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Maternal ethnicity and socioeconomic deprivation: influence on adverse pregnancy outcomes

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Short title: Ethnicity, social deprivation and adverse pregnancy outcomes

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CONTRIBUTION

What are the novel findings of this work?

The risk of pregnancy complications related to placental dysfunction is higher in women of Black and Asian ethnicity compared to women of White ethnicity. Even so, the majority of these adverse pregnancy outcomes occur in White women living in the most deprived socioeconomic conditions.

What are the clinical implications of this work?

Both ethnicity and socioeconomic deprivation should be considered in the prediction of placentally-mediated disorders to prevent an underestimation of the effective burden of these adverse pregnancy outcomes in the overall population.

ABSTRACT

Objectives: To evaluate the relative importance of ethnicity and socioeconomic deprivation in determining the likelihood and the percentage of composite adverse pregnancy outcomes (CAPO) and composite of severe adverse pregnancy outcomes (CAPO-S)

Methods: This is a single centre retrospective cohort study conducted in a tertiary maternity unit. Data regarding the ethnicity and socioeconomic deprivation were collected for 13,165 singleton pregnant women routinely screened in the first trimester for preeclampsia using the Fetal Medicine Foundation combined algorithm.

Results: The prevalence or risk of CAPO was 16.3% for White women, 29.3% for Black women and 29.3% for South Asian women. However, half of all CAPO cases (51.7%) occurred in White women. There is a strong interaction between ethnicity and socioeconomic deprivation (as measured with indices of multiple deprivation). Both influence the prevalence of CAPO and CAPO-S, with the contribution of ethnicity being strongest.

Conclusions: Black and Asian ethnicity as well as socioeconomic deprivation influence the prevalence of placentally-mediated adverse pregnancy outcomes. Despite this, most adverse pregnancy outcomes occur in White women, who represent the majority of the population and are also affected by socioeconomic deprivation. For these reasons, inclusion of socioeconomic deprivation should be considered in early pregnancy risk assessment for placentally-mediated CAPO.

INTRODUCTION

Black and ethnic minority groups represent a subset of the population at greatest risk of an adverse health outcome. In pregnancy, complications such as preeclampsia and perinatal mortality are more prevalent in women of Black and South Asian ethnicity compared to White women [1-3]. Similarly, socioeconomic deprivation also constitutes a key driver for both general and pregnancy-specific adverse outcomes [4-6].

Maternal ethnicity, but not socioeconomic deprivation, is included in the Fetal Medicine Foundation (FMF) first trimester combined screening test for preeclampsia [7]. The latter is justified in the study of Arechvo *et al.*(2023), who concluded that the inclusion of indices of multiple deprivation (IMD) as a measure of socioeconomic deprivation [8] in the FMF algorithm did not improve screening performance for preeclampsia [9]. However, women identified at high-risk of preterm preeclampsia by the FMF algorithm are also at increased risk of developing a wide range of additional adverse pregnancy outcomes related to uteroplacental dysfunction including small-for-gestational-age birth, preterm birth, and stillbirth [10-12].

The aim of this study is to evaluate the relative importance of ethnicity and socioeconomic deprivation in determining the likelihood and the burden of a composite of adverse pregnancy outcomes (CAPO), which include hypertensive disorders of pregnancy; preterm birth; small-for-gestational-age; and stillbirth, in a population routinely screened for preterm preeclampsia in the first trimester using the FMF algorithm.

METHODS

This is a single centre retrospective cohort study conducted in a tertiary maternity unit at St. George's University Hospitals NHS Foundation Trust. Data were routinely collected from all women screened for preterm preeclampsia in the first trimester using the FMF multifactorial algorithm between March 2018 and May 2022. IMD indices were used as a well-established and validated measure of relative deprivation by inclusion of data from seven domains (income, employment, education, health and disability, crime, barriers to housing and services, and living environment) combined according to their respective weights, for small, postcode-defined geographical areas. Each neighbourhood is ranked according to the level of deprivation relative to other areas, with categorization into one of ten (deciles) groups. Those areas that are the most deprived are allocated in the lowest group (group 1), while the least deprived are in the highest group (group 10). IMD indices have extensively been used in the literature as a proxy for socioeconomic deprivation [3,9,13], and are periodically updated [8].

