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Racial and ethnic disparities in fecundability: a North American preconception cohort study

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ABSTRACT

STUDY QUESTION: To what extent are there racial and ethnic disparities in fecundability in North America?

SUMMARY ANSWER: In a North American preconception cohort study, we observed large differences in fecundability across racial and ethnic groups.

WHAT IS KNOWN ALREADY: Several studies in the United States (USA) have shown that Black women tend to wait longer for fertility treatment and are less likely to seek medical care for infertility than White women. Among those who seek infertility treatment, there are large racial disparities in access to treatment and treatment success rates. However, research has been limited and conflicting on the extent to which fertility measures such as fecundability (per-cycle probability of conception) vary by race and ethnicity.

STUDY DESIGN, SIZE, DURATION: We examined the associations of race and ethnicity with fecundability in Pregnancy Study Online (PRESTO), a prospective preconception cohort study of US and Canadian residents aged 21–45 years who were actively trying to conceive without the use of fertility treatment at enrollment (2013–2024). We restricted the analysis to 18 573 participants with fewer than 12 cycles of pregnancy attempt time at enrollment.

PARTICIPANTS/MATERIALS, SETTING, METHODS: Participants self-reported data on race and ethnicity on a baseline questionnaire and completed bimonthly follow-up questionnaires for up to 12 months to update data on pregnancy status. We estimated fecundability ratios (FRs) and 95% confidence intervals (CI) using proportional probabilities regression models. We stratified by pregnancy attempt time at enrollment, reproductive history, country of residence, age, and educational attainment. In sensitivity analyses, we applied inverse probability of continuation weights to account for differential loss-to-follow-up. We also calculated the cumulative incidence of infertility during 12 cycles of attempt time by race and ethnicity using life-table methods to account for censoring.

MAIN RESULTS AND THE ROLE OF CHANCE: Compared with non-Hispanic White participants, fecundability was appreciably lower among participants who identified as non-Hispanic Black (FR = 0.60, 95% CI: 0.52–0.70), non-Hispanic American Indian/Alaskan Native/Indigenous (FR = 0.70, 95% CI: 0.44–1.11), non-Hispanic multiracial (FR = 0.89, 95% CI: 0.81–0.99), or Hispanic other/unknown race (FR = 0.77, 95% CI: 0.65–0.90). Results were similar when we performed various sensitivity analyses including: application of inverse probability of continuation weights to account for differential loss-to-follow-up; stratification by age and educational attainment; and restriction of analyses to (i) participants with <3 cycles of pregnancy attempt time at enrollment, (ii) nulligravid participants without an infertility history, and (iii) US residents. The 12-cycle cumulative incidence of infertility (i.e. clinical definition) among participants with <2 cycles of attempt time at entry also differed meaningfully by race and ethnicity (33.2% among non-Hispanic Black participants and 29.7% among Hispanic other/unknown race participants vs 16.4% among non-Hispanic White participants).

LIMITATIONS, REASONS FOR CAUTION: Due to limited numbers, we grouped participants into broad racial and ethnic groups within which there is considerable heterogeneity. Such groupings will obscure any differences in fecundability that exist between subgroups. Differential loss-to-follow-up was an important source of selection bias, though findings did not vary appreciably when we applied inverse probability of continuation weights. PRESTO is an internet-based convenience sample of pregnancy planners of higher-than-average socioeconomic status and is, therefore, not representative of all individuals who conceive, which may limit generalizability.

WIDER IMPLICATIONS OF THE FINDINGS: These descriptive data indicate the strong need for additional studies to carefully measure and better understand the mechanisms underlying disparities in fecundability, including the effects of structural racism and discrimination, as well as programs and policies to advance reproductive health equity. As more research is conducted on the drivers of these

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disparities, greater efforts should be made to increase fertility awareness, enhance preconception health, expand access to fertility treatments, and improve patient care among underserved populations to reduce the burden of subfertility among those affected.

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Introduction

Racism is a root cause of racial disparities in health (Jones, 2000; Bailey *et al.*, 2017, 2021). Racism can adversely influence health through multiple pathways, such as limiting access to high-quality societal resources (e.g. food, housing, employment, and medical care); promoting physiologic stress; and increasing exposure to harmful chemicals (e.g. smoking, air pollution) (Taylor, 2014; Bailey *et al.*, 2017, 2021). Race, a social and political construct, serves as a proxy for exposure to multiple aspects of racism and other social factors (Williams and Collins, 1995, 2001; Williams, 1996; Bonilla-Silva, 1997; Jones, 2000, 2001; Williams *et al.*, 2022). Studies of North American populations have shown racial and ethnic disparities in diabetes, cerebrovascular disease, and cancer (Lasser *et al.*, 2006; Meyer *et al.*, 2013; O'Keefe *et al.*, 2015; Cenat *et al.*, 2023; Harris, 2023; Siegel *et al.*, 2023; Tjepkema *et al.*, 2023). Fewer studies, however, have investigated racial and ethnic disparities in infertility (i.e. the inability to conceive after 12 months of unprotected intercourse; Chandra et al., 2013; Thoma *et al.*, 2013; Cox *et al.*, 2022; Snow *et al.*, 2022), which affects up to 20% of US and Canadian couples (Chandra et al., 2013; Thoma *et al.*, 2013; Cox *et al.*, 2022; Snow *et al.*, 2022).

Though the literature is limited, some US studies have shown that Black women tend to wait longer for fertility treatment (Chin *et al.*, 2015; Olig *et al.*, 2019) and are less likely to seek medical care for infertility than White women (Chin *et al.*, 2015). Among those who seek infertility treatment, there are large racial disparities in access to treatment (Seifer *et al.*, 2008; Galic *et al.*, 2021; Dongarwar *et al.*, 2022; Correia *et al.*, 2023; Merkison *et al.*, 2023) and treatment success rates (Seifer *et al.*, 2010, 2020; McQueen *et al.*, 2015; Humphries *et al.*, 2016; Correia *et al.*, 2023; Merkison *et al.*, 2023) that are not wholly explained by state insurance mandates (Correia *et al.*, 2023; Korkidakis *et al.*, 2024). Research is also limited and conflicting on the extent to which various measures of infertility (e.g. 12-month clinical definition of infertility) vary by race and ethnicity (Wellons *et al.*, 2008; Chandra *et al.*, 2013; Thoma *et al.*, 2013; Snow *et al.*, 2022). In the 2006–2010 National Survey of Family Growth (NSFG), a nationally representative study of married or cohabitating women aged 15–44 years, the prevalence of 12-month clinical definition of infertility was highest among non-Hispanic Black women (7.2%) compared with non-Hispanic White women (5.5%), Hispanic women (6.1%), and non-Hispanic Asian women (5.6%) (Thoma *et al.*, 2013). Using the same NSFG data, but applying the current duration (i.e. cross-sectional) approach to estimate time-to-pregnancy (TTP) (Scheike and Keiding, 2006; Slama *et al.*, 2006; Keiding *et al.*, 2012; Gasbarra *et al.*, 2015), non-Hispanic Black and Hispanic participants had shorter adjusted median TTP than non-Hispanic White women (Thoma *et al.*, 2013). The latest data from NSFG (1995–2019) (Snow *et al.*, 2022) are consistent with earlier cross-sectional waves of the study (2006–2010) in showing that non-Hispanic Black women had the highest odds of infertility (odds ratio [OR] = 1.44, 95% confidence interval [CI]: 1.09–1.89 vs Hispanic women) while non-Hispanic White women had the lowest odds of infertility (OR = 0.90, 95% CI: 0.74–1.10 vs Hispanic women). In a cross-sectional analysis of follow-up data from the Coronary Artery Risk Development in Young Adults (CARDIA) study (2000–2001), Black women had 2-fold increased odds of self-reported 12-month infertility (95% CI: 1.3–3.1) compared with White women after accounting for pregnancy intent (Wellons *et al.*, 2008). Finally, cross-sectional data from 974 participants aged 23–45 years (2013–2016) of the National Health and Nutrition Examination Survey (NHANES) indicated no association between race and ethnicity and 12-month infertility (Shirazi and Rosinger, 2021). All of the above studies adjusted for measures of adult socioeconomic status (SES) such as education, which may have attenuated associations given that they are likely to be causal intermediates, not confounders. Moreover, none of these studies was prospective in design.

