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Neighborhood Deprivation and Outcomes of Donor Oocyte IVF in Georgia

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Master of Public Health

Epidemiology

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B.S., Georgia Institute of Technology, 2018

Thesis Committee Chair: Audrey J. Gaskins, Sc.D.

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Epidemiology
2023

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Background. Socioeconomically disadvantaged neighborhoods have adverse effects on reproductive health outcomes. However, the extent to which the neighborhood environment affects female fertility outcomes remains unclear. By utilizing a donor oocyte cohort, we can gain insights into the effects exclusively at the oocyte level.

Objective. To examine the relation of neighborhood deprivation index (NDI) to markers of ovarian reserve and outcomes of controlled ovarian stimulation among young, healthy oocyte donors.

Design. Retrospective cohort study.

Setting. Reproductive Biology Associates, a private fertility center in Sandy Springs, Georgia, USA.

Patients. 547 oocyte donors who underwent a total of 905 retrieval cycles between 2008 and 2020.

Intervention(s). None.

Main outcome measure(s). Markers of ovarian reserve, antral follicle count(AFC) and anti-Mullerian hormone(AMH) levels, and outcomes of controlled ovarian stimulation, total number of oocytes retrieved and total number of mature oocytes retrieved.

Results. Among our population of oocyte donors, the mean age was 25 years and 71% identified as White, 12% Black, 6% Asian, 5% Hispanic, and 6% Other. There was no association between donor NDI and markers of ovarian reserve. The adjusted mean AMH and AFC value among women in the lowest quintile of neighborhood deprivation was 4.7 (95% CI 4.1, 5.5) and 38.9 (95% CI 36.9, 41.4) compared to 4.9 (95% CI 4.4, 5.5) and 39.5 (95% CI 36.9, 42.4) among women in the highest NDI quintile. There was a modest negative association between NDI quintile and total number of oocytes retrieved. Donors from the most deprived neighborhoods had a lower adjusted mean count of 32.9 (95% CI 31.0, 34.9) total oocytes retrieved compared to donors from least deprived neighborhoods with an adjusted mean count of 34.7 (95% CI 32.2, 37.5). When analyses were stratified by race, little significant differences were observed; however, the association between NDI and total oocyte count was only evident among White donors.

Conclusions. Among our large donor oocyte cohort, we found no associations between NDI and markers of ovarian reserve and only a modest negative association between NDI and total number of oocytes retrieved. Future research might focus on additional measures of neighborhood deprivation and cumulative impacts over time.

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Contents

Introduction

The use of assisted reproductive technology (ART) in the United States has increased over the past two decades. [1,2] In-vitro fertilization (IVF) is one of the most common forms of ART. In 2019, IVF cycles performed using donor oocytes or embryos increased 50% from 2015, to over 27,131 cycles, with 44% of embryo transfer resulting in a live-birth delivery.[3] While individual risk factors impacting IVF success rates have been more studied[4-6], there is less known about how neighborhood level factors can influence individual reproductive outcomes. By understanding how neighborhood-level factors can influence fertility above and beyond individual characteristics, we can better inform policies and interventions impacting reproductive health outcomes at a local level.

Socioeconomically disadvantaged neighborhood environments have been shown to negatively impact individual health outcomes. For example, neighborhood disadvantage has been shown to have an association with adverse pregnancy outcomes like preterm birth, low birth weight, still birth, gestational weight gain/loss, gestational hypertension, and severe maternal morbidity[7-12] Moreover, there is evidence to show that neighborhood effects on pregnancy outcomes are differential by race.[13] There is also evidence demonstrating reduced fecundability among couples living in more disadvantaged neighborhoods.[14] Possible underlying mechanisms could be the lack of access to health promoting resources, like green spaces, healthy food sources, and healthcare facilities combined with increased exposure to environmental pollutants and increased levels of chronic stress can impact reproductive environment.[15-17] One validated approach to measuring neighborhood disadvantage and its impact on health outcomes is the neighborhood deprivation index.[18] We hypothesize that utilizing this index will provide the best estimate of neighborhood environment in relation to in-vitro fertilization outcomes. Furthermore, by examining a cohort of oocyte donors at a private fertility clinic in Georgia, we have an opportunity to evaluate this question in a diverse cohort of women where we are uniquely able to separate out the potential effects of neighborhood deprivation on the oocyte versus on the sperm and endometrium.