Participant characteristics included maternal race (White, Black, South Asian, Mixed and Other) and postcode used to calculate IMD were collected at the first trimester visit. Ethnicity was self-reported. Only women with complete information about socioeconomic deprivation and ethnicity were included in the study. All women with a preterm preeclampsia chance of ≥1 in 50 were offered a program of monitoring and interventions: daily administration of 150mg prophylactic aspirin as well as serial ultrasound growth scans at 28 and 36-weeks' gestation and induction of labour from 40^{+0} weeks [10]. As per Saving babies' lives care bundle version 3, induction of labour was offered after 37^{+0} in case of estimated fetal weight (EFW) <5th centile and after 39^{+0} with EFW<10th [14]. CAPO was defined as the presence of one or more interrelated outcomes associated with placental dysfunction, namely hypertensive disorders of pregnancy [15], preterm birth [16], infants at or below the 10th centile at birth, according to the international standards developed by Intergrowth-21 [17] and stillbirth. Composite of severe adverse perinatal outcomes (CAPO-S) was defined as the presence of one or more of the

following: preterm hypertensive disorders of pregnancy (<37^{+0} weeks), preterm birth <34^{+0} weeks, birthweight at or below the 5th centile and preterm stillbirth (<37^{+0} weeks).

Outcome data were collected retrospectively from the ultrasound database and maternity birth registry, which undergo systematic clinical governance evaluation. The present study was deemed not to require ethics approval or signed patient consent as per the Health Research Authority decision tool. Summary data were expressed by median and interquartile range for continuous variables and by number and percentage for categorical variables. Correlation between ethnicity, CAPO and IMD was tested with Spearman's rho and Pearson Chi-square tests. Logistic regression analysis (uni/bi/multivariate) was performed to examine the association between ethnicity, IMD and CAPO (or CAPO-S); White ethnicity and the group with the lowest level of deprivation (IMD 10) were chosen as a reference. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 28.0.1.0 (IBM Inc.).

RESULTS

During the study period from March 2018 and May 2022, data were collected from 13,165 singleton pregnancies. Maternal demographic and socioeconomic deprivation indices are shown in Table 1. Women of non-white ethnicity constituted 35.6% of the study population with 5.5% being in the lowest two deciles (IMD 1 and 2). The rates of hypertensive disorders of pregnancy, preterm birth, small-for-gestational-age birth, and stillbirth were 5.1%, 5.0%, 13.7% and 0.5%, respectively. The distribution of maternal ethnicity by IMD is shown in Figure 1. Women of White, Asian, and Mixed/Other backgrounds had very similar distributions for IMD deciles, whereas women of Black ethnicity showed a distribution skewed to the lowest IMD deciles.

The overall incidence of CAPO and CAPO-S was 20.4% (n=2683) and 9.4 % (n=1244), respectively. The prevalence (or risk) of CAPO was 16.3% for White women, 29.3% for Black women and 29.3% for South Asian women (Table 2). However, half of all CAPO cases (51.7%) occurred in White women, with 24.4% and 16.7% of all CAPO cases occurring in the South Asian and Black groups, respectively (Table 2). Similar trends were noted for CAPO-S cases (Table S1). The prevalence of CAPO decreased from 25.3% in women from the lowest IMD deciles (1 to 2 – most deprived) to 18.3% in women from the highest IMD deciles (9 to 10 – least deprived) (Table 2). Similar trends were noted for CAPO-S cases (Table S2). White women from the most deprived areas (IMD deciles 1 to 4) accounted for 14.5% and 13.8% of all CAPO and CAPO-S cases respectively (Figures S1 and S2).

There was a significant interaction ($p<0.001$) between ethnicity and IMD with a correlation coefficient of -0.223 (-0.21 to -0.24). This interaction was particularly strong for women of Black (Pearson Chi-squared value 614.4, $p<0.001$) and White ethnicities (Pearson Chi-squared value 869.8, $p<0.001$), weaker for Asian (Pearson Chi-squared value 96.4, $p<0.001$) and non-significant for Mixed/Other backgrounds ($p<0.96$) (Table S2). In view of the strong interaction between ethnicity and IMD, the data were subjected to multivariate rather than univariate/bivariate analyses. In multivariate analysis, only ethnicity was a significant predictor

of CAPO (p<0.001), whereas both ethnicity (p<0.001) and IMD (p=0.002) were significant predictors of CAPO-S (Table 3 and Figure 2). The risk of developing CAPO-S was 2.4 (95% CI: 2.0-2.8) and 2.8 (95% CI: 2.4-3.2) times higher for Black and South Asian women, compared to White women. The risk of developing CAPO-S was 2.2 (95% CI: 1.5-3.1) times higher for women belonging to the IMD 3 group as compared to women from the IMD 10 group (Table 2). In the subgroup of the population composed by only women of White ethnicity there was a significant correlation between IMD indices and CAPO or CAPO-S (Table S3).