The use of varied definitions to measure infertility may contribute to the conflicting associations reported in previous studies (Marchbanks *et al.*, 1989; Wellons *et al.*, 2008; Thoma *et al.*, 2013; Jacobson *et al.*, 2018; Shirazi and Rosinger, 2021). In addition, if there are racial and ethnic differences in other characteristics such as pregnancy intentions, education, or income (Pulley *et al.*, 2002; Maxson and Miranda, 2011; Luderer *et al.*, 2017; Holliday *et al.*, 2018), results could be challenging to compare across studies (Weinberg *et al.*, 1994). A measure of fecundity that is widely used by reproductive epidemiologists is fecundability, the per-cycle probability of conception in a given menstrual cycle among non-contracepting couples (Baird *et al.*, 1986). Fecundability is considered a more sensitive measure of fecundity (i.e. the biological capacity to reproduce) than the binary definition of infertility (<12 vs ≥12 months) (Baird *et al.*, 1986). Furthermore, prospective cohort studies can avoid non-differential (e.g. digit preference) and differential (e.g. recall bias) misclassification of TTP and, by not conditioning on pregnancy, include couples along the full fertility spectrum, thereby increasing the generalizability of results.

Preconception cohort studies have struggled to recruit and enroll diverse cohorts of participants (Buck Louis *et al.*, 2011; Schisterman *et al.*, 2013; Wise *et al.*, 2015; Porucznik *et al.*, 2016). In a prospective preconception cohort study of North American pregnancy planners, we provide descriptive data on differences in fecundability across racial and ethnic groups.

Materials and methods

Study population

Pregnancy Study Online (PRESTO) is an ongoing prospective preconception cohort study of couples residing in the USA and Canada. The study methodology has been described in detail elsewhere (Wise *et al.*, 2015). Initiated in June 2013, PRESTO recruits participants via advertising on social media and health-related websites. Individuals are eligible if they were assigned female at birth, are aged 21–45 years, not using contraception or fertility treatments, and not currently pregnant. Participants complete an online baseline questionnaire to provide detailed information on socio-demographics, anthropometrics, medical and reproductive history, and lifestyle and behavioral factors. Updated data on covariates and pregnancy status are obtained via online follow-up questionnaires every 2 months for up to 12 months or until reported pregnancy. The Boston University Medical Campus Institutional Review Board approved the study protocol and all participants provided informed consent.

Assessment of fecundability

We estimated fecundability via measurement of time-to-pregnancy (TTP), which was derived from baseline and follow-up questionnaires. At study enrollment (baseline), participants reported the date of their last menstrual period (LMP), cycle regularity, average menstrual cycle length, and the number of cycles that they had been trying to conceive. Participants with irregular cycles reported their typical number of periods per year. On each follow-up questionnaire, we asked about the most recent LMP date and whether participants had conceived or initiated fertility treatment since the completion of the previous questionnaire. We sought additional outcome information on participants who were lost to follow-up by emailing or telephoning them directly, searching for baby registries and birth announcements online, and/or linking to birth registry data from select states. We calculated total discrete menstrual cycles at risk of pregnancy as: cycles of attempt at study entry + [(LMP date from most recent follow-up questionnaire − date of baseline questionnaire completion)/usual cycle length] +1.

Assessment of race and ethnicity

Participants reported their race and ethnicity on the baseline questionnaire. The question was phrased as follows: ‘What is your race? (check all that apply).’ Response categories included: White; Black or African American; American Indian or Alaskan Native; Asian (please specify: Indian; Chinese; Japanese; Korean; Vietnamese; Filipino; Other: open-text box); Middle Eastern or North African; Native Hawaiian or Pacific Islander; Some other race (please specify); don’t know; and refused. Hispanic ethnicity was assessed via the question, ‘Are you from Hispanic origin or descent, such as Mexican, Puerto Rican, Cuban, or other Spanish background?’ Starting August 2021, all participants could provide additional information in an open text-box: ‘Please feel free to provide additional details about your race and ethnicity.’

We categorized race and ethnicity as follows: non-Hispanic White; non-Hispanic Black; non-Hispanic Asian; non-Hispanic American Indian, Alaskan Native, or Indigenous; non-Hispanic multiracial; non-Hispanic other race (including Middle Eastern or North African; Native Hawaiian or Pacific Islander; some other race; or unknown race); Hispanic White; Hispanic multiracial; and Hispanic other/unknown race (including Black; American Indian, Alaskan Native, or Indigenous; Asian; Native Hawaiian or Pacific Islander; some other race; or unknown race) (Office of Information and Regulatory Affairs, Office of Management and Budget, Executive Office of the President, 2024). Canadian participants who selected ‘some other race’ only and described themselves as ‘First Nation(s),’ ‘Metis,’ ‘Aboriginal,’ or ‘Indigenous’ were classified as ‘American Indian, Alaskan Native, or Indigenous.’ We used investigator-assigned race information for 4 participants (0.02%) based on external data (e.g. birth records, professional websites, or social media accounts). ‘Unknown’ race was reported by 17 (0.1%) of non-Hispanic participants and 272 (19.7%) of Hispanic participants.

