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Association of income and education with fecundability in a North American preconception cohort

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Abstract

Purpose—To evaluate socioeconomic determinants of fecundability.

Methods—Among 8,654 female pregnancy planners from Pregnancy Study Online, a North American prospective cohort study (2013–2019), we examined associations between socioeconomic status and fecundability (the per-cycle probability of conception). Information on income and education was collected via baseline questionnaire. Bimonthly follow-up questionnaires were used to ascertain pregnancy status. We estimated fecundability ratios (FRs) and 95% confidence intervals (CI) using proportional probabilities regression, controlling for potential confounders.

Results—Relative to an annual household income of \$150,000, adjusted FRs were 0.91 (95% CI: 0.83–1.01) for <\$50,000, 0.99 (95% CI: 0.92–1.07) for \$50,000–\$99,000, and 1.09 (95% CI: 1.01–1.18) for \$100,000–\$149,000. FRs for <12, 13–15, and 16 years of education, relative to 17 years, were 0.90 (95% CI: 0.76–1.08), 0.84 (95% CI: 0.78–0.91), and 0.89 (95% CI: 0.84–0.95), respectively. Slightly stronger associations for income and education were seen among older women.

Conclusions—Lower levels of education and income were associated with modestly reduced fecundability. These results demonstrate the presence of socioeconomic disparities in fecundability.

Keywords

fecundability; time-to-pregnancy; income; education; socioeconomic status; social determinants of health

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Background

In the United States (US), and to a lesser extent in Canada, there are well-documented socioeconomic disparities in cardiovascular disease, cancer, and all-cause mortality.^{1–5} Though socioeconomic status (SES) is widely considered a fundamental determinant of health,⁶ few studies, have investigated SES disparities in fecundity, the biological capacity to reproduce.^{7, 8} One measure of fecundity, infertility, is defined as the inability to conceive after 12 months of unprotected intercourse. Infertility affects 10–15% of couples in the US and Canada,^{9, 10} can cause psychological and financial hardship,¹¹ and is associated with \$5 billion in annual health care costs.¹² In contrast, high fecundity may be associated with unplanned or mistimed pregnancies, which may adversely affect several maternal and child health outcomes.^{13–18}

There has been limited and conflicting research on the extent to which measures of SES, such as educational attainment or income,¹⁹ influence fecundity-related outcomes. In the 2006–2010 National Survey of Family Growth (NSFG), a nationally-representative study of married or cohabitating women aged 15–44 years, women with lower educational attainment had a higher prevalence of infertility and impaired fecundity (defined as difficulty becoming pregnant and carrying a fetus to term), and longer median time-to-pregnancy (TTP). On the other hand, lower income was associated with improved fecundity and shorter median TTP).¹⁰ In the nationally-representative Coronary Artery Risk Development in Young Adults (CARDIA) study, women with less education were more likely to report infertility, and difficulty paying for basic necessities was associated with infertility among Black but not White women.²⁰ In a study of infertility patients, education was positively associated with seeking medical evaluation for infertility, but income was not.²¹

The use of varied definitions to measure infertility could explain the conflicting associations reported in previous studies,^{7, 8} especially if pregnancy planning differs by socio-demographic characteristics.^{22–25} Moreover, unmeasured behavioral and lifestyle patterns could confound or mediate comparisons of infertility rates across SES groups.^{26, 27} Additionally, infertility rates are limited to women who have been attempting pregnancy for 12 months. An improved measure of fecundity is fecundability, the per-cycle probability of conception in a given menstrual cycle.

In a prospective cohort study of North American pregnancy planners, we examined differences in fecundability according to socioeconomic status, as measured by annual household income and educational attainment.

Methods

Study population

Pregnancy Study Online (PRESTO) is an ongoing prospective preconception cohort study of female pregnancy planners and their male partners in the US and Canada. The study methodology has been described in detail elsewhere.²⁸ Initiated in June 2013, PRESTO recruits participants via advertising on social media and health-related websites. Eligible women are aged 21–45 years, not using contraception or fertility treatments, in a stable

relationship with a male partner, and not currently pregnant. The Boston University Medical Campus Institutional Review Board approved the study protocol and all participants provided informed consent.

