	0.065	0.072	0.077	0.068	0.087
PAYER	0.000	-0.003	0.004	-0.030	-0.041	-0.020	0.000	-0.007	0.007	-0.006	-0.018	0.007
WIC	-0.008	-0.012	-0.004	0.065	0.034	0.106	0.010	0.005	0.015	0.010	-0.002	0.025
PNC	-0.002	-0.003	0.000	-0.008	-0.016	-0.001	-0.002	-0.004	0.000	0.002	-0.001	0.005
PRGBP	-0.085	-0.088	-0.083	-0.078	-0.092	-0.061	-0.084	-0.089	-0.079	-0.068	-0.076	-0.060
PRGDM	-0.009	-0.012	-0.006	0.024	0.002	0.041	0.004	-0.002	0.01	-0.025	-0.031	-0.019
SEXINF	0.124	0.121	0.127	0.118	0.111	0.125	0.104	0.099	0.110	0.088	0.081	0.096

Legend: Intercepts are path coefficients from causal factors to birthweight (BWT), from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients for variables that increase BWT in ethnic minorities (95%CIs do not overlap those of nHEA) are in green; those that decrease BWT are in red. Key: as in Tables S7a-b.

Table S7h: effects of demographic and care variables and fetal sex on duration of gestation, separately in each ethnic group.

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
x → GEST	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI
CIG0	-0.005	-0.014	0.005	-0.047	-0.084	-0.011	0.006	-0.028	0.041	0.045	-0.013	0.106
FAGE	-0.006	-0.012	0.000	0.018	0.005	0.031	0.005	-0.006	0.015	-0.008	-0.021	0.006
MAGE	0.012	0.003	0.021	-0.185	-0.279	-0.111	0.035	0.017	0.053	-0.009	-0.031	0.013
MEDUC	-0.013	-0.022	-0.004	-0.163	-0.259	-0.096	0.013	-0.003	0.029	-0.014	-0.055	0.021
MHT	0.061	0.054	0.068	0.028	0.011	0.046	0.075	0.061	0.090	0.070	0.050	0.089
BMI	0.090	0.084	0.096	0.202	0.152	0.275	0.088	0.077	0.098	0.108	0.081	0.142
PAYER	-0.015	-0.025	-0.004	-0.075	-0.105	-0.045	0.006	-0.014	0.026	-0.017	-0.054	0.021
WIC	-0.021	-0.033	-0.010	0.153	0.084	0.253	0.034	0.018	0.050	0.046	0.006	0.097
PNC	0.053	0.049	0.057	0.033	0.013	0.049	0.038	0.032	0.043	0.032	0.023	0.041
PRGBP	-0.434	-0.440	-0.428	-0.348	-0.382	-0.309	-0.313	-0.327	-0.299	-0.268	-0.291	-0.245
PRGDM	-0.177	-0.186	-0.169	-0.192	-0.243	-0.151	-0.178	-0.196	-0.161	-0.180	-0.199	-0.162
SEXINF	-0.041	-0.049	-0.032	-0.003	-0.025	0.018	-0.060	-0.077	-0.043	-0.100	-0.121	-0.079

Legend: Intercepts are path coefficients from causal factors to duration of gestation (OBGEST), from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients for variables that increase OBGEST in ethnic minorities (95%CIs do not overlap those of nHEA) are in green; those that decrease OBGEST are in red. Key: as in Tables S7a-b.

Table S7i: Variances of continuous variables for each of ethnic groupings

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
Variable	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI
FAGE	1.028	1.021	1.035	1.425	1.404	1.447	1.19	1.173	1.207	1.071	1.058	1.085
MAGE	0.591	0.586	0.596	0.598	0.583	0.614	0.666	0.654	0.677	0.641	0.631	0.651
MHT	0.443	0.441	0.445	0.461	0.456	0.466	0.379	0.376	0.383	0.339	0.335	0.343
BMI	0.907	0.898	0.916	1.049	1.007	1.087	0.969	0.958	0.980	0.623	0.609	0.635
PRECAREM	1.275	1.27	1.281	2.206	2.161	2.244	2.278	2.257	2.299	1.949	1.921	1.975
OBGEST	1.423	1.416	1.431	1.438	1.368	1.483	1.425	1.409	1.440	1.381	1.359	1.402
BWT	0.186	0.185	0.187	0.180	0.169	0.188	0.181	0.179	0.183	0.173	0.171	0.175