Assessment of covariates

On the baseline questionnaire, participants reported information on their date of birth; residence at birth, age 15, and enrollment; height and weight; physical activity; parity; cigarette smoking; alcohol consumption; intercourse frequency; menstrual cycle regularity; history of infertility before enrollment (i.e. tried to conceive for >12 months without success); history of sexually transmitted infections (STI); ways in which they were doing something to improve their chances of conception (e.g. menstrual charting; use of ovulation tests; measurement of basal body temperature; monitoring of cervical mucus); last method of contraception used; sleep duration; employment status; hours worked per week; perceived stress (Perceived Stress Scale-10, PSS) (Cohen *et al.*, 1983); and depressive symptoms (Major Depression Inventory, MDI) (Bech, 1997). Participants also reported their total annual household income (in US dollars) before tax on the baseline questionnaire in several categories (<$15 000; $15 000–$24 999; $25 000–$49 999; $50 000–$74 999; $75 000–$99 999; $100 000–$124 999; $125 000–$149 999; $150 000–$199 999; and ≥$200 000) and the highest level of education completed by themselves, their partner, their mother, their father, or their primary caretaker (if applicable) in the following response categories: less than 12th grade; high school degree or equivalent; some college/vocational school; college degree (4 years); and graduate degree. Participants reported their dietary intake on food frequency questionnaires completed 10 days after baseline, from which we calculated the Healthy Eating Index (HEI) score (Kennedy *et al.*, 1995; Guenther *et al.*, 2013). We calculated body mass index (BMI) as weight in kilograms divided by height in meters squared.

Exclusions

Between June 2013 and November 2024, 21 134 participants completed the baseline questionnaire. In this analysis, we excluded participants whose LMP occurred >6 months before completing the baseline questionnaire or with an implausible LMP (n = 285); who did not experience menses during follow-up (n = 73); who completed their baseline questionnaire >60 days after their eligibility screener (n = 51); or had been trying to conceive for ≥12 menstrual cycles at study entry (n = 2225). The final analytic sample comprised 18 573 participants.

Data analysis

Participants contributed observed menstrual cycles to the analysis from study entry until pregnancy, initiation of fertility treatment, cessation of pregnancy attempts, loss-to-follow-up, or 12 menstrual cycles, whichever came first. We used proportional probabilities regression models to estimate fecundability ratios (FR) and 95% CIs for each racial and ethnic group relative to the reference group. The models were adjusted for observed cycles of attempt time, as indicator terms, to account for the declining fecundability of the analytic population over time (Weinberg *et al.*, 1989). The FR is the ratio of fecundability comparing exposed with unexposed participants; a FR < 1 corresponds to reduced fecundability among the exposed relative to the unexposed. We used the Andersen-Gill data structure (Therneau, 1997), with one observation per menstrual cycle, to update weights over time and to account for left truncation due to delayed entry into the risk set (Howards *et al.*, 2007; Schisterman *et al.*, 2013).

Guided by a review of the literature and a directed acyclic graph (Supplementary Figure S1) (Howe et al., 2022), we decided against controlling for variables that could be downstream effects of racism (e.g. educational attainment, household income, occupation, gynecologic conditions, age at trying to conceive). In sensitivity analyses, we stratified the analyses by pregnancy attempt time at study entry (<3, 3–6, 7–11 cycles) and restricted to nulligravid participants with no history of infertility to assess the extent to which selection bias may have influenced our results. Given the differences in racial and ethnic relations, social and political context, and health care systems across the USA and Canada, we also stratified analyses by country of residence. In addition, we stratified analyses by: (i) age at enrollment given its strong association with fertility, and (ii) educational attainment given its strong association with race and ethnicity. Finally, to increase comparability with previous studies, we calculated the cumulative incidence of infertility during 12 cycles of follow-up by race and ethnicity using life-table methods to account for censoring (Cox, 1972); these analyses were restricted by pregnancy attempt time at enrollment (<2 cycles and <3 cycles) to emulate the incident cohort study design (Eijkemans et al., 2019).

We used fully conditional specification methods to multiply impute missing covariate data. In addition, for the 3273 (17.6%) participants who did not complete any follow-up questionnaires, we assigned 1 cycle of follow-up and multiply-imputed their pregnancy status at the end of that cycle (pregnant vs not pregnant). We included 60 demographic, lifestyle, and reproductive variables in the imputation model to create 20 imputed datasets after which we combined the beta coefficients and standard errors across datasets. The percentage of missing covariate data by race and ethnicity is presented in Supplementary Table S1.

We examined the reason for censoring with respect to selected socio-demographic factors. Cohort retention varied by race and ethnicity (Supplementary Table S2). Loss-to-follow-up during 12 months was highest among non-Hispanic Black participants (44.4%), followed by non-Hispanic American Indian, Alaskan Native, or Indigenous participants (40.0%). In addition, loss-to-follow-up was higher among participants with lower educational attainment and income (data not shown). To account for differential loss-to-follow-up, we repeated our main analyses after applying inverse probability weights (Weuve et al., 2012; Howe et al., 2016; Howe and Robinson, 2018). We used two pooled logistic regression models, one with baseline and time-varying demographic, lifestyle, and reproductive history variables, and one with only baseline variables, to predict the probability of study continuation at each follow-up and to compute stabilized weights inversely proportional to the probability of continuation (Supplementary Table S3) (Howe et al., 2016). Participants with a low probability of continuation received larger weights to correct for differential attrition. We truncated the weights at the 99th percentile to reduce the effect of outliers and then applied the stabilized weights to the regression model for race and ethnicity (Supplementary Table S3). We conducted all analyses using SAS software (version 9.4, SAS Institute, Cary, NC, USA).

Results

Overall, 18 573 participants contributed 68 618 cycles and 9985 pregnancies during follow-up. The majority (81.6%) of participants self-identified as non-Hispanic White, 4.8% as Hispanic White, 3.9% as non-Hispanic multiracial, 3.5% as non-Hispanic Black, 2.7% as non-Hispanic Asian, 1.9% as Hispanic other/unknown race, and <1% as Hispanic multiracial, non-Hispanic other/unknown race, and non-Hispanic American Indian, Alaskan Native, or Indigenous. Overall, the median age of participants was 30 years (interquartile range: 28–33 years) and 43% of participants had ≥17 years of education (corresponding to a graduate degree), 5% had ≤12 years of education (high school degree or less) and 17% and 23% had annual household incomes of <\$50 000 and ≥\$150 000, respectively.

Non-Hispanic Black participants were more likely to have lower household incomes, lower educational attainment, shorter sleep durations, and longer pregnancy attempt times at enrollment, than other racial and ethnic groups (Table 1). Non-Hispanic Asian participants had lower BMI and were less likely to consume alcohol or smoke tobacco products than participants of other racial and ethnic groups. Non-Hispanic American Indian, Alaskan Native, or Indigenous and non-Hispanic Black participants reported greater gravidity and parity but were also more likely to report a history of infertility.