Study procedures

Participants completed an online baseline questionnaire to provide detailed information on demographics, including nationality, anthropometrics, medical and reproductive history, and lifestyle and behavioral habits. Updated exposure information and pregnancy status were obtained by online follow-up questionnaires every 2 months for up to 12 months or until reported pregnancy. Over 80% of participants completed at least one follow-up questionnaire.²⁸

Assessment of socioeconomic status

We operationalized socioeconomic status using measures of annual household income and educational attainment.¹⁹ On the baseline questionnaire, women reported their total annual household income (in US dollars) before tax 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. Annual household income was then collapsed into four categories for the analyses: <\$50,000; \$50,000-\$99,999; \$100,000-\$149,000, and \$150,000.

Women reported their highest level of completed education on the baseline questionnaire. Responses were then collapsed into the following categories: less than 12th grade or high school degree or equivalent (< 12 years); some college/vocational school (13–15 years); four-year college degree (16 years); and graduate degree (> 17 years).

Assessment of fecundability

We estimated fecundability, the average per-cycle probability of conception, via direct measurement of TTP. TTP was derived from baseline and follow-up questionnaires. At baseline, women reported the date of their last menstrual period (LMP), cycle regularity, average menstrual cycle length, and the number of cycles they had been trying to conceive at study entry. Women with irregular cycles reported their typical number of periods per year. On each follow-up questionnaire, we asked about most recent LMP date and whether they had conceived or initiated fertility treatment since the completion of the previous questionnaire. We attempted to identify outcome information on women lost to follow-up by contacting 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 using the following equation: 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 covariates

On the baseline questionnaire, women reported data on current age; height and weight; race/ethnicity (non-Hispanic Black, non-Hispanic White, non-Hispanic Asian, Hispanic/Latina, or mixed/other race); vigorous physical activity (average hours per week spent biking,

jogging, swimming, racquetball, aerobic activities, or weight training/resistance exercising); parity; cigarette smoking; alcohol consumption; intercourse frequency; menstrual cycle regularity; history of infertility; history of sexually transmitted infections (ever diagnosed with pelvic inflammatory disease, chlamydia, genital warts, herpes, or bacterial vaginosis); whether they were doing something to improve their chances of contraception (*e.g.*, menstrual charting, use of ovulation tests); last method of contraception used; educational attainment of their mother, father, primary caregiver (if not mother or father), and their male partner; marital status (currently married vs. not); sleep duration; employment status and hours worked per week; perceived stress (Perceived Stress Scale-10, PSS);²⁹ and depressive symptoms (Major Depression Inventory, MDI).³⁰ We ascertained dietary intake on food frequency questionnaires completed ten days after baseline, from which we calculated the Healthy Eating Index (HEI) score.^{31, 32} Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared.

Exclusions

Between July 2013 and August 2019, 10,988 women completed the baseline questionnaire. We excluded women from this analysis whose LMP occurred more than 6 months before completing the baseline questionnaire or with an implausible LMP ($n=129$); who did not experience menses during follow-up ($n=24$); or had been trying to conceive for more than 6 menstrual cycles at study entry ($n=2,181$), to reduce potential for selection bias.

Data analysis

We calculated the proportion of women who conceived over follow-up using life table methods to account for censoring.³³ Women contributed observed menstrual cycles to the analysis from study entry until pregnancy, fertility treatment, cessation of pregnancy attempt, loss to follow-up, or 12 cycles, whichever came first. We used proportional probabilities regression models to estimate fecundability ratios (FR) and 95% confidence intervals (CI) for each exposure category relative to the reference category. The FR is the ratio of fecundability comparing exposed with unexposed women; an $FR < 1$ corresponds to reduced fecundability among the exposed relative to the unexposed. We used the Anderson-Gill data structure³⁴ with one observation per menstrual cycle, to update covariates over time and to account for left truncation due to delayed entry into the risk set.^{35, 36}

We selected potential confounders *a priori* from the literature and construction of directed acyclic graphs. Models were adjusted for age (years), male partner educational attainment (12, 13–15, 16, 17 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian, and mixed/other race), and mutually-adjusted for the other exposure variable (*e.g.*, education analyses were adjusted for income).