DISCUSSION

Hypertensive disorders of pregnancy, small-for-gestational-age birth, preterm birth, and stillbirth are potentially avoidable adverse pregnancy outcomes. Despite this, 1 in 5 women in our study population developed at least one of the composite adverse pregnancy outcomes (CAPO), with 1 in 10 women developing at least one severe adverse pregnancy outcome (CAPO-S). Maternal ethnicity appears to have a stronger influence than socioeconomic deprivation represented by IMD, with the risk of CAPO being higher in Black and South Asian women. Despite this pattern, within our study population, the majority of adverse pregnancy outcomes (51.7%) occurred in White women, who represent the largest group (64.4%) and are impacted by the effects of socioeconomic deprivation, with 14% of all CAPO cases occurring in White women from the lowest IMD deciles (1 to 4).

Comparison with existing literature

There are no other published studies on the impact of ethnicity and socioeconomic deprivation on CAPO, however, a cohort study of 1,155,981 women demonstrated an increased individual risk for stillbirth, preterm birth, and small-for-gestational-age birth in women from minority ethnic backgrounds and living in the most deprived IMD groups [5]. The authors concluded that concerted action was needed to reduce socioeconomic and ethnic inequalities in pregnancy outcomes but stopped short of specifying how this could be achieved other than by targeting Black and South Asian women in deprived socioeconomic groups. A more recent publication from Arechvo *et al.* showed that in a cohort of 159,125 singleton pregnancies the risk of preeclampsia and stillbirth were 2 to 3-fold higher in women of Black ethnicity compared to White women [3]. They also reported that women living in underprivileged conditions had an increased risk of preeclampsia and stillbirth. However, the authors demonstrated that incorporating IMD quintiles into screening algorithms did not improve the prediction of preeclampsia or stillbirth. It is of note that in the latter studies only 15% of women were of

Black origin, whereas 47% were from the most socioeconomically deprived areas (IMD quintiles 1 and 2)[3].

Interpretation and biological plausibility of the study findings

According to the World Health Organisation report on social determinants of health, inequity plays a fundamental role in determining health outcomes [18]. Migrants fleeing from persecution or war-torn regions are known to have poorer health outcomes. However, the prevalence of illness among immigrants converges towards that of the host population with increased duration of residence over the decades through a process termed acculturation [19]. Immigration, ethnicity, and socioeconomic deprivation interact with existing societal structures of power, privilege, and sexual/ethnic oppression to shape health experiences and outcomes of pregnancy [20,21]. The data of the current study and that of Arechvo *et al.* demonstrate that both ethnicity and socioeconomic deprivation show a strong correlation with preeclampsia, stillbirth, and CAPO. Ethnicity had a stronger impact on adverse pregnancy outcomes than socioeconomic deprivation [3], and this can be exemplified through the strong correlation highlighted in our data. An alternative explanation is that maternal ethnicity is in fact, a better proxy for socioeconomic deprivation than calculated IMD indices. The limitation of IMD indices is that the choice of components and their relative weighting in the construction of the overall multiple deprivation score is unavoidably subjective.

Clinical and research implications

The FMF first trimester combined screening algorithm has demonstrated superior detection rates for preeclampsia and small-for-gestational-age birth compared to the use of a checklist-based approach[22]. This can be attributed to the algorithm's incorporation of various demographic characteristics, risk factors and biomarkers, including ethnicity but not IMD indices, as confirmed by the work of Arechvo and colleagues [3,7,10,23,24].

It is a common incorrect assumption that risk represents a good proxy for the burden of disease. Our data demonstrated that even if Black women had the highest risk (~30%) for CAPO, only 17% of CAPO cases occurred in this group, with 52% occurring in White women. This disjunction between risk and burden emphasizes that the impact of socioeconomic deprivation is a crucial factor. Even though the risk of CAPO may be lower in White women, this group constitutes a significant portion (65%) of the study cohort and was not immune to the deleterious impact of socioeconomic deprivation which was significantly correlated with adverse pregnancy outcomes. The discordance is likely to be more evident in a larger cohort, such as the one from the study conducted by Jardine *et al.*(2019), where only 17% of women were of Black or Asian origin, yet 51% were from the lowest four IMD deciles [5]. Relying solely on race in screening algorithms may result in underserving socioeconomically deprived White women, hence the need to incorporate both ethnicity and IMD indices for more personalized and equitable CAPO prediction models.