FRs with and without weighting to account for differential loss-to-follow-up are shown in Table 2. In unweighted analyses, compared with non-Hispanic White participants, fecundability was appreciably lower among participants who identified as non-Hispanic Black (FR = 0.60, 95% CI: 0.52–0.70); non-Hispanic American Indian, Alaskan Native, or Indigenous (FR = 0.70, 95% CI: 0.44–1.11); Hispanic other/unknown race (FR = 0.77, 95% CI: 0.65–0.90); and non-Hispanic multiracial (FR = 0.89, 95% CI: 0.81–0.99) (Table 2, Figure 1). We observed little difference in fecundability between participants who identified as non-Hispanic White; non-Hispanic Asian; non-Hispanic other/unknown race; Hispanic White; or Hispanic multiracial. In analyses that accounted for differential loss-to-follow-up using stabilized inverse probability weights, associations were not appreciably different from the unweighted analyses (Table 2). Curves depicting the cumulative probability of conception by race and ethnicity were consistent with FRs from the categorical analyses and did not show appreciable convergence or crossing over with increasing pregnancy attempt time (Figure 2).

Unweighted FRs were similar when restricted to participants with <3 cycles of pregnancy attempt time at study entry (Table 3), a subgroup in which selection bias is expected to be lower. In this subgroup (<3 cycles at entry), further restriction to nulligravid participants without a history of infertility showed similar associations to the main analysis (Supplementary Table S4). Results were relatively uniform across strata of educational attainment (Table 4). When we stratified by country of residence (Table 5), we observed reduced fecundability among participants who identified as non-Hispanic American Indian, Alaskan Native, or Indigenous or Hispanic other/unknown race across both the USA and Canada, consistent with the overall results. In contrast to the overall results, in Canada, there was no appreciable difference in fecundability between participants who identified as non-Hispanic Black and non-Hispanic White, though numbers were small and associations were imprecise. Results were similar across strata of age (Table 5). Further control for age at trying to conceive and gynecologic conditions associated with subfertility (diagnoses of uterine fibroids, endometriosis, and polycystic ovarian syndrome) also showed similar results to the main results (Supplementary Table S5). Finally, results based on the 12-cycle 'clinical definition' of infertility were similar to—albeit less precise than—the fecundability results, with non-Hispanic Black participants and Hispanic other/unknown race participants having approximately twice the risk of infertility as compared with non-Hispanic White participants (Table 6). These

Table 1. Baseline characteristics of 18 573 participants in Pregnancy Study Online by self-identified race and ethnicity, 2013–2024.

	Race and ethnicity								
	Non-Hispanic						Hispanic		
	White	Black	Asian	American Indian, Alaskan Native, Indigenous	Multiracial	Other or unknown race[a]	White	Multiracial	Other or unknown race[b]
Number of participants, N (%)	15 162 (81.6)	640 (3.4)	506 (2.7)	50 (0.3)	730 (3.9)	105 (0.6)	886 (4.8)	136 (0.7)	358 (1.9)
Age (years), mean	30.3	32.0	32.0	30.2	30.3	31.3	30.4	31.1	30.2
Partner age (years), mean	32.2	34.5	33.7	30.9	31.9	33.4	32.5	33.2	32.2
Married to partner, %	89.0	61.4	94.1	74.0	81.1	88.6	85.3	83.8	82.4
Educational attainment (years), %									
≤12	4.4	15.6	0.8	22.0	5.8	4.8	5.0	5.9	8.9
13–15	18.0	34.7	4.2	28.0	26.0	9.5	22.0	23.5	29.6
16	33.8	22.5	30.4	28.0	31.5	26.7	33.0	27.2	27.9
≥17	43.8	27.2	64.6	22.0	36.7	59.1	40.1	43.4	33.5
Partner educational attainment (years), %									
≤12	12.9	34.2	4.7	39.1	18.7	14.7	15.1	13.7	23.3
13–15	26.6	28.6	10.0	23.9	27.0	21.6	28.5	29.8	30.4
16	36.3	23.2	33.5	19.6	31.9	31.4	31.7	29.0	27.1
≥17	24.2	14.0	51.8	17.4	22.4	32.4	24.7	27.5	19.2
Mother ≥17 years education, %	18.8	15.6	23.1	8.7	15.7	20.6	13.7	16.0	11.3
Father ≥17 years education, %	21.7	14.5	37.8	5.0	19.9	28.1	16.7	20.0	16.3
Household income (US dollars), %									
<$50 000	14.8	42.4	8.8	50.0	20.3	17.5	21.4	15.6	28.9
$50 000–$99 999	33.1	31.7	18.5	31.3	35.7	28.9	31.5	37.0	36.0
$100 000–$149 999	27.8	14.0	21.3	12.5	22.4	18.6	25.1	27.4	19.9
≥$150 000	24.4	11.9	51.5	6.3	21.6	35.1	21.9	20.0	15.2
BMI (kg/m^2), mean	27.7	32.3	24.6	30.1	28.3	27.7	28.5	29.0	29.6
Physical activity (MET-hours/week), mean	34.6	30.8	32.0	40.3	34.9	34.7	33.9	32.9	32.9
Smoking history, %									
Ever smoker	19.1	18.7	7.7	30.6	22.7	19.1	18.8	20.7	16.5
Current smoker	5.1	8.8	1.2	10.0	5.9	4.8	3.6	6.6	3.9
Alcohol intake (drinks/week), mean	3.0	2.6	1.7	3.1	2.7	2.0	2.8	2.4	2.4
Attempt time at study entry (cycles), mean	2.6	3.9	2.6	3.6	2.9	2.9	2.9	2.7	3.1
Doing something to improve chances of conception, %	81.0	67.4	78.1	68.0	78.9	81.9	78.1	74.3	73.7
Intercourse frequency									
<1 time/week, %	22.2	23.2	33.6	22.0	21.1	27.6	24.0	29.4	23.5
≥4 times/week, %	14.0	25.4	9.9	30.0	17.8	13.3	16.8	17.7	16.2
History of infertility, %	8.7	24.3	6.9	22.0	12.6	11.4	12.0	13.2	17.0
History of STI, %	23.7	43.8	15.2	28.0	31.4	23.8	27.0	39.0	32.1
Gravid, %	49.4	65.4	39.7	72.0	54.7	47.6	56.1	64.0	57.6
Parous, %	31.8	44.7	19.8	52.0	33.0	28.6	33.9	34.6	30.3
Last contraceptive method: hormonal, %	35.1	29.5	30.2	38.0	33.3	27.6	33.4	38.2	35.8
PSS-10 score, mean	16.1	16.8	16.5	18.9	16.9	17.2	16.2	17.0	17.6
MDI severity score, mean	10.9	12.8	10.8	16.9	12.8	12.8	11.3	13.5	14.2
HEI score, mean	65.9	63.1	68.6	62.8	64.9	66.0	65.0	63.6	66.6
Currently employed, %	87.8	80.3	85.9	69.4	83.5	84.3	85.0	86.7	81.3
Job hours/week (if employed), mean	38.7	39.0	39.9	37.9	38.7	39.0	38.0	35.8	37.2
Sleep duration: <7 hours/day, %	21.6	46.7	22.7	38.0	28.1	21.2	26.0	30.4	33.1

BMI = body mass index, HEI = Healthy Eating Index, MDI = Major Depression Inventory, MET = metabolic equivalent, PSS = Perceived Stress Scale, STI = sexually transmitted infection.