Legend: Intercepts are variances from Bayesian estimation, together with their lower and upper 95% credibility intervals. Variances that are greater in ethnic minorities (95%CIs do not overlap those of nHEA) are in red; those that are smaller are in green. Key: FAGE = paternal age; MAGE = maternal age; MHT = maternal height; BMI = pre-pregnancy maternal BMI; PRECAREM = month of gestation when pre-natal care began; OBGEST = duration of gestation (obstetric estimate); BWT = birthweight.

Table S7j: Miscellaneous effects of different demographic variables on each other

Ethnicity		Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
Cause	effect	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI
FAGE	FEDUC	0.003	-0.006	0.011	0.071	0.059	0.082	-0.063	-0.079	-0.048	0.012	-0.002	0.025
CIG0	MAGE	0.011	0.006	0.017	0.019	0.002	0.036	-0.027	-0.047	-0.007	0.021	-0.004	0.046
CIG0	MEDUC	-0.120	-0.134	-0.107	-0.113	-0.146	-0.079	-0.069	-0.099	-0.039	-0.001	-0.055	0.053
MEDUC	BMI	0.126	0.114	0.138	0.226	0.187	0.268	0.084	0.070	0.098	0.088	0.064	0.114
MAGE	BMI	0.216	0.207	0.226	0.354	0.311	0.398	0.199	0.185	0.213	0.047	0.032	0.063
CIG0	BMI	-0.035	-0.043	-0.026	0.040	0.014	0.067	0.023	-0.003	0.050	0.059	0.027	0.090

Legend: Intercepts are path coefficients from causal factors to effects, from Bayesian estimation, together with their lower and upper 95% credibility intervals. Coefficients that are higher in ethnic minorities (95%CIs do not overlap those of nHEA) are in red; those that are lower are in green. Key: as in Table S7a-b..

Figure S7k: correlations between demographic factors

Ethnicity:		Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
X1 ↔ X2		Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI	Intercept	lo 95%CI	hi 95%CI
FAGE	MAGE	0.526	0.521	0.531	0.599	0.584	0.614	0.573	0.561	0.585	0.511	0.501	0.52
FEDUC	MEDUC	0.200	0.188	0.214	0.327	0.308	0.345	0.356	0.342	0.371	0.437	0.408	0.464
MEDUC	MAGE	0.072	0.067	0.078	0.058	0.046	0.071	0.085	0.076	0.094	0.089	0.078	0.100
PAYER	WIC	-0.526	-0.536	-0.515	-0.316	-0.343	-0.288	-0.503	-0.520	-0.485	-0.410	-0.468	-0.357
PAYER	BMI	0.175	0.167	0.184	0.189	0.162	0.218	0.098	0.083	0.113	0.145	0.118	0.174
PAYER	CIG0	-0.118	-0.129	-0.106	-0.103	-0.142	-0.064	-0.107	-0.153	-0.062	0.138	0.053	0.225
WIC	BMI	-0.073	-0.087	-0.060	-0.187	-0.276	-0.112	-0.013	-0.027	0.001	-0.116	-0.186	-0.066
WIC	CIG0	0.181	0.168	0.194	0.105	0.061	0.150	0.024	-0.012	0.060	-0.101	-0.225	0.006
PRGBP	PNC	-0.023	-0.029	-0.017	0.030	0.002	0.060	-0.003	-0.022	0.016	0.003	-0.027	0.033
PRGDM	PNC	0.003	-0.005	0.011	0.004	-0.038	0.040	-0.006	-0.028	0.016	-0.037	-0.059	-0.016
PRGBP	PRGDM	0.065	0.054	0.076	0.141	0.109	0.176	0.143	0.118	0.167	0.087	0.056	0.117
OBGEST	BWT	0.234	0.232	0.236	0.239	0.214	0.258	0.228	0.224	0.232	0.231	0.225	0.237

Legend: Intercepts are means of path coefficients from causal factors to duration of gestation (OBGEST), from Bayesian estimation, together with their lower and upper 95% credibility intervals. Correlations that are absolutely smaller in ethnic minorities (95%CIs do not overlap those of nHEA) are in green; those that are absolutely larger are in red. Key: as in Tables S7a-b.