The objective of this analysis is to examine the relation of neighborhood deprivation to ovarian reserve and outcomes of controlled ovarian stimulation among young, healthy oocyte donors. Furthermore, we aim to understand if this association is modified by donor race/ethnicity.

Methods

Study Design/Population. This retrospective study utilized data from non-identified vitrified oocytes donors undergoing controlled ovarian stimulation cycles at a private fertility clinic in Sandy Springs, Georgia, from 2008 to 2020. The data collection project was approved through the institutional review board (IRB) of Emory University (IRB00080463). Our initial database contained information on 662 donors. From there we excluded donors who did not reside in Georgia (n=80) and donors with P.O. boxes listed for their residential address (n=3). From the sample containing 579 donors and 966 oocyte retrieval cycles, we further excluded 32 donors and 61 cycles who completed their retrieval before 2008, who were missing information on retrieval year, who underwent Lupron stimulation, who did not have information on number of oocytes retrieved, and/or number of mature oocytes retrieved. After all exclusions, our analytic sample contained 547 unique donors who underwent 905 oocyte retrieval cycles.

Briefly, oocyte donors were screened prior to donation according to ASRM recommendations (ASRM and SART 2021). At the time of the first oocyte retrieval, donors provided information on date of birth, race, education level, parity, and smoking status using a standardized questionnaire. Height and weight were measured using standardized procedures to calculate body mass index (BMI). Cycle characteristics including number of mature oocytes retrieved, number of follicles over 14mm and 18mm before stimulation, estradiol levels from day 5 to day 14 were collected through chart abstraction.

Exposure Assessment. The donor's residential addresses were collected from their medical record and geocoded using ArcGIS. If the address changed over time, this was noted, along with the year of move. To estimate place-based socioeconomic status of a donor's residential neighborhood environment, we used a validated, composite measure called the Neighborhood Deprivation Index (NDI).[18] This metric was created with Georgia specific perinatal outcomes, so we wanted to use this measure of deprivation for our Georgia donors. Calculated using principal component analysis on federal and state data, the NDI score is comprised of 8 subcomponents: percent of households in poverty, percent of female headed households with dependents, percent of households earning <$30k, percent of households on public assistance, percent in management or professional occupations, percent of crowded housing, percent unemployed, and percent earning less than a high school education. NDI scores are continuous values ranging from 0 to 1, with 1 representing neighborhoods with the highest possible level of deprivation. Donor's residential address was used to assign census tract IDs and NDI was matched by tract ID. NDI was categorized into quintiles representing 5 levels from highest to lowest deprivation.

Outcome Assessment. Primary outcomes of interest were measures of ovarian reserve, antral follicle count (AFC) and anti-Mullerian hormone (AMH) levels, and outcomes of controlled ovarian stimulation, total number of oocytes retrieved, and number of mature oocytes retrieved. Ovarian AFC, defined as the sum of antral follicles in both ovaries, was measured by a reproductive endocrinologist using transvaginal ultrasonography on the 3rd day of an unstimulated menstrual cycle. Immediately following AFC assessment, the antagonist protocol was employed for the oocyte donors' ovarian stimulation. After eight to fourteen days of ovarian stimulation, oocyte retrieval was performed using a transvaginal ultrasound guided aspiration. Embryologists classified the retrieved oocytes as germinal vesicle, metaphase I, metaphase II (MII) or degenerated. Total oocyte yield was defined as the sum of all oocytes retrieved regardless of type. Mature oocyte yield was the sum of all MII oocytes.