[a] 'Non-Hispanic other or unknown race' includes Middle Eastern or North African, Native Hawaiian or Pacific Islander and those with unknown race.

[b] 'Hispanic other or unknown race' includes Black; American Indian, Alaskan Native, or Indigenous; Asian; Middle Eastern or North African; Native Hawaiian or Pacific Islander; and those with unknown race.

results did not depend on our choice of restriction cut point for pregnancy attempt time at enrollment (<2 vs <3 cycles).

Discussion

In this prospective cohort study of North American pregnancy planners aged 21–45 years (median age = 30), we observed racial and ethnic disparities in fecundability. Specifically, non-Hispanic Black; non-Hispanic American Indian, Alaskan Native, or Indigenous; Hispanic other/unknown race; or non-Hispanic multiracial participants had appreciably lower fecundability than non-Hispanic White participants. Results were similar in analyses restricted to participants with shorter pregnancy attempt times at study entry and those without an infertility history, and with further control for age at trying to conceive and diagnoses of gynecologic conditions. Results were also generally uniform

Table 2. Associations of race and ethnicity with fecundability, PRESTO, 2013–2024.

	Pregnancies	Cycles	Unweighted FR (95% CI)	Weighted FR (95% CI)[a]
Non-Hispanic				
White	8505	56 736	Reference	Reference
Black	181	2156	0.60 (0.52–0.70)	0.56 (0.47–0.67)
Asian	233	1687	0.92 (0.81–1.05)	0.96 (0.84–1.10)
American Indian, Alaskan Native, or Indigenous	18	191	0.70 (0.44–1.11)	0.66 (0.38–1.16)
Multiracial	346	2661	0.89 (0.81–0.99)	0.90 (0.81–1.00)
Other or unknown race[b]	51	345	1.01 (0.79–1.31)	1.01 (0.77–1.32)
Hispanic				
White	438	3078	0.95 (0.86–1.04)	0.97 (0.89–1.07)
Multiracial	70	467	1.00 (0.80–1.24)	1.01 (0.81–1.27)
Other or unknown race[c]	143	1297	0.77 (0.65–0.90)	0.73 (0.60–0.88)

CI = confidence interval, FR = fecundability ratio, PRESTO = Pregnancy Study Online.

[a] Stabilized inverse probability of continuation weights with baseline and time-varying predictors were used to correct for differential attrition by racial and ethnic group.

[b] 'Non-Hispanic other or unknown race' includes Middle Eastern or North African, Native Hawaiian or Pacific Islander and those with unknown race.

[c] 'Hispanic other or unknown race' includes Black; American Indian, Alaskan Native, or Indigenous; Asian; Native Hawaiian or Pacific Islander; Middle Eastern or North African; and those with unknown race.

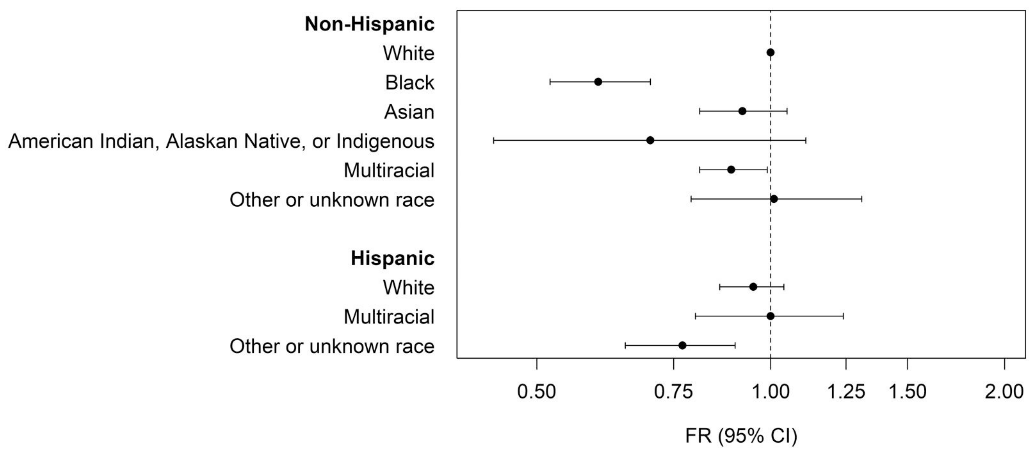

Figure 1. **Associations of race and ethnicity with fecundability, PRESTO, 2013–2024.** FR = fecundability ratio (unweighted), CI = confidence interval, PRESTO = Pregnancy Study Online. 'Non-Hispanic other or unknown race' includes Middle Eastern or North African, Native Hawaiian or Pacific Islander, and those with unknown race. 'Hispanic other or unknown race' includes Black; American Indian, Alaskan Native, or Indigenous; Asian; Middle Eastern or North African, Native Hawaiian or Pacific Islander, and those with unknown race.

across strata of age at enrollment and educational attainment. While some associations were consistent across country of residence (i.e. reduced fecundability among non-Hispanic American Indian, Alaskan Native, or Indigenous or Hispanic other/unknown race participants), it was difficult to make inferences about cross-national differences because the number of Canadian participants was small.

Comparisons with previous studies are challenging given differences in: (i) study design; (ii) study populations in terms of pregnancy planning, age, and socio-demographics; (iii) definitions of race and ethnicity; (iv) fertility outcome measures (e.g. 12-month clinical definition of infertility, fecundability), and (v) control for covariates. We used a larger number of categories to classify race and ethnicity and, unlike most studies, we did not control for adult SES measures (e.g. education, income, occupation, marital status) out of concern for overcontrol (Howe *et al.*, 2022). We recognize that race and SES are two dimensions of social stratification that relate to each other in complex ways and that for most health outcomes, disparities by SES (education or income) among Black and White populations are larger than Black-White disparities (Williams *et al.*, 2010; Williams and Mohammed, 2013). At the same time, race still matters at every level of SES (Williams *et al.*, 2010; Williams and Mohammed, 2013). In the present analysis, when we stratified by education, associations of race and ethnicity with fecundability were generally similar across education strata. Thus, it is unlikely that control for SES measures was an important reason for differences across studies. While our findings for race and ethnicity are inconsistent with two studies based on nationally-representative data—an analysis using the current-duration approach to define infertility in the NSFG (Thoma *et al.*, 2013) and NHANES data (12-month infertility definition) (Shirazi and Rosinger, 2021)—they are generally consistent with other publications based on NSFG data that rely on the 12-month infertility definition (Chandra *et al.*, 2013; Snow *et al.*, 2022), including their most recent publication (Snow *et al.*, 2022), indicating that non-Hispanic Black participants had 1.6 times the prevalence of infertility as non-Hispanic White participants. Our findings comparing non-Hispanic Black vs White participants are also consistent with findings from CARDIA (Hispanic participants comprised <0.03% of CARDIA and were excluded from analyses) (Wellons *et al.*, 2008). In the NSFG, Hispanic participants also had a higher prevalence of infertility than non-Hispanic White participants, consistent with our study for participants who identified as 'Hispanic other race' but not 'Hispanic White' or 'Hispanic multiracial' (Snow *et al.*, 2022). To our knowledge, no studies have compared racial or ethnic