Recent research indicates that an effective early pregnancy CAPO risk assessment, facilitating modified care with increased surveillance and targeted interventions including aspirin prophylaxis and serial fetal wellbeing scans, has led to reduced incidence of adverse pregnancy outcomes [7,10-12,23]. These findings suggest that relatively simple healthcare solutions can address disparities, even though the underlying mechanisms connecting ethnicity and socioeconomic deprivation to adverse pregnancy outcomes remain complex.

Strengths and limitations

This retrospective study, spanning five years, included over 13,000 women from a London tertiary maternity unit, which implemented the FMF combined screening programme and interventions in 2018. This led to notable reductions in preterm preeclampsia, small-for-gestational-age births, and stillbirth rates[10-12], and might have variably underestimated the associations of ethnicity and socioeconomic deprivation with CAPO. Furthermore, the study

was conducted on a single centre cohort where the distributions of ethnicity and IMD deciles may be different from those of the national population.

Conclusions

Ethnicity and socioeconomic deprivation are both correlated with the risk of developing placentally-mediated adverse pregnancy outcomes, which in combination affect 1 in 5 pregnancies. Although maternal ethnicity had a stronger influence on CAPO than socioeconomic deprivation represented by IMD deciles, the burden of adverse pregnancy outcomes was higher in White women, who represent the largest group and are still impacted by the effects of socioeconomic deprivation. Pregnancy risk assessment algorithms should take both ethnicity and socioeconomic deprivation into account in the prediction of placentally-mediated adverse outcomes of pregnancy.

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None.

DISCLOSURE OF INTERESTS

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualisation: BT.

Methodology: BT, AB.

Data collection and processing: MM, LN, AD, GB.

Statistical analysis: AB, MM, LN.

Data interpretation: MM, LN, BT.

Manuscript draft: MM, LN.

Manuscript review and editing: BT, AB, MM, AD, GB.

DETAILS OF ETHICS APPROVAL

This retrospective study of routinely collected clinical data were collated from ongoing continuous audit and was deemed not to require ethics approval or signed patient consent as per the HRA decision tool.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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REFERENCES

1. Arechvo A, Voicu D, Gil MM, Syngelaki A, Akolekar R, Nicolaides KH. Maternal race and pre-eclampsia: Cohort study and systematic review with meta-analysis. BJOG 2022;129(12):2082-2093.
2. Sheikh J, Allotey J, Kew T, Fernández-Félix BM, Zamora J, Khalil A, Thangaratinam S. Effects of race and ethnicity on perinatal outcomes in high-income and upper-middle-income countries: an individual participant data meta-analysis of 2 198 655 pregnancies. Lancet 2022;400(10368):2049-2062.
3. Arechvo A, Nikolaidi DA, Gil MM, Rolle V, Syngelaki A, Akolekar R, Nicolaides KH. Incidence of stillbirth: effect of deprivation. Ultrasound Obstet Gynecol 2022 (In eng).
4. Seaton SE, Field DJ, Draper ES, Manktelow BN, Smith GC, Springett A, Smith LK. Socioeconomic inequalities in the rate of stillbirths by cause: a population-based study. BMJ Open 2012;2(3).
5. Jardine J, Walker K, Gurol-Urganci I, Webster K, Muller P, Hawdon J, Khalil A, Harris T, van der Meulen J. Adverse pregnancy outcomes attributable to socioeconomic and ethnic inequalities in England: a national cohort study. Lancet 2021;398(10314):1905-1912.
6. Ethnic Inequalities in Healthcare: A Rapid Evidence Review. NHS Race and Health Observatory, 2022. (https://www.nhsrho.org/publications/ethnic-inequalities-in-healthcare-a-rapid-evidence-review/).
7. Rolnik DL, Wright D, Poon LC, O'Gorman N, Syngelaki A, de Paco Matallana C, Akolekar R, Cicero S, Janga D, Singh M, Molina FS, Persico N, Jani JC, Plasencia W, Papaioannou G, Tenenbaum-Gavish K, Meiri H, Gizurarson S, Maclagan K, Nicolaides KH. Aspirin versus Placebo in Pregnancies at High Risk for Preterm Preeclampsia. N Engl J Med 2017;377(7):613-622. (In eng).
8. Stefan Noble DM, Michael Noble, Emma Plunkett, Nils Gutacker, Mary Silk and Gemma Wright. The English indices of Deprivation 2019, Research report. Ministry of

Housing, Communities & Local Government (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833947/IoD2019_Research_Report.pdf).