Statistical Analysis. We compared demographic, reproductive, and ovarian stimulation parameters at a donor's first oocyte retrieval by quintile of NDI to describe our study sample. To compare the NDI by census tracts for the state of Georgia to tracts included in the sample, frequency distributions were calculated, along with NDI range and percentiles. We used unadjusted and adjusted generalized estimating equations with Poisson distribution and robust standard errors to assess associations between NDI (measured both continuously per interquartile range increase and in quintiles) and AFC, number of total oocytes retrieved, and number of mature oocytes retrieved. These models take into account the repeated observations that some women contributed. Robust standard errors were utilized in all models to account for overdispersion. After confirming that AMH values were roughly normally distributed, we used generalized estimating equations with normal distribution to evaluate the association between NDI and AMH values. For all outcomes, non-linearity was assessed with restricted cubic splines, which used the likelihood ratio test comparing the model with the linear term to the model with the linear and the cubic spline terms. We also stratified each of our models by race, as a proxy for structural racism, to evaluate if there was a different association between disadvantaged neighborhood environment and ovarian reserve and stimulation outcomes in Black vs. White donors.

Confounding was evaluated using a priori knowledge and a directed acyclic graph (DAG). Confounders included donor age at retrieval (continuous), donor body mass index (continuous), and year of retrieval (discrete). Race/ethnicity was evaluated as both a confounder and effect modifier. Since missing covariate data was rare, we performed single imputation for covariates with missing data using the median value for continuous variables and the most common level for categorical variables. Sensitivity analysis was performed to truncate 10 extreme outliers of total oocytes and 12 extreme outliers for mature oocytes, but the results did not differ after exclusion. Data cleaning was performed in RStudio 4.2.2. All statistical analyses were performed using SAS version 9.4.

Results

Our final analytic sample included 547 oocyte donors who lived in Georgia that had complete data on ovarian stimulation outcomes**.** The state of Georgia includes 1949 census tracts, 382 (19%) of which were represented by donors in our study. The NDI distribution of census tracts in our sample ranged from -0.01 to 0.86, while the NDI distribution for all census tracts in the state of Georgia was -0.05 to 1.24. Our donors were young (mean age: 25 years) and racially diverse – 71.1% White, 11.6% Black, 5.7% Asian, 5.2% Hispanic, and 6.5% other race. The majority (64.2%) of donors underwent 1 retrieval, 18.3% underwent 2, and 17.6% underwent 3 or more during the time period. The median AMH was 4.7 (Range: 0.3 to 32.5), the median AFC was 36 (Range: 10 to 101), and the median number of total and mature eggs retrieval was 32 (Range: 9 to 108) and 24 (Range: 5 to 78), respectively.

Very few demographic and reproductive characteristics differed by quintile of NDI (**Table 1**). Participant age at first retrieval was largely similar across NDI quintile as was BMI, education status, and smoking status. Fertility characteristics like gonadotrophin total dose, number of follicles >14mm at trigger start, peak estradiol (pg/mL), and maturation trigger type were also similar across NDI quintiles. Days of stimulation differed by NDI quintile, with 82%

of women in the most deprived quintile receiving 10-11 days of stimulation compared to 56% of people in the least deprived quintile (p=0.002). Donors in the lowest quintile had a higher proportion of women with less (8-9) and more (12-13) days of stimulation as compared to women in the highest quintile. Year of retrieval also varied by NDI quintile with a larger proportion of donors being from the least deprived neighborhoods in the earlier years (2008-2011).

Overall, we observed no association between donor NDI (measured both in quintiles and continuously) and markers of ovarian reserve including AMH and AFC. For example, the adjusted mean AMH and AFC value among women in the lowest quintile of neighborhood deprivation was 4.7 (95% CI 4.1, 5.5) and 38.9 (95% CI 36.9, 41.4) compared to 4.9 (95% CI 4.4, 5.5) and 39.5 (95% CI 36.9, 42.4) among women in the highest quintile of NDI. For outcomes of ovarian stimulation, there was a modest negative association between NDI quintile and total number of oocytes retrieved (**Table 3**). Donors from the most deprived neighborhoods had a lower adjusted mean count of 32.9 (95% CI 31.0, 34.9) total oocytes retrieved compared to donors from least deprived neighborhoods with an adjusted mean count of 34.7 (95% CI 32.2, 37.5). When we modelled NDI as a continuous variable using restricted cubic splines, there was no evidence of a non-linear association between total oocyte count and NDI (p for linearity = 0.0336, **Figure 1**). In the adjusted model, for every IQR increase in NDI, there was 1.5% (95% CI -5.0%, 2.0%) fewer total oocytes retrieved. Although associations were in a similar direction, we did not observe any statistically significant association between NDI and number of mature oocytes retrieved.