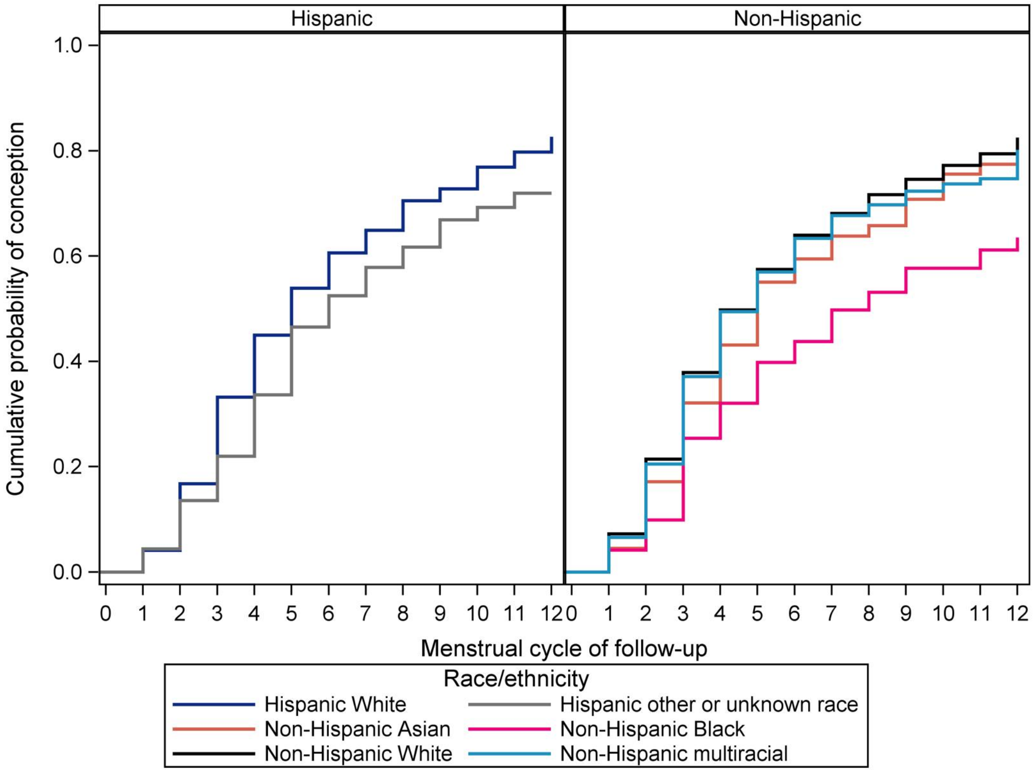

Figure 2. Cumulative probability of conception by race and ethnicity, PRESTO, 2013–2024. Restricted to 11 283 participants with <3 cycles of pregnancy attempt time at cohort entry. PRESTO = Pregnancy Study Online. Omits racial/ethnic groups with <150 participants (non-Hispanic American Indian, Alaskan Native, or Indigenous; non-Hispanic other/unknown race; Hispanic multiracial). 'Hispanic other or unknown race' includes Black; American Indian, Alaskan Native, or Indigenous; Asian; Middle Eastern or North African, Native Hawaiian or Pacific Islander, some other race, or unknown race.

Table 3. Associations of race and ethnicity with fecundability, stratified by attempt time at study entry, PRESTO, 2013–2024.

	Pregnancy attempt time at study entry								
	<3 cycles (N = 11 283 participants)			3–6 cycles (N = 5486 participants)			7–11 cycles (N = 1804 participants)		
	Pregnancies	Cycles	Unweighted FR (95% CI)	Pregnancies	Cycles	Unweighted FR (95% CI)	Pregnancies	Cycles	Unweighted FR (95% CI)
Non-Hispanic									
White	6220	37 012	Reference	2,011	16 479	Reference	274	3245	Reference
Black	110	1089	0.62 (0.52–0.75)	57	822	0.56 (0.43–0.74)	14	245	0.62 (0.35–1.11)
Asian	170	1123	0.92 (0.79–1.06)	55	449	0.95 (0.73–1.25)	8	115	0.82 (0.41–1.65)
American Indian, Alaskan Native, or Indigenous	13	91	0.79 (0.46–1.37)	5	77	0.64 (0.27–1.50)	0	23	—
Multiracial	254	1583	0.95 (0.85–1.07)	78	870	0.74 (0.59–0.93)	14	208	0.81 (0.46–1.42)
Other or unknown race[a]	37	232	0.98 (0.73–1.31)	12	85	1.26 (0.75–2.14)	2	28	0.52 (0.08–3.43)
Hispanic									
White	301	1928	0.93 (0.83–1.03)	120	954	1.00 (0.83–1.20)	17	196	1.01 (0.62–1.65)
Multiracial	53	306	1.02 (0.80–1.30)	14	129	0.94 (0.58–1.54)	3	32	0.89 (0.24–3.37)
Other or unknown race[b]	92	754	0.76 (0.63–0.92)	47	452	0.83 (0.62–1.11)	4	91	0.50 (0.17–1.49)

CI = confidence interval, FR = fecundability ratio, PRESTO = Pregnancy Study Online.
[a] 'Non-Hispanic other or unknown race' includes Middle Eastern or North African, Native Hawaiian or Pacific Islander and those with unknown race.
[b] 'Hispanic other or unknown race' includes Black; American Indian, Alaskan Native, or Indigenous; Asian; Native Hawaiian or Pacific Islander; Middle Eastern or North African and those with unknown race.

disparities in fertility in the USA vs Canada using the same outcome measures.

We considered and attempted to mitigate multiple sources of selection bias in our analyses. Longer pregnancy attempt times at enrollment on average among participants who identified as non-Hispanic Black or non-Hispanic American Indian, Native Alaskan, or Indigenous could have introduced selection bias if participation by subfertile participants varied by race and

Table 4. Associations of race and ethnicity with fecundability stratified by educational attainment at study entry, PRESTO, 2013–2024.