In additional models, we estimated the direct effect of income and education on fecundability that does not operate through other behavioral and health variables that are mediators of the association between exposure and outcome. These models were adjusted for the variables included in Model 1 and marital status (currently married vs. no), BMI (kg/m^2), smoking (never, past, and current smoking), vigorous physical activity (0, <1, 1–2, 3–4, 5 hours per week), last method of contraception (hormonal contraception yes versus

no), menstrual cycle length (<22, 22–35, 36 days), intercourse frequency (<1, 1, 2–3, 4 times per week), PSS-10 score (<10, 10–19, 20–29, 30), doing something to improve chances of contraception (yes versus no),²⁹ history of sexually transmitted infections (STIs) (yes versus no), depressive symptoms (MDI score: none/low [²⁹20], mild [20–24], moderate [25–29], severe [30]),³⁰ sleep duration (<5, 5, 6, 7, 8, 9, 10 hours per night), employment status (currently employed: yes versus no), job hours (hours worked per week), and diet quality (Healthy Eating Index score).^{31, 32}

We assessed the shape of the curves relating income and education with fecundability using restricted cubic splines.³⁷ We modeled income and educational attainment as linear variables. For income, we used the midpoints of the categorical data and assigned an income of \$7,499.50 to the smallest income category (<\$15,000) and \$225,000 to the largest income category (≥\$200,000). For education, we assigned 12 years of education to women reporting a high school degree or equivalent, 14 years to women reporting some college, 16 years to women reporting a college degree, and 18 years to women reporting a graduate degree.

We stratified the results by age at baseline (<30 vs. ≥30 years) to examine whether associations were stronger among older women, for whom fertility is naturally declining. We also restricted the cohort to women with <3 cycles of attempt time at study entry, among whom behaviors (*e.g.*, marijuana use, alcohol intake) would have been less likely to change in response to delayed TTP,³⁸ to reduce the potential for confounder misclassification as a result of change over time. Additionally, we performed secondary analyses restricted to US women, to account for different social welfare benefits and economic policies between the US and Canada. In the education analysis, we considered the joint effect of education of male and female partners (both partners <16 years; female <16 years, male ≥16 years; female ≥16 years, male <16 years; and both partners ≥16 years).

We performed multiple imputation to calculate missing exposure, outcome, and covariate data. For the 1,310 (15.1%) women who did not complete any follow-up questionnaires, we assigned one cycle of follow-up and imputed their pregnancy status at that cycle (pregnant vs. not pregnant). We included over 120 demographic, lifestyle, behavioral, and reproductive variables in the prediction model to create five imputed data sets. The prevalence of missing exposure or covariate data ranged from 0% (*e.g.*, education, age) to 3.4% (household income).

Rates of attrition varied by income and education. Loss to follow-up decreased with increasing education and income. We examined reason for end of follow-up (viable pregnancy, pregnancy loss, initiation of infertility treatment, censored at 12 cycles, stopped attempting pregnancy, lost to follow-up after completing at least one follow-up questionnaire, lost to follow-up without completing at least one follow-up questionnaire, or still participating) according to income and education. Additionally, we used inverse probability weights to correct for differential attrition.^{39, 40} We used two pooled logistic regression models, one with baseline and time-varying behavioral, health, and demographic 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. Women with a low probability of continuation received

larger weights to correct for attrition. We applied the stabilized weights to the unadjusted models and adjusted Model 1. Analyses were conducted using SAS software (Version 9.4, SAS Institute, Cary, NC).