When we stratified by race, we did not observe an association between NDI and markers of ovarian reserve in Black or White donors **(Table 4).** For outcomes of ovarian stimulation, the negative association between NDI and number of oocytes retrieved was only apparent among White donors, while no significant association was observed between NDI and oocyte counts among Black donors.

Discussion

Among our large cohort of non-identified vitrified oocyte donors, we found no associations between NDI and markers of ovarian reserve and only a modest negative association between NDI and total number of oocytes retrieved. When analyses were stratified by race, little significant differences were observed; however, the association between NDI and total oocyte count was only evident among White donors.

To our knowledge, there are very few studies that has examined the relation of neighborhood deprivation with ovarian reserve and outcomes of ovarian stimulation. Using a cross-sectional study of 193 healthy, regularly menstruating women from St. Louis, Missouri, Komorowski and colleagues found that women who were overweight or obese who were living in most disadvantaged neighborhood (using a similar measure of exposure to NDI, area deprivation index) had significantly lower AMH values than women who were overweight or obese living in less disadvantaged neighborhoods.[19] Reasons for the discrepant findings between our two studies include differences in sample population and different measure of exposure. For example, in the Komorowski study, the mean BMI was 28.4 kg/m^2 (+/- 7.1), while the mean BMI of our donors was 22.6 kg/m^2 (+/- 2.4) due to our extensive screening process that removes participants with high BMIs prior to inclusion in our study. Also, while NDI uses similar components as ADI, Komorowski and colleagues used national ADI levels to create their quantiles, which might be different than Georgia's distribution of deprivation, making it harder to compare similar levels of deprivation.

While the existing literature on NDI and markers of female fertility is sparse, there is a growing body of literature showing significant associations between NDI and couple-based fertility outcomes including time to pregnancy and live birth following IVF. For example, among a large prospective cohort of North American pregnancy planners, Willis et al. observed that neighborhood disadvantage and fecundability were negatively associated, particularly among participants with lower annual incomes (<$50,000).[15] Similarly, Richardson and colleagues showed that, among a retrospective cohort of 3901 women undergoing their first fresh single-embryo transfer in the United Kingdom, the rate of clinical pregnancy and live birth was higher among women from least deprived area compared to the most deprived areas.[20] Horns and coauthors also observed that couples from more deprived areas (defined using ADI) were less likely to experience a live birth than couples from lower deprived areas among a large cohort of 13,873 subfertile men undergoing semen analysis in Utah.[21]

The biological mechanisms underlying the effect of neighborhood deprivation on markers of ovarian health, including ovarian reserve and response, are not entirely clear. It is known that neighborhood deprivation can have impact on other health outcomes, which may in turn impact reproductive health. For example, other studies have found that NDI can impact the severity of depression, telomere length, child physical activity, prenatal smoke exposure, and weight gain which could be important mediators for effects of NDI on fertility.[22-26] Additionally, other studies have tried to distinguish how race, a social construct, versus NDI impact perinatal outcomes. For example, in a large, multi-site cohort of women, O'Campo and coauthors found that neighborhood deprivation had a stronger association with pre-term birth among non-Hispanic white women (OR: 1.57, 95% CI 1.41-1.74 comparing the highest to lowest deprivation quartiles) as compared to non-Hispanic Black women (OR: 1.15, 95% CI 1.08-1.23).[13]

Yet other studies, including our own, have found little differences in the association between NDI and reproductive outcomes by race. Clearly more research is needed to better understand how racism, neighborhood environment, and disparate exposures of weathering impacts markers of ovarian reserve and controlled ovarian stimulation.[27]