	Educational attainment								
	<16 years (N = 4430 participants)			16 years (N = 6127 participants)			≥17 years (N = 8016 participants)		
	Pregnancies	Cycles	Unweighted FR (95% CI)	Pregnancies	Cycles	Unweighted FR (95% CI)	Pregnancies	Cycles	Unweighted FR (95% CI)
Non-Hispanic									
White	1397	12 262	Reference	2908	19 749	Reference	4200	24 725	Reference
Black	64	958	0.61 (0.47–0.79)	49	578	0.60 (0.45–0.79)	68	620	0.70 (0.56–0.89)
Asian	13	88	1.09 (0.61–1.94)	68	471	1.01 (0.81–1.26)	152	1128	0.82 (0.70–0.95)
American Indian, Alaskan Native, Indigenous	6	75	0.88 (0.42–1.83)	7	74	0.67 (0.31–1.44)	5	42	0.67 (0.27–1.67)
Multiracial	77	842	0.84 (0.67–1.05)	112	838	0.90 (0.75–1.08)	157	981	0.97 (0.83–1.12)
Other or unknown race[a]	4	39	0.93 (0.37–2.33)	13	88	0.92 (0.55–1.53)	34	218	1.00 (0.74–1.37)
Hispanic									
White	93	757	1.05 (0.86–1.29)	146	1038	0.98 (0.84–1.14)	199	1283	0.90 (0.78–1.02)
Multiracial	13	118	0.93 (0.54–1.59)	25	131	1.27 (0.89–1.81)	32	218	0.88 (0.64–1.22)
Other or unknown race[b]	45	514	0.68 (0.50–0.92)	41	341	0.94 (0.70–1.26)	57	442	0.82 (0.64–1.05)

CI = confidence interval, FR = fecundability ratio, PRESTO = Pregnancy Study Online.
[a] 'Non-Hispanic other or unknown race' includes Middle Eastern or North African, Native Hawaiian or Pacific Islander and those with unknown race.
[b] 'Hispanic other or unknown race' includes Black; American Indian, Alaskan Native, or Indigenous; Asian; Native Hawaiian or Pacific Islander; Middle Eastern or North African and those with unknown race.

Table 5. Associations of race and ethnicity with fecundability, stratified by country of residence and age at enrollment, PRESTO, 2013–2024.

	Country of residence						Age at enrollment					
	United States (N = 15 875 participants)			Canada (N = 2698 participants)			<30 years (N = 7913 participants)			≥30 years (N = 10 660 participants)		
	Pregs	Cycles	Unweighted FR (95% CI)	Pregs	Cycles	Unweighted FR (95% CI)	Pregs	Cycles	Unweighted FR (95% CI)	Pregs	Cycles	Unweighted FR (95% CI)
Non-Hispanic												
White	7169	48 081	Reference	1336	8655	Reference	3717	24 056	Reference	4788	32 680	Reference
Black	165	2062	0.58 (0.49–0.67)	16	94	1.19 (0.76–1.86)	74	726	0.70 (0.55–0.88)	107	1430	0.56 (0.46–0.68)
Asian	191	1462	0.88 (0.77–1.01)	42	225	1.15 (0.87–1.51)	52	412	0.82 (0.63–1.07)	181	1275	0.97 (0.84–1.11)
American Indian, Alaskan Native, Indigenous	10	110	0.69 (0.38–1.27)	8	81	0.68 (0.34–1.38)	9	78	0.77 (0.40–1.46)	9	113	0.64 (0.33–1.24)
Multiracial	289	2306	0.86 (0.77–0.97)	57	355	1.05 (0.82–1.35)	158	1120	0.92 (0.79–1.07)	188	1541	0.87 (0.76–1.00)
Other or unknown race[a]	42	269	1.07 (0.81–1.42)	9	76	0.79 (0.41–1.50)	16	105	0.93 (0.58–1.47)	35	240	1.06 (0.78–1.44)
Hispanic												
White	425	2978	0.95 (0.87–1.05)	13	100	0.83 (0.49–1.40)	181	1302	0.91 (0.79–1.04)	257	1776	0.98 (0.87–1.10)
Multiracial	65	442	0.99 (0.79–1.23)	5	25	1.27 (0.59–2.75)	22	175	0.85 (0.58–1.26)	48	292	1.09 (0.84–1.42)
Other or unknown race[b]	126	1153	0.77 (0.65–0.92)	17	144	0.75 (0.47–1.19)	67	626	0.75 (0.59–0.95)	76	671	0.78 (0.63–0.98)

CI = confidence interval, FR = fecundability ratio, pregs = pregnancies, PRESTO = Pregnancy Study Online.
[a] 'Non-Hispanic other or unknown race' includes Middle Eastern or North African, Native Hawaiian or Pacific Islander and those with unknown race.
[b] 'Hispanic other or unknown race' includes Black; Asian; American Indian, Alaskan Native, or Indigenous; Middle Eastern or North African; Native Hawaiian or Pacific Islander; and those with unknown race.

ethnicity. However, restriction of the analytic cohort to participants who reported trying for <3 cycles at enrollment yielded nearly identical results to the overall results.

PRESTO does not have any eligibility restrictions pertaining to pregnancy attempt time at enrollment (i.e. all participants are eligible to enroll regardless of their response to the question: 'how long have you been trying to conceive?') and there was no obvious incentive or motivation for participants to underestimate their pregnancy attempt time at enrollment. However, what it means to be 'planning a pregnancy' or 'trying to conceive' may differ by key socio-demographic factors, such as race, ethnicity, and religion (Lifflander et al., 2007; Luderer et al., 2017; Galic et al., 2021). For example, Black Americans are more likely than White Americans to endorse the statement that 'the ability to bear children rests upon God's will' (Galic et al., 2021). Religious individuals are also more likely to endorse this statement (Galic et al., 2021). Selection bias could be introduced if: (i) non-planners of pregnancy are less likely to include all at-risk time in their reported pregnancy attempt time at enrollment, and (ii) non-planners are more likely to enroll in PRESTO after they have already started experiencing infertility problems. If this phenomenon happens more frequently among non-Hispanic Black

Table 6. Cumulative incidence of infertility during 12 cycles after accounting for censoring, by race and ethnicity.