Results

Overall, 8,654 women contributed 33,087 cycles and 5,103 pregnancies during follow-up (Table 1). The percentage lost to follow-up was higher among women with lower income (< \$50,000: 33.6%; \$150,000: 10.5%) and lower educational attainment (12 years: 48.2%; 17 years: 11.2%). Approximately 38% of women had 17 years of education (corresponding to a graduate degree), and 5% had 12 years of education (high school degree or less). Twenty percent had annual household incomes <\$50,000 and 15% had annual household incomes \$150,000.

We observed similar patterns in demographic characteristics for categories of income and education (Table 1). Education and income were positively associated with one another and with other SES measures, including parental education, male partner education, and employment status. Education and income both increased with increasing age, percentage non-Hispanic White, hours worked per week, sleep duration, and HEI score, but only income increased with increasing physical activity. Greater education was associated with shorter mean attempt time at study entry. Both education and income decreased with increasing BMI, ever smoking, infertility history, parity, gravidity, MDI score, intercourse frequency and PSS-10 score.

We found a modest positive association between education and fecundability (Table 2). In the minimally-adjusted Model 1, compared with women with graduate degrees, fecundability was lower for women with a high school degree or less (FR: 0.90, 95% CI: 0.76–1.08), some college (FR: 0.84, 95% CI: 0.78–0.91) or a college degree (FR: 0.89, 95% CI: 0.84–0.95). Results did not change appreciably when adjusting for potential confounders and mediators (Model 2). In bivariate analyses, income, BMI, and male partner educational attainment produced the largest changes in effect estimates from unadjusted to fully-adjusted models. Associations between education and fecundability were attenuated among women aged <30 years, and did not vary appreciably based on attempt time at study entry or country of residence. Couples in whom both members had 12 years of education had reduced fecundability compared with couples in whom both members had 16 years of education (FR: 0.86, 95% CI: 0.79–0.94). The restricted cubic spline analysis were consistent with the categorical results (Figure 1); we observed a positive linear association between education and fecundability.

Compared with household incomes \$150,000, FRs for household incomes <\$50,000, \$50,000–\$99,999, and \$100,000–\$149,999 were 0.91 (95% CI: 0.83–1.01), 0.99 (95% CI: 0.92–1.07), and 1.09 (95% CI: 1.01–1.18), respectively (Table 3). In bivariate analyses, educational attainment, male partner educational attainment, BMI, and HEI score produced the largest changes in effect estimates from unadjusted to fully-adjusted models. Among women 30 years, there was a stronger reduction in fecundability associated with the lowest income category compared with the highest income category (FR: 0.88, 95% CI: 0.76–1.03).

Associations between income and fecundability did not vary markedly by attempt time at study entry or by country of residence. The restricted cubic spline analysis supported the categorical results. Women in the lowest income category had the lowest fecundability, and there was a positive linear association between fecundability and income, until incomes of approximately \$100,000, at which point additional increases in fecundability were minimal (Figure 2).

Reasons for censoring varied by income and education. Use of infertility treatment and viable pregnancies were lowest among women with lower income and education. Pregnancy loss increased with increasing education and income (Supplemental Table 1). Though attrition was associated with income and education, correcting for attrition using stabilized inverse probability of continuation weights did not appreciably change the results for unadjusted models or Model 1 (Supplemental Table 2).

Discussion

In this prospective cohort study of North American pregnancy planners, annual household income was positively associated with fecundability up to about \$100,000, at which point the effect plateaued. In addition, women with less than 17 years of education had small reductions in fecundability. Control for additional confounders and mediators did not appreciably change these results. Associations for income and education with fecundability were slightly stronger among women aged ≥ 30 years in the lowest income and education categories.

Among participants aged <30 years, results for education and income were attenuated. Differences in income and education may have a smaller impact at younger ages, when fertility is naturally higher.

The mechanisms underlying socioeconomic-based disparities in fecundability are unclear and may comprise a combination of access to and utilization of resources, health literacy, and lifestyle factors. We observed that other measures of SES (*e.g.*, in analyses of education, income, and male partner education) and lifestyle factors (BMI, diet) were important contributors to the observed changes between unadjusted and adjusted models in both analyses. This suggests mechanisms are likely complex among correlated factors.