A primary limitation of our study is that donors were heavily screened to exclude any donors with obesity, sexually transmitted infections, or reporting risky behaviors, prior to inclusion. This might have biased our results towards the null as there is a possibility that these exposures are pathways in which NDI can impact female fertility. Another potential bias is using neighborhood tracts as the unit of study. Since we measured NDI at the Census tract level, we are unable to observe within-tract differences in NDI as some donors might experience more or less deprivation than the assigned score. Smaller block groups or larger aggregations might provide a better estimate for NDI. Also, while we do have a much higher proportion of racial/ethnic groups represented in our sample population compared to other fertility clinic populations, we still had a limited number of Black donors in our sample, which might have affected our power to observe a difference in ovarian stimulation outcomes between White and Black donors. Moreover, we only had information on donors' home address and this location might not be where they spend the majority of their time due to work, school, or social activities so we might not be capturing their true NDI exposure. It is also possible that our generalizability to other states in the US may be limited as the Southeast has some of the highest levels of NDI compared to other states.[28] It is possible that we might have found different results if we examined a national cohort or including women residing in other regions in the US. Strengths of our study include the retrospective design, diverse sample, and objective measures of markers of ovarian reserve and outcomes of controlled ovarian stimulation. The retrospective design allows us to look at outcomes from the same cohort of women over more than a decade of oocyte donation. We include a large, diverse cohort of young, healthy donors from a wide range of NDI exposure to best estimate the potential association. Using objective measures to observe outcomes of markers of ovarian reserve and outcomes of controlled ovarian stimulation can help limit misclassification bias.

In conclusion, we observed limited associations between neighborhood deprivation and markers of ovarian reserve and ovarian stimulation among our large, diverse cohort of young, healthy oocyte donors residing in Georgia. Future research on this topic should consider including additional measures of neighborhood deprivation, which might help better elucidate this relationship. It may also be important to collect information on residence during key periods of reproductive development – such as in utero and puberty - to better capture potential cumulative effects of neighborhood deprivation on adult fertility.

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Table 1: Characteristics of oocyte donors by neighborhood deprivation index, 2008-2020

		Quintile of Neighborhood Deprivation Index					
	Total	<20th	20th-39th	40th-59th	60th-79th	≥80th	p-value
Number of women		118	106	101	104	118	
Age at first retrieval	547						0.155
20-22 yr		34 (29%)	53 (45%)	23 (22%)	36 (36%)	31 (30%)	
23-26 yr		37 (31%)	30 (25%)	41 (39%)	28 (28%)	36 (35%)	
27-29 yr		37 (31%)	29 (25%)	33 (31%)	29 (29%)	29 (28%)	
30-32 yr		10 (8.5%)	6 (5.1%)	9 (8.5%)	8 (7.9%)	8 (7.7%)	
Year of retrieval	547						0.02
2008-2011		49 (42%)	30 (25%)	34 (32%)	39 (39%)	30 (29%)	
2012-2014		34 (29%)	29 (25%)	33 (31%)	15 (15%)	27 (26%)	
2015-2017		19 (16%)	37 (31%)	25 (24%)	35 (35%)	28 (27%)	
2018-2020		16 (14%)	22 (19%)	14 (13%)	12 (12%)	19 (18%)	
Race/Ethnicity	542						0.04
Asian		9 (7.8%)	6 (5.2%)	5 (4.7%)	5 (5.0%)	6 (5.8%)	
Black		6 (5.2%)	25 (22%)	7 (6.6%)	15 (15%)	15 (14%)	
Hispanic		2 (1.7%)	7 (6.0%)	6 (5.7%)	5 (5.0%)	5 (4.8%)	
Other		7 (6.0%)	8 (6.9%)	5 (4.7%)	4 (4.0%)	9 (8.7%)	
White		92 (79%)	70 (60%)	83 (78%)	71 (71%)	69 (66%)	
BMI	545						0.17
≤21.0 kg/m^2		31 (26%)	40 (34%)	29 (27%)	26 (26%)	26 (25%)	
21.0-24.9 kg/m^2		72 (61%)	51 (43%)	56 (53%)	54 (54%)	50 (49%)	
≥25.0 kg/m^2		15 (13%)	27 (23%)	21 (20%)	20 (20%)	27 (26%)	
Education	536						0.33
≤ High School		1 (0.8%)	1 (0.9%)	2 (1.9%)	0 (0.0%)	3 (3.0%)	
Some College		98 (83%)	84 (72%)	78 (76%)	81 (82%)	75 (74%)	
Advanced Degree		19 (16%)	31 (27%)	23 (22%)	18 (18%)	23 (23%)	
Smoking Status	536						0.77
Never smoker		106 (91%)	108 (95%)	94 (91%)	90 (90%)	94 (91%)	
Ever smoker		10 (8.6%)	6 (5.3%)	9 (8.7%)	10 (10%)	9 (8.7%)	
Number of prior births	297						
0		19 (16%)	10 (9.4%)	14 (14%)	13 (13%)	12 (10%)	0.20
1		17 (14%)	20 (19%)	15 (15%)	25 (24%)	19 (16%)	
2 or more		37 (31%)	18 (17%)	34 (34%)	29 (28%)	15 (13%)	
Gonadotrophin dose (IU)	546						0.11
<=1500		5 (4.2%)	3 (2.5%)	1 (1.0%)	1 (1.0%)	7 (6.7%)	
1501-2500		59 (50%)	70 (59%)	55 (52%)	53 (52%)	46 (44%)	
2501-3500		51 (43%)	43 (36%)	43 (41%)	42 (42%)	50 (48%)	
3501-5000		3 (2.5%)	2 (1.7%)	6 (5.7%)	5 (5.0%)	1 (1.0%)	
Days of stimulation	546						<.01
8-9		33 (28%)	20 (17%)	21 (20%)	16 (16%)	10 (9.6%)	
10-11		66 (56%)	75 (64%)	62 (59%)	63 (62%)	85 (82%)	