9. Arechvo A, Wright A, Syngelaki A, von Dadelszen P, Magee LA, Akolekar R, Wright D, Nicolaides KH. Incidence of pre-eclampsia: effect of deprivation. Ultrasound Obstet Gynecol 2023;61(1):26-32.
10. Guy GP, Leslie K, Diaz Gomez D, Forenc K, Buck E, Bhide A, Thilaganathan B. Effect of routine first-trimester combined screening for pre-eclampsia on small-for-gestational-age birth: secondary interrupted time series analysis. Ultrasound Obstet Gynecol 2022;59(1):55-60.
11. Giorgione V, Quintero Mendez O, Pinas A, Ansley W, Thilaganathan B. Routine first-trimester pre-eclampsia screening and risk of preterm birth. Ultrasound Obstet Gynecol 2022;60(2):185-191.
12. Liu B, Nadeem U, Frick A, Alakaloko M, Bhide A, Thilaganathan B. Reducing health inequality in Black, Asian and other minority ethnic pregnant women: impact of first trimester combined screening for placental dysfunction on perinatal mortality. BJOG 2022;129(10):1750-1756.
13. Vos AA, Posthumus AG, Bonsel GJ, Steegers EAP, Denktaş S. Deprived neighborhoods and adverse perinatal outcome: a systematic review and meta-analysis. Acta Obstetricia et Gynecologica Scandinavica 2014;93(8):727-740.
14. England NHSN. Saving babies' lives: version 3. A care bundle for reducing perinatal mortality. 2023.
15. Brown MA, Magee LA, Kenny LC, Karumanchi SA, McCarthy FP, Saito S, Hall DR, Warren CE, Adoyi G, Ishaku S. The hypertensive disorders of pregnancy: ISSHP classification, diagnosis & management recommendations for international practice. Pregnancy Hypertens 2018;13:291-310.
16. WHO. Preterm birth. 2018 (http://www.who.int/en/news-room/fact-sheets/detail/preterm-birth).

17. Villar J, Cheikh Ismail L, Victora CG, Ohuma EO, Bertino E, Altman DG, Lambert A, Papageorghiou AT, Carvalho M, Jaffer YA, Gravett MG, Purwar M, Frederick IO, Noble AJ, Pang R, Barros FC, Chumlea C, Bhutta ZA, Kennedy SH. International standards for newborn weight, length, and head circumference by gestational age and sex: the Newborn Cross-Sectional Study of the INTERGROWTH-21st Project. Lancet 2014;384(9946):857-68.

18. WHO. Closing the gap in a generation: health equity through action on the social determinants of health - Final report of the commission on social determinants of health. 2008.

19. Jatrana S, Pasupuleti SSR, Richardson K. Nativity, duration of residence and chronic health conditions in Australia: Do trends converge towards the native-born population? Social Science & Medicine 2014;119:53-63. DOI: https://doi.org/10.1016/j.socscimed.2014.08.008.

20. Abubakar I, Aldridge RW, Devakumar D, Orcutt M, Burns R, Barreto ML, Dhavan P, Fouad FM, Groce N, Guo Y, Hargreaves S, Knipper M, Miranda JJ, Madise N, Kumar B, Mosca D, McGovern T, Rubenstein L, Sammonds P, Sawyer SM, Sheikh K, Tollman S, Spiegel P, Zimmerman C. The UCL-Lancet Commission on Migration and Health: the health of a world on the move. Lancet 2018;392(10164):2606-2654.

21. Hossin MZ. International migration and health: it is time to go beyond conventional theoretical frameworks. BMJ Global Health 2020;5(2):e001938.

22. Tan MY, Wright D, Syngelaki A, Akolekar R, Cicero S, Janga D, Singh M, Greco E, Wright A, Maclagan K, Poon LC, Nicolaides KH. Comparison of diagnostic accuracy of early screening for pre-eclampsia by NICE guidelines and a method combining maternal factors and biomarkers: results of SPREE. Ultrasound Obstet Gynecol 2018;51(6):743-750.

23. Guy GP, Leslie K, Diaz Gomez D, Forenc K, Buck E, Khalil A, Thilaganathan B. Implementation of routine first trimester combined screening for pre-eclampsia: a clinical effectiveness study. Bjog 2021;128(2):149-156.

24. Poon LC, Wright D, Thornton S, Akolekar R, Brocklehurst P, Nicolaides KH. Efficacy and Mechanism Evaluation. Mini-combined test compared with NICE guidelines for early risk-assessment for pre-eclampsia: the SPREE diagnostic accuracy study. Southampton (UK): NIHR Journals Library

FIGURE LEGENDS

Figure 1: Distribution of the various ethnic groups by IMD decile.