To our knowledge, no prospective study has examined the association between SES and fecundability as a measure of fecundity. Our results agree with NSFG data indicating an inverse association between education and impaired fecundity.⁹ In addition, our findings for education, but not income, are consistent with an analysis of NSFG data that used the current-duration approach to define infertility.¹⁰ Inconsistencies between studies could reflect differences in study designs, study populations, definitions of infertility and impaired fecundity, and control for potential confounders.

While our study accounted for several potential confounders and mediators, we were unable to examine all possible mechanisms, including the effects of chronic psychosocial stress due to lower socioeconomic status or lifetime access to healthcare on fecundability. Socioeconomic inequities across the fertility spectrum deserve attention, especially if there

are modifiable downstream factors to improve reproductive potential among couples trying to conceive. For example, in our study, women with lower SES had longer pregnancy attempt times at study entry and were less likely to be censored due to either a viable pregnancy or the initiation of infertility treatment during follow-up.

There are several limitations to this study. Small numbers of women with lower educational attainment reduced our ability to precisely estimate effects in these subgroups. Longer pregnancy attempt times at enrollment among women with lower SES could have introduced selection bias if participation by subfertile women varied by exposure. Restricting to women trying <3 cycles at baseline, which would reduce potential for selection bias, yielded associations that were similar (income) or stronger (education), indicating that, if present, such bias may be attenuating our results. Selection bias due to loss to follow-up is also possible. Loss to follow-up was higher among women with lower income and lower educational attainment. If women lost to follow-up were less likely to conceive during the study period, this would result in an upward bias. In contrast, women who conceive quickly may have elected to discontinue participating in the study, which would result in a downward bias. However, we accounted for this using inverse probability weighting methods, and the effect of the bias was minimal.

We used a wide range of variables to multiply-impute pregnancy status for women lost to follow-up. However, we may have inadvertently omitted variables predictive of pregnancy status in our multiple-imputation model, which would result in an unpredictable bias. In addition, exposure variables were measured by self-report, introducing potential for misclassification. Furthermore, while educational attainment and annual household income are commonly-used measures of particular dimensions of SES, this operationalization is limited in breadth. For example, household income does not measure wealth (*e.g.*, home ownership, family inheritance) nor access to societal resources, such as healthier neighborhoods and foods. For the sake of simplicity, we did not adjust annual household income by number of people supported by that income by using per capita income or an equivalence scale,⁴¹ although household size decreased only slightly with increasing income and education. Additionally, educational attainment does not measure quality of education, which may contribute to potential mechanisms of association. Nevertheless, due to the prospective study design, such misclassification is unlikely to be differential (*i.e.*, related to fecundability), and is expected to bias FRs towards the null in the extremes of the ordinal categories. Misclassification of fecundability was possible. The calculation of conception cycle was dependent on self-reported LMP and average cycle length. If accurate reporting of these factors differed by exposure, the resulting bias would be unpredictable. Though we controlled for several confounders, residual confounding cannot be ruled out. Unmeasured factors, such as potential genetic factors, may predict both exposure and outcome.

PRESTO is an internet-based convenience sample of female pregnancy planners and is not representative of all women who conceive. About 50% of pregnancies in the U.S. are unintended.⁴² Because pregnancy planning is a requirement for cohort inclusion, if pregnancy planning is inversely associated with SES, and pregnancy planning is inversely related to fecundability, our results may be biased upward. Though participation in an internet-based study may vary by demographic or lifestyle characteristics, measures of

association are not necessarily biased due to self-selection.^{28, 43, 44} Nevertheless, a selection bias could exist, though it is difficult to predict the direction and magnitude of such bias, considering women who do not plan their pregnancies and women who choose not to participate likely have varying underlying fecundability. This potential selection bias could explain some of the observed differences in results between our study and previous studies.