Table S7l: Thresholds of ordinal variables for each of the main ethnic groupings

Ethnicity:	Non-Hispanic European American			African-American			Hispanic			Other (mostly Asian)		
Variable	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI	Intercept	low 95%CI	high 95%CI
FEDUC-1	-2.636	-2.667	-2.605	-1.717	-1.744	-1.692	-1.019	-1.037	-1.002	-2.521	-2.631	-2.428
FEDUC-2	-0.877	-0.889	-0.865	0.012	-0.001	0.026	0.435	0.416	0.454	-1.477	-1.545	-1.420
FEDUC-3	-0.101	-0.107	-0.094	0.853	0.833	0.875	1.232	1.201	1.263	-0.976	-1.024	-0.935
FEDUC-4	0.248	0.241	0.254	1.14	1.116	1.165	1.588	1.551	1.625	-0.739	-0.778	-0.705
FEDUC-5	2.585	2.555	2.615	3.026	2.972	3.084	3.363	3.288	3.435	1.796	1.737	1.868
MEDUC-1	-3.217	-3.259	-3.179	-2.162	-2.212	-2.114	-1.412	-1.434	-1.391	-2.766	-2.84	-2.696
MEDUC-2	-1.513	-1.534	-1.495	-0.376	-0.394	-0.358	0.008	-0.004	0.019	-1.699	-1.745	-1.655
MEDUC-3	-0.608	-0.618	-0.598	0.677	0.657	0.698	0.870	0.855	0.886	-1.161	-1.194	-1.129
MEDUC-4	-0.152	-0.159	-0.145	1.054	1.027	1.081	1.247	1.227	1.267	-0.876	-0.903	-0.85
MEDUC-5	2.879	2.844	2.917	3.508	3.433	3.591	3.388	3.337	3.441	2.072	2.018	2.126
CIG0	1.794	1.783	1.806	2.054	2.029	2.08	2.376	2.351	2.402	2.916	2.822	3.012
PAYER	-1.181	-1.195	-1.167	0.303	0.287	0.32	0.25	0.231	0.27	-1.288	-1.386	-1.199
WIC	1.397	1.374	1.426	-0.049	-0.063	-0.034	-0.022	-0.032	-0.012	1.563	1.366	1.83
PRGBP	1.377	1.367	1.388	1.365	1.343	1.387	1.549	1.526	1.573	1.806	1.748	1.874
PRGDM	1.828	1.815	1.841	1.935	1.891	1.991	1.812	1.785	1.84	1.400	1.367	1.434

Values are unstandardised mean values and their 95% credibility intervals. values for the thresholds are probits. Note also that for binary variables, Mplus reports higher thresholds for rarer events. I have colour-coded values for minority ethnicities where 95% CIs do not overlap non-Hispanic European Americans' (NHEA): red = (notionally) worse than nHEA; green = (notionally) better than nHEA

Separate analyses of the "realistic" model for each ethnicity

Tables S7a-d show the direct effects of demographic factors, except ethnicity, separately for each ethnic group. These analyses parallel the 'realistic' model in the main report, except that they analysed each ethnic group separately and omitted all direct effects of ethnicity. Hence, comparisons between ethnicities in these tables allow assessment of heterogeneity of interactive effects of demographic factors with ethnicity. I mention briefly here only the major differences, comparing each minority ethnicity with nHEA:-

1) The loadings of demographic variables on the factor of social deprivation differed substantially between nHEA and ethnic-minority births (Table S7a). Specifically:-
a) Age loaded more strongly on deprivation in AA and Hispanic fathers
b) Both paternal and maternal education loaded less on deprivation in all ethnic-minority parents. This may reflect discrimination in employment.
c) Maternal height loaded less on deprivation in AA and Other-ethnicity mothers, but more in Hispanic mothers.
d) Smoking loaded less on deprivation in AA and Hispanic mothers.
e) BMI loaded less on deprivation in Hispanic and Other-ethnicity mothers

2) Deprivation had much worse direct effects on birth outcomes in AA parents, but had mixed effects in Hispanic and Other-ethnicity parents (Table S7b).