IMD, indices of multiple deprivation (IMD 1 and 2 most deprived, IMD 9 and 10 least deprived)

Figure 2: Forest plot showing the results of the logistic regression analysis conducted to determine the interaction between ethnicity, IMD and CAPO-S in the study population.

IMD, indices of multiple deprivation (IMD 1 and 2 most deprived, IMD 9 and 10 least deprived); CAPO-S, severe composite of adverse pregnancy outcomes

TABLES

Table 1: Maternal demographic characteristics and pregnancy outcomes in the study cohort (n=13,165). Data are presented as medians (IQR) or as numbers (%).

	Medians (IQR) or numbers (%)
Maternal age (years)	32 (29-35)
Weight (kg)	66 (58.9-75.9)
Height (cm)	164 (160-169)
BMI (kg/m^2)	24.3 (21.8-28.0)
Ethnicity	
White	8484 (64.4%)
Black	1528 (11.6%)
South-Asian	2232 (17.0%)
Mixed / Other	921 (7.0%)
Index of multiple deprivation (IMD deciles)	
IMD 1 and 2	719 (5.5%)
IMD 3 and 4	3273 (24.9%)
IMD 5 and 6	4025 (30.6%)
IMD 7 and 8	3065 (23.3%)
IMD 9 and 10	2083 (15.8%)
Adverse pregnancy outcomes	
Hypertensive disorders of pregnancy	667 (5.1%)
Small for gestational age (<10th centile)	1803 (13.7%)
Preterm birth	656 (5.0%)

Stillbirth	64 (0.5%)
CAPO	2683 (20.4%)
CAPO-S	1244 (9.4%)

IQR, interquartile range, IMD, indices of multiple deprivation (IMD 1 and 2 most deprived, IMD 9 and 10 least deprived); CAPO, composite of adverse pregnancy outcomes

Table 2: Prevalence of CAPO cases according to ethnicity and IMD deciles.

	CAPO cases (n=2683)	**Prevalence or risk of CAPO (95% CI)**	**Percentage of all CAPO cases (95% CI)**
Ethnicity			
White (n=8484)	1386	16.3% (15.5-17.1)	51.7% (50.6-52.7)
Black (n=1528)	447	29.3% (27.0-31.5)	16.7% (14.8-18.5)
South Asian (n=2232)	655	29.3% (27.5-31.2)	24.4% (22.6-26.2)
Mixed/Other (n=921)	195	21.2% (18.5-23.8)	7.3% (5.6-8.9)
IMD deciles			
IMD 1 and 2 (n=719)	182	25.3% (22.1-28.5)	6.8% (4.9-8.6)
IMD 3 and 4 (n=3273)	758	23.2% (21.7-24.6)	28.3% (26.7-29.8)
IMD 5 and 6 (n=4025)	807	20.0%	30.1%

		(18.8-21.3)	(28.7-31.5)
IMD 7 and 8 (n=3065)	555	18.1% (16.7-19.5)	20.7% (19.3-22.1)
IMD 9 and 10 (n=2083)	381	18.3% (16.6-20.0)	14.2% (12.7-15.7)

IMD, indices of multiple deprivation (IMD 1 and 2 most deprived, IMD 9 and 10 least deprived); CAPO, composite of adverse pregnancy outcomes, CAPO-S, severe composite of adverse pregnancy outcomes

Table 3: Multivariate logistic regression showing the impact of ethnicity and IMD deciles on CAPO and CAPO-S.

	CAPO			**CAPO-S**		
	OR	**95% CI**	**P-value**	**OR**	**95% CI**	**P-value**
Ethnicity			<0.001			<0.001
Black	**2.01**	1.77 – 2.30	**<0.001**	**2.39**	2.01 – 2.83	**<0.001**
South Asian	**2.10**	1.88 – 2.34	**<0.001**	**2.81**	2.44 – 3.24	**<0.001**
Mixed/Others	**1.37**	1.16 – 1.62	**<0.001**	**1.63**	1.30 – 2.06	**<0.001**
White	1			1		
IMD deciles			0.05			0.002
IMD1	1.46	0.77 – 2.78	0.25	1.79	0.71 – 4.50	0.22
IMD2	1.18	0.91 – 1.52	0.22	**1.80**	1.20 – 2.71	**0.005**
IMD3	1.23	0.98 – 1.54	0.07	**2.16**	1.50 – 3.11	**<0.001**
IMD4	1.06	0.85 – 1.31	0.61	**1.88**	1.32 – 2.68	**<0.001**
IMD5	1.03	0.82 – 1.28	0.82	**1.54**	1.06 – 2.23	**0.02**
IMD6	1.05	0.85 – 1.29	0.66	**1.85**	1.30 – 2.62	**<0.001**
IMD7	0.90	0.72 – 1.11	0.31	1.440	1.00 – 2.07	0.05
IMD8	0.99	0.77 – 1.26	0.92	**1.70**	1.14 – 2.52	**0.009**
IMD9	1.02	0.81 – 1.29	0.87	**1.70**	1.16 – 2.49	**0.006**