PRESTO differs from previous studies in that participants were enrolled before conception and data were collected prospectively, reducing the degree of selection bias and differential exposure misclassification, respectively. The study population represents the full spectrum of fertility, from those who conceive quickly to those who take 12 months to conceive. We additionally collected information on a wide range of potential biomedical, lifestyle, and behavioral confounders.

Overall, these results indicate that higher income and educational attainment are associated with modestly improved fecundability, and these associations appear to be slightly stronger among women over age 30, when fertility is naturally declining. Our data indicate that fertility is yet another aspect of health that may be related to socioeconomic status.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Restricted cubic spline^a and 95% CI showing the association between educational attainment and fecundability, with knots at 10%, 50%, and 90%, PRESTO, North America, 2013–2019.

^aSpline adjusted for age, race/ethnicity, income, BMI, smoking, physical activity, male partner education, last method of contraception, cycle length, intercourse frequency, history of sexually transmitted infection, doing something to improve chances of pregnancy, PSS score, MDI score, sleep duration, employment status, hours worked per week, and Healthy Eating Index score.

Figure 2. Restricted cubic spline^a and 95% CI showing the association between household income and fecundability, with knots at 10%, 50%, and 90%, PRESTO, North America, 2013–2019.

^aSpline adjusted for age, race/ethnicity, education, BMI, smoking, physical activity, male partner education, last method of contraception, cycle length, intercourse frequency, history of sexually transmitted infection, doing something to improve chances of pregnancy, PSS score, MDI score, sleep duration, employment status, hours worked per week, and Healthy Eating Index score.

Table 1.

Baseline characteristics of pregnancy planners by educational attainment and household income, PRESTO (N=8,654), North America, 2013–2019

	Education (years)				Income (\$)			
	12	13–15	16	17	<50K	50K–99K	100–149K	150K
Number of Participants N (%)	464 (5.4)	1,969 (22.8)	2,974 (34.4)	3,247 (37.5)	1,779 (20.6)	3,333 (38.5)	2,219 (25.6)	1,323 (15.3)
Age (years), mean	28.3	28.8	29.5	31.0	28.2	29.5	30.6	31.8
Partner age (years), mean	32.5	31.8	31.8	31.9	31.5	31.7	32.1	32.8
Married, %	64.8	81.8	93.2	95.4	76.2	91.1	94.8	96.5
Non-Hispanic White, %	73.6	80.3	86.0	86.7	75.8	85.2	88.0	87.1
Annual household income < \$50K	67.2	37.7	14.2	8.7				
Number of individuals in household, mean	3.0	2.9	2.5	2.3	2.8	2.6	2.4	2.3
16 years education, %					38.9	70.6	88.2	92.1
Male partner 16 years education, %	13.0	24.9	57.9	74.2	28.0	48.8	65.8	83.4
Mother 16 years education, %	17.1	24.5	40.3	55.2	30.2	38.0	46.0	54.8
Father 16 years education, %	12.1	23.3	41.6	56.9	28.8	38.5	47.1	59.1
BMI (kg/m ²), mean	31.9	30.8	27.6	26.3	31.2	28.6	26.5	25.0
Physical activity (MET-hrs/wk), mean	30.5	29.6	33.5	36.7	29.7	32.4	35.1	39.1
Ever smoker, %	54.6	42.2	21.6	14.2	39.3	26.8	18.6	14.2
Current smoker, %	27.7	13.8	4.5	1.4	18.2	5.7	2.7	1.7
Alcohol (drinks per week), mean	2.8	2.8	3.3	3.2	2.1	3.1	3.4	4.0
Pregnancy attempt time at study entry (cycles), mean	3.0	2.4	2.0	1.8	2.6	2.0	1.9	1.8
Doing something to improve chances of conceiving, %	72.7	75.3	76.4	77.2	71.3	76.3	78.2	78.6
Intercourse frequency <1 time/week, %	18.9	19.7	21.7	21.2	20.5	20.2	21.9	22.2
Intercourse frequency 4 times/week, %	30.1	22.3	14.2	13.5	26.1	16.1	13.5	10.9
History of infertility, %	31.4	16.0	6.7	3.6	19.6	8.7	4.5	2.9
History of any STI, %	27.6	30.6	24.4	20.2	27.3	25.0	22.5	21.8
Parous, %	60.1	48.1	31.3	22.5	48.3	35.7	25.2	22.0
Gravid, %	76.7	68.1	49.4	38.8	65.9	53.4	42.4	39.6
Last contraceptive method hormonal, %	39.5	39.4	37.8	38.4	38.9	36.8	40.3	38.0
PSS-10 score, mean	19.1	17.4	16.0	15.4	18.1	16.4	15.4	14.8
MDI severity score, mean	16.9	13.3	10.6	8.9	14.6	11.0	9.3	8.4
HEI score, mean	54.1	59.7	65.2	67.8	58.3	63.8	67.1	69.3
Currently employed, %	62.5	75.7	87.0	91.3	66.0	86.4	91.9	94.1
Hours worked per week, mean	34.0	36.3	37.7	39.3	33.2	37.9	39.4	40.9