3) More educated mothers of all ethnic-minorities more often participated in WIC (Table S7c).

4) Older or more educated mothers of all ethnic minorities began pre-natal care earlier (Table S7d).

5) Effects of demographic factors on pregnancy hypertension and gestational diabetes showed relatively little heterogeneity between ethnic groups (Tables S7e-f).

6) Effects of demographic factors on birthweight showed substantial heterogeneity (Table S7g).
a) Birthweights were less for AA mothers who paid privately, smoked, were older or more educated
b) Boy babies of Hispanic or Other ethnicity were relatively lighter.
c) Surprisingly, Other-ethnicity mothers who smoked had heavier babies
d) Participation in WIC increased birthweight in all ethnic minorities.

7) Effects of demographic factors on duration of gestation showed substantial heterogeneity (Table S7h).
a) later initiation of pre-natal care lengthened gestation *less* for all ethnic minority mothers than for nHEA mothers.
b) Participation in WIC lengthened gestation in all ethnic minorities.
c) Pregnancy hypertension shortened gestation in all ethnic minorities *less* than in nHEA mothers.
d) Private payment, smoking, more education and older maternal age all shortened gestation in AA mothers.

8) Correlations between demographic factors
a) Private payment and participation in WIC showed weaker inverse correlations in all ethnic minorities, compared with nHEA.
b) Maternal and paternal education correlated more strongly in all ethnic minorities than in nHEA.

In summary, there is substantial heterogeneity between different ethnicities in all aspects of the realistic model. This may partly explain why the model's imperfect fit (see Main Report).

Supplementary Discussion

Exclusions

I excluded *a priori* births to mothers who had prepregnancy hypertension or diabetes, or extreme physical characteristics, or of babies born prematurely or at very low birthweight. These cases had worse outcomes. So, their exclusion probably diminished effect sizes of variables in the study, for the population as a whole. On the other hand, if I had included these cases, then could distort the results because poor outcomes in the small numbers of these cases could exert undue leverage in the analysis. Therefore, I chose to omit these atypical cases in order to ensure that the present results are more likely to be relevant to most primigravidae. Further studies could extrapolate the realistic model (see Main Report) to determine how well it can predict the outcomes of excluded cases.

Missing data

There is clear evidence that missing data are "missing not at random" (MNAR). That is, the causes of missingness – particularly paternal ethnicity and education – also cause obstetric outcomes (see Tables 4-5 in Main Report). Tables S2-S4 indicate that (a) cases with partial missing data have worse outcomes, (b) maternal ethnicity may cause missingness, and (c) patterns of missingness are very different for mothers of minority ethnicities, compared with nHEA mothers. Hence, overall, the Main Report's analysis of cases with complete data most likely *under*-estimates adverse effects of minority ethnicity. Since parental minority ethnicity also strongly predicts deprivation, it is also probable that the Main Reports model *under*-estimates effects of deprivation on outcomes.

It is uncertain if data imputation would improve estimates of ethnicity and deprivation on outcomes. Random forest procedures for imputation can cope with non-linear causal effects and complex interactions,[16] but may still result in severely biased estimates of missing values.[17] Potentially, Mplus analyses can themselves impute missing data in the context of the model.[6] However, the accuracy of such imputation would depend on model fit – which here is imperfect – and on model validity, which is uncertain (see below). In the present context, imputation should ideally incorporate geopolitical and financial factors that may determine missingness.