IMD10	1			1		

IMD, indices of multiple deprivation (IMD 1 and 2 most deprived, IMD 9 and 10 least deprived); CAPO, composite of adverse pregnancy outcomes, CAPO-S, severe composite of adverse pregnancy outcomes; OR, odds ratio. The model R-squared coefficient was 0.19 for the analysis performed with only ethnicity as independent variable and 0.21 with ethnicity and IMD deciles for both CAPO and CAPO-S

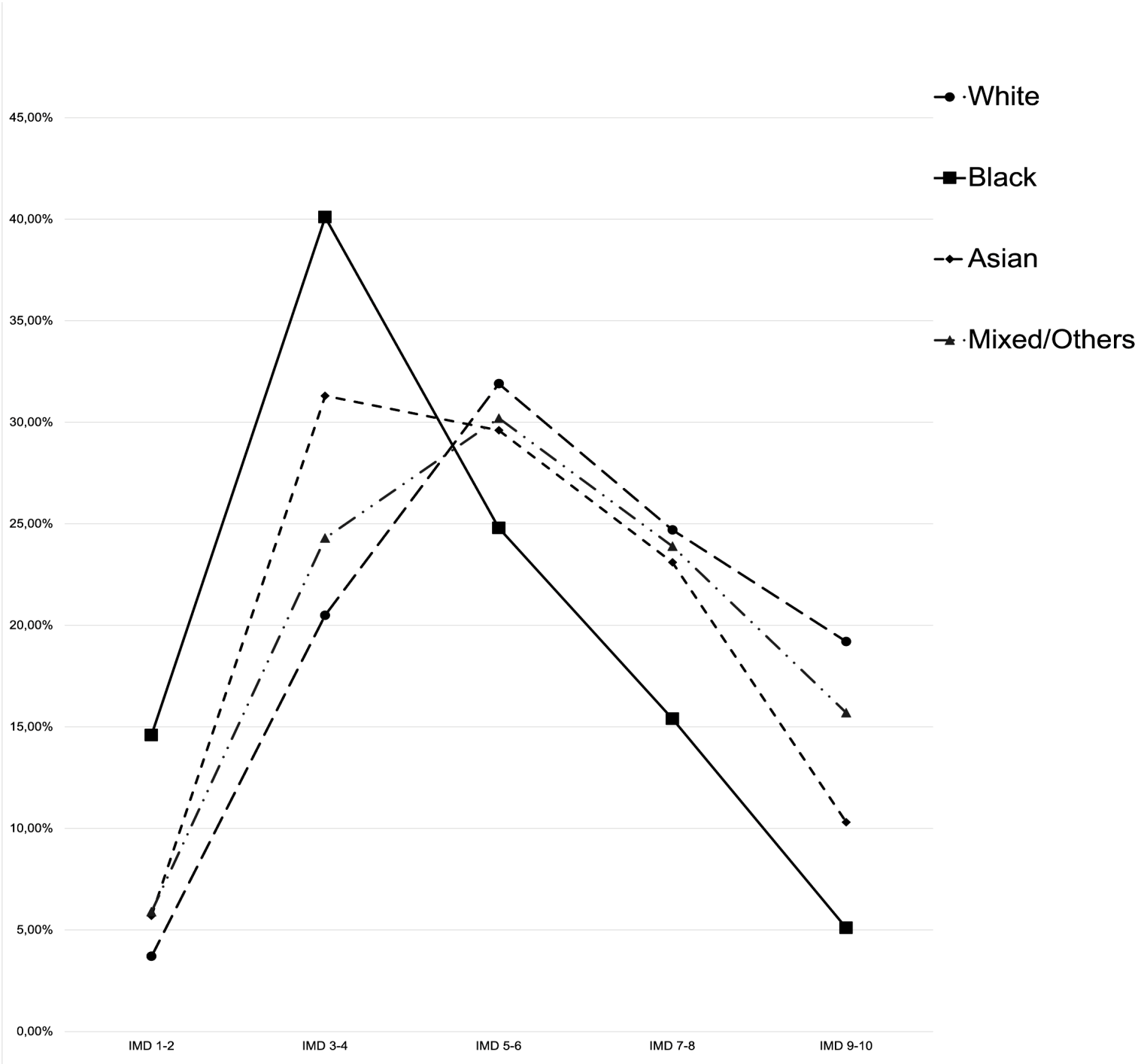
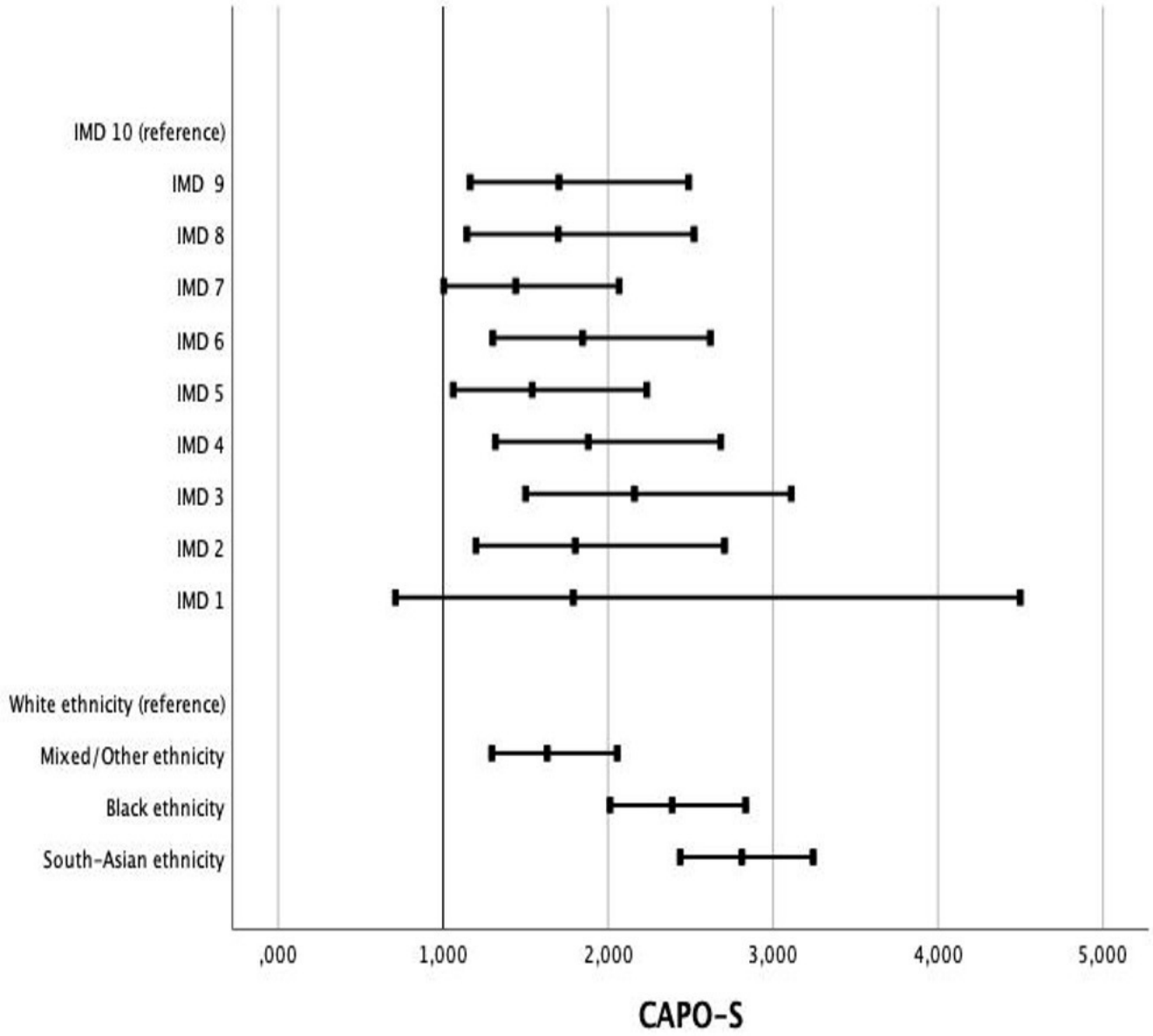


Figure 1.png



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