	Education (years)				Income (\$)			
	12	13–15	16	17	<50K	50K–99K	100–149K	150K
Less than 7 hours sleep per night, %	40.1	36.5	25.3	17.0	37.1	26.7	19.9	17.3

All characteristics except for age are age-standardized to the cohort at baseline.

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

Table 2.

Educational attainment and fecundability, overall and stratified by age at baseline, cycles of pregnancy attempt time at study entry, and nationality (n=8,654)

	No. of Cycles	No. of Pregnancies	Unadjusted FR (95% CI)	Adjusted FR (95% CI) ^a	Adjusted FR (95% CI) ^b
Educational attainment (years)					
12	1,473	185	0.83 (0.70–0.98)	0.90 (0.76–1.08)	0.94 (0.78–1.12)
13–15	7,524	969	0.80 (0.75–0.86)	0.84 (0.78–0.91)	0.87 (0.80–0.95)
16	11,749	1,781	0.90 (0.85–0.96)	0.89 (0.84–0.95)	0.91 (0.86–0.97)
17	12,341	2,168	Reference	Reference	Reference
Age <30 years (n=4,251)					
12	937	129	0.82 (0.68–0.99)	0.97 (0.79–1.19)	1.02 (0.82–1.27)
13–15	4,429	610	0.78 (0.71–0.86)	0.88 (0.79–0.99)	0.91 (0.81–1.03)
16	5,911	980	0.89 (0.82–0.97)	0.92 (0.84–1.01)	0.94 (0.86–1.03)
17	4,254	818	Reference	Reference	Reference
Age ≥30 years (n=4,403)					
12	536	56	0.76 (0.58–1.01)	0.90 (0.68–1.20)	0.82 (0.61–1.09)
13–15	3,095	359	0.78 (0.70–0.87)	0.89 (0.79–1.00)	0.85 (0.75–0.96)
16	5,838	801	0.88 (0.81–0.96)	0.90 (0.82–0.98)	0.90 (0.82–0.98)
17	8,087	1,350	Reference	Reference	Reference
<3 cycles (n=5,689)					
12	780	102	0.75 (0.62–0.91)	0.83 (0.68–1.02)	0.85 (0.69–1.05)
13–15	4,571	647	0.80 (0.73–0.87)	0.84 (0.76–0.93)	0.87 (0.79–0.97)
16	8,078	1,288	0.88 (0.83–0.94)	0.87 (0.81–0.93)	0.89 (0.83–0.95)
17	8,814	1,662	Reference	Reference	Reference
US women (n=7,247)					
12	1,212	154	0.83 (0.69–1.00)	0.93 (0.76–1.13)	0.91 (0.75–1.11)
13–15	6,166	762	0.79 (0.73–0.85)	0.86 (0.78–0.94)	0.85 (0.77–0.93)
16	9,528	1,398	0.90 (0.84–0.96)	0.90 (0.84–0.97)	0.90 (0.84–0.97)
17	10,941	1,898	Reference	Reference	Reference

FR=fecundability ratio, CI=confidence interval.