	<2 cycles of pregnancy attempt time at cohort entry (N = 8376 participants) % Infertility during 12 cycles (95% CI)	<3 cycles of pregnancy attempt time at cohort entry (N = 11 283 participants) % Infertility during 12 cycles (95% CI)
Non-Hispanic		
White	16.36 (15.74, 16.98)	17.48 (16.93, 18.03)
Black	33.17 (27.98, 38.36)	36.48 (31.95, 41.01)
Asian	15.10 (11.14, 19.06)	18.81 (15.13, 22.49)
American Indian, Alaskan Native, or Indigenous	9.86 (0.61, 19.11)	15.88 (5.77, 25.99)
Multiracial	18.07 (14.72, 21.42)	19.80 (16.95, 22.65)
Other race[a]	14.12 (7.11, 21.13)	17.74 (11.13, 24.35)
Hispanic		
White	12.18 (9.40, 14.96)	17.34 (14.79, 19.89)
Multiracial	17.59 (11.33, 23.85)	16.31 (10.93, 21.69)
Other race[b]	29.75 (24.62, 34.88)	28.07 (23.69, 32.45)

CI = confidence interval.
[a] 'Non-Hispanic other or unknown race' includes Middle Eastern or North African, Native Hawaiian or Pacific Islander and those with unknown race.
[b] 'Hispanic other or unknown race' includes Black; American Indian, Alaskan Native, or Indigenous; Asian; Middle Eastern or North African, Native Hawaiian or Pacific Islander, and those with unknown race.

participants or Hispanic participants because they are less likely to be planning their pregnancies (Kim *et al.*, 2016; Finer *et al.*, 2018; Rossen *et al.*, 2023), the overrepresentation of less fecund participants in these subgroups could have created the false appearance of disparities in fecundability. Stated differently, systematic underestimation of reported (vs actual) pregnancy attempt time at enrollment in PRESTO by selected racial/ethnic groups could have produced spurious associations.

Selection bias due to differential loss-to-follow-up was also a possible threat to internal validity. We observed that loss to follow-up was higher among participants who self-identified as non-Hispanic Black and non-Hispanic American Indian, Alaskan Native, or Indigenous, as well as participants with lower income and educational attainment. If participants who were lost-to-follow-up were less likely to conceive during the study period, this could have resulted in an upward bias (i.e. underestimating the extent of racial/ethnic disparities). Conversely, participants who conceived quickly may have elected to discontinue participating in the study, which could have resulted in a downward bias. Nevertheless, when we accounted for differential loss-to-follow-up using inverse probability of continuation weighting by a wide range of socio-demographic factors, lifestyle, and reproductive history, and medical history variables, we found minimal evidence of selection bias. To reduce potential for bias due to missing data, we multiply-imputed covariate data and pregnancy status for participants lost-to-follow-up.

Small numbers of racial and ethnic minorities in our cohort reduced precision and introduced potential for misclassification. We grouped participants into broad racial and ethnic groups within which there is considerable heterogeneity, possibly obscuring differences in fecundability that exist between subgroups. While we acknowledge that additional dimensions of race and ethnicity (e.g. socially-assigned) could have been examined in this study (Cobb *et al.*, 2016; Roth, 2016), we did not collect data on these additional measures. Nevertheless, self-identified race and ethnicity are still considered highly accurate measures of the lived experience (Roth, 2016). Due to the prospective study design, any misclassification of reported self-identified race and ethnicity is unlikely to be related to fecundability. Differential misclassification of fecundability is possible because the calculation of conception cycle was dependent on self-reported LMP and average cycle length. If accurate reporting of LMP and cycle length differed by race and ethnicity, the resulting bias would be in an unpredictable direction.

PRESTO is an internet-based convenience sample of pregnancy planners and is not representative of all individuals who conceive. Given that about 50% of pregnancies in the USA are unintended (Finer *et al.*, 2018; Rossen *et al.*, 2023), our results may have been susceptible to selection bias if pregnancy planning is associated with both race/ethnicity and fecundability. Moreover, our cohort overrepresents high-SES individuals relative to the general population (Guzman and Kollar, 2023; United States Census Bureau, 2025). Though participation in our study differs by race and ethnicity, socio-demographic factors, lifestyle, and reproductive characteristics (Wise *et al.*, 2015), measures of association are not necessarily biased due to self-selection (Nohr *et al.*, 2006; Nilsen *et al.*, 2009; Hatch *et al.*, 2016). Given that PRESTO participants were recruited before conception, our study population includes couples along the full spectrum of fertility, including those who conceive quickly and those who take much longer (≥12 cycles) to conceive. Finally, our study was geographically diverse, encompassing participants from all US states and Canadian provinces.

The mechanisms underlying racial and ethnic disparities in fecundability are likely multifactorial, comprising a combination of structural and systemic factors (e.g. neighborhood segregation, reduced access to societal resources, residence in food deserts, health care discrimination) and lived experience (e.g. interpersonal discrimination, social capital) which may contribute to greater exposure to a broad array of factors that adversely affect fecundity, such as long working hours, stress, sleep deprivation, weight gain, food insecurity or malnutrition, tobacco use, and use of long-acting hormonal contraceptives (e.g. depot medroxyprogesterone acetate). Exposure to adverse economic and social factors may also cause delays in pregnancy planning, leading individuals to attempt pregnancy at older ages. Indeed, several studies have documented the detrimental effects of structural racism and discrimination on reproductive and perinatal health (Chambers *et al.*, 2020, 2021; Krieger *et al.*, 2020; Alson *et al.*, 2021).

Fecundability is considered a more sensitive measure of fecundity than the binary clinical definition of infertility (≥12 vs <12 cycles). Documenting racial and ethnic disparities in fecundability is essential because it shows evidence that is consistent with widespread systemic racism and reproductive injustice, and points to a need for more research on the mechanisms driving these associations. As more research is conducted on the ultimate drivers of these health disparities (Bailey *et al.*, 2017; Groos *et al.*, 2018; Adkins-Jackson *et al.*, 2022), greater efforts should be made to increase fertility awareness (Stanford *et al.*, 2019), enhance preconception health (Harper *et al.*, 2023), expand access to fertility treatments (Galic *et al.*, 2021), and improve patient care among underserved populations to reduce the burden of subfertility among those affected.

In summary, we found strong evidence of racial and ethnic differences in fecundability in a North American preconception cohort study. These descriptive data indicate the need for additional studies to investigate the mechanisms underlying these disparities in fecundity, including the effects of structural racism and discrimination, as well as programs and policies to advance reproductive health equity.

Supplementary data

Supplementary data are available at *Human Reproduction* online.

Data availability

The data analyzed this article cannot be shared publicly because the participants did not provide informed consent to share these data.

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Authors' roles

L.A.W. obtained grant support for the present study and oversaw primary data collection. M.N.H. and N.L.S. performed the statistical analyses. R.J.G. performed code review. L.A.W. took the lead on drafting the manuscript. All authors contributed to the interpretation of the data, reviewed the manuscript for intellectual content, and approved the final version.

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Conflict of interest

In the past 3 years, L.A.W. served as a consultant for AbbVie, Inc. and the Gates Foundation. She was also a member of the steering committee for AbbVie on Abnormal Uterine Bleeding and Fibroids, where payments were made to Dr Wise. Her study, PRESTO, received in-kind donations from Kindara.com (fertility apps) and Swiss Precision Diagnostics (home pregnancy tests). C. N. received payments to her institution from the National Institute on Minority Health and Health Disparities K01-MD013911. The other authors have no competing interests to declare.

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