The 'no-racism' model

I do not describe the 'no-racism' model in detail, for three reasons. First, the realistic model can fit the data, but the 'no-racism' model cannot. Second, the 'no-racism' model appears implausible. For example, it implies that smoking *causes* younger maternal age, whereas the realistic model views both smoking and younger maternal age as *effects* of deprivation. Third, the realistic model's results parallel external causal evidence – e.g. that smoking increases maternal age (due to smoking's toxicity – see Main Report), *contra* the 'no-racism' model's result (see Mplus outputs). Therefore, I present the 'no-racism' model only highlight its inadequacies, in relation the the realistic model.

Model interpretation

The model presents an "open theory" of the data-generating processes for obstetric outcomes.[18] The fact that the model can fit a 1% sample of the data indicates that the model's paths can bear interpretation as causal effects. Appropriate combinations of the model's direct effects (see Tables 3-5 in Main Report) can quantify indirect effects, to test how far intermediate variables may mediate total causal effects. In general, deprivation mediated many – but not all – effects of minority ethnicity.

The underlying rationale for the present study is that linear structural equation models can be a "useful microscope" for causal analysis.[19] However, causal interpretations depend on unmet "cross-world counterfactual assumptions".[20] The presence of variables (measured or unmeasured) that result from a 'treatment' and in turn cause both mediators and outcomes is guaranteed to violate these assumptions.[21] The present model includes variables of this kind. For, example, if we regard maternal ethnicity as a 'treatment', this causes social deprivation, which in turn can cause both mediators – e.g. maternal education, height, or smoking – and outcomes, e.g. birthweight. Unknown variables may also violate the cross-world assumption. For example, rurality may determine proximity to a teaching hospital, which in turn may influence both the nature of care and outcomes.[22] It is possible that observational data can never fulfil the cross-world assumption in obstetric settings. However, the present study may help to highlight questions that merit more detailed study, using randomised controlled trials.

Statistical considerations

Model fit

Assessing model fit is a general problem.[10] With large N, χ^2 may be highly sensitive for detecting poor fit, but other fit indices may be insensitive. My analysis of a 1% sample (7908 cases) here may achieve an adequate balance between sensitivity and misspecification – it has 42 cases per path coefficient, but fits according to the posterior predictive χ^2 (95% CI = -26.140 – 710.705, posterior predictive probability =0.132).

The Main Report discusses possible reasons for its model's imperfect fit. Additional remediable causes are: (i) the model used the probit link for categorical variables (which is intolerant of outliers); (ii) the model used identity links for continuous variables (e.g. age, BMI, height), even though appropriate transformations can improve model fit, overall.[24]

Effect sizes

The realistic model's causal effects are generally small. Two possible reasons for this are (1) the study excluded cases with missing data, but these cases showed worse outcomes (for available data). Hence, it is likely that the model under-estimated causal effects. (2) The model structure allows "false witness" effects that render causal paths non-identified and could dilute causal estimates.[21] Nevertheless, (a) even small effects in the study surpass the strict criterion of the 't' approximation to the Bayes Factor that I adopted here[25] – which indicates that the data show very strong evidence for them (b) small effects are often more realistic[26] and together can add up (although many indirect effects did not reinforce each other but cancelled each other's effects); (c) the omission of obstetric interventions from the model may partly obscure some causal effects on birth outcomes (see below). In spite of these limitations, the present model may help to guide clinicians' reasoning about causes and treatments of some adverse outcomes.

Model incompleteness – effects of obstetric interventions

A further limitation of the present study is that it omits effects of obstetric management on outcomes. However, it is unlikely that this omission obscures these causal effects completely, because active obstetric management (e.g. induction, or Caesarean section) is often a response to pregnancy complications – gestational hypertension and diabetes – that are present in the model.

Hence, active obstetric management does not obscure causal paths to these *pregnancy* complications, but may distort their apparent effects on *birth* outcomes – birthweight and duration of gestation. Elective delivery, for non-obstetric reasons, may also affect birth outcomes – and the model does not account for these effects. It is likely that elective delivery is more frequent when mothers have private insurance or pay directly, but emergency delivery is more likely in mothers who suffer more deprivation. Further studies should extend the present model to include obstetric management and ascertain its effects on outcomes more fully.

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