^aModel 1 adjusted for age, male partner education, race/ethnicity, and income. .

^bModel 2 adjusted for variables in model A and marital status, BMI, smoking, physical activity, cycle length, intercourse frequency, last method of contraception, history of sexually transmitted infection, doing something to improve chances of pregnancy, PSS score, MDI score, sleep duration, employment status, hours worked per week, and Healthy Eating Index score.

Table 3.

Annual household income and fecundability, overall and stratified by age at baseline, cycles of pregnancy attempt time at study entry, and nationality (n=8,654)

	No. of cycles	No. of Pregnancies	Unadjusted FR (95% CI)	Adjusted FR (95% CI) ^a	Adjusted FR (95% CI) ^b
Income (USD)					
<50,000	6,529	840	0.88 (0.80–0.96)	0.91 (0.83–1.01)	0.95 (0.86–1.06)
50,000–99,000	13,068	1,970	0.97 (0.90–1.05)	0.99 (0.92–1.07)	1.01 (0.93–1.09)
100,000–149,000	8,148	1,432	1.09 (1.01–1.18)	1.09 (1.01–1.18)	1.10 (1.02–1.19)
150,000	5,342	861	Reference	Reference	Reference
Age <30 years (n=4,251)					
<50,000	4,182	596	0.93 (0.81–1.07)	1.10 (0.95–1.28)	1.12 (0.96–1.31)
50,000–99,000	6,727	1,095	1.01 (0.89–1.16)	1.12 (0.98–1.29)	1.12 (0.98–1.29)
100,000–149,000	3,232	616	1.16 (1.01–1.33)	1.20 (1.05–1.38)	1.20 (1.04–1.38)
150,000	1,390	230	Reference	Reference	Reference
Age ≥30 years (n=4,403)					
<50,000	2,347	244	0.76 (0.65–0.88)	0.88 (0.76–1.03)	0.86 (0.73–1.01)
50,000–99,000	6,341	875	0.92 (0.84–1.01)	0.98 (0.89–1.09)	0.96 (0.86–1.06)
100,000–149,000	4,916	816	1.04 (0.95–1.15)	1.05 (0.95–1.16)	1.05 (0.95–1.16)
150,000	3,952	631	Reference	Reference	Reference
<3 cycles (n=5,689)					
<50,000	3,779	525	0.86 (0.77–0.96)	0.91 (0.81–1.02)	0.95 (0.84–1.08)
50,000–99,000	8,962	1,438	0.99 (0.90–1.08)	1.01 (0.92–1.11)	1.03 (0.93–1.13)
100,000–149,000	5,585	1,084	1.13 (1.04–1.24)	1.13 (1.03–1.24)	1.14 (1.05–1.25)
150,000	3,917	652	Reference	Reference	Reference
US women (n=7,247)					
<50,000	5,643	718	0.88 (0.79–0.97)	0.96 (0.86–1.07)	0.96 (0.85–1.08)
50,000–99,000	10,814	1,597	0.97 (0.89–1.05)	1.02 (0.93–1.11)	1.01 (0.92–1.10)
100,000–149,000	6,712	1,144	1.07 (0.99–1.16)	1.08 (0.99–1.17)	1.08 (0.99–1.18)
150,000	4,678	753	Reference	Reference	Reference

FR=fecundability ratio, CI=confidence interval, USD=United States dollar.

^aModel 1 adjusted for age, education, male partner education, and race/ethnicity.

^bModel 2 adjusted for variables in model A and marital status, BMI, smoking, physical activity, cycle length, intercourse frequency, last method of contraception, history of sexually transmitted infection, doing something to improve chances of pregnancy, PSS score, MDI score, sleep duration, employment status, hours worked per week, and Healthy Eating Index score.