		Quintile of Neighborhood Deprivation Index					
	Total	<20th	20th-39th	40th-59th	60th-79th	≥80th	p-value
Number of women		118	106	101	104	118	
12-13		19 (16%)	23 (19%)	22 (21%)	22 (22%)	9 (8.7%)	
Number of follicles >14mm at trigger	540						0.65
<=12		8 (6.8%)	5 (4.3%)	8 (7.8%)	2 (2.0%)	5 (4.9%)	
13-24		75 (64%)	64 (55%)	59 (57%)	65 (64%)	60 (59%)	
25-40		30 (26%)	41 (35%)	32 (31%)	32 (32%)	33 (32%)	
41-55		4 (3.4%)	7 (6.0%)	4 (3.9%)	2 (2.0%)	4 (3.9%)	
Peak estradiol (pg/mL)	539						0.35
<2000		28 (24%)	15 (13%)	21 (20%)	25 (25%)	20 (20%)	
>6000		24 (21%)	33 (28%)	18 (17%)	23 (23%)	21 (21%)	
2001-4500		45 (38%)	41 (35%)	48 (47%)	37 (37%)	39 (39%)	
4501-6000		20 (17%)	28 (24%)	16 (16%)	16 (16%)	21 (21%)	
Maturation trigger type	541						0.15
GnRH Agonist(Lupron)		86 (73%)	97 (84%)	80 (75%)	71 (72%)	84 (81%)	
hCG		32 (27%)	18 (16%)	26 (25%)	27 (28%)	20 (19%)	

[1]n (%)

[2]Pearson's Chi-squared test

Table 2: Association between donor neighborhood deprivation index and markers of ovarian reserve.

	Anti-Mullerian Hormone				Antral Follicle Count			
	No. of Women	**No. of Cycles**	**Unadjusted Mean (95% CI)**	**Adjusted Mean (95% CI)***	**No. of Women**	**No. of Cycles**	**Unadjusted Mean (95% CI)**	**Adjusted Mean (95% CI)***
Donor NDI								
Q1 (lowest deprivation)	68	113	4.7 (4.0-5.5)	4.7 (4.1-5.5)	112	172	38.6 (36.6-40.8)	38.9 (36.9-41.1)
Q2	67	121	4.3 (3.8-4.9)	4.4 (3.9-4.9)	101	171	36.6 (34.6-38.7)	36.9 (35.0-38.9)
Q3	58	116	4.8 (4.3-5.4)	4.8 (4.2-5.4)	92	169	37.8 (35.5-40.2)	37.7 (35.5-40.0)
Q4	71	128	4.7 (4.2-5.3)	4.7 (4.2-5.3)	99	172	39.5 (36.9-42.2)	38.6 (36.3-41.1)
Q5 (highest deprivation)	83	129	4.9 (4.4-5.5)	4.9 (4.4-5.5)	110	169	40.1 (37.5-43.0)	39.5 (36.9-42.4)
P-trend			0.37	0.42			0.13	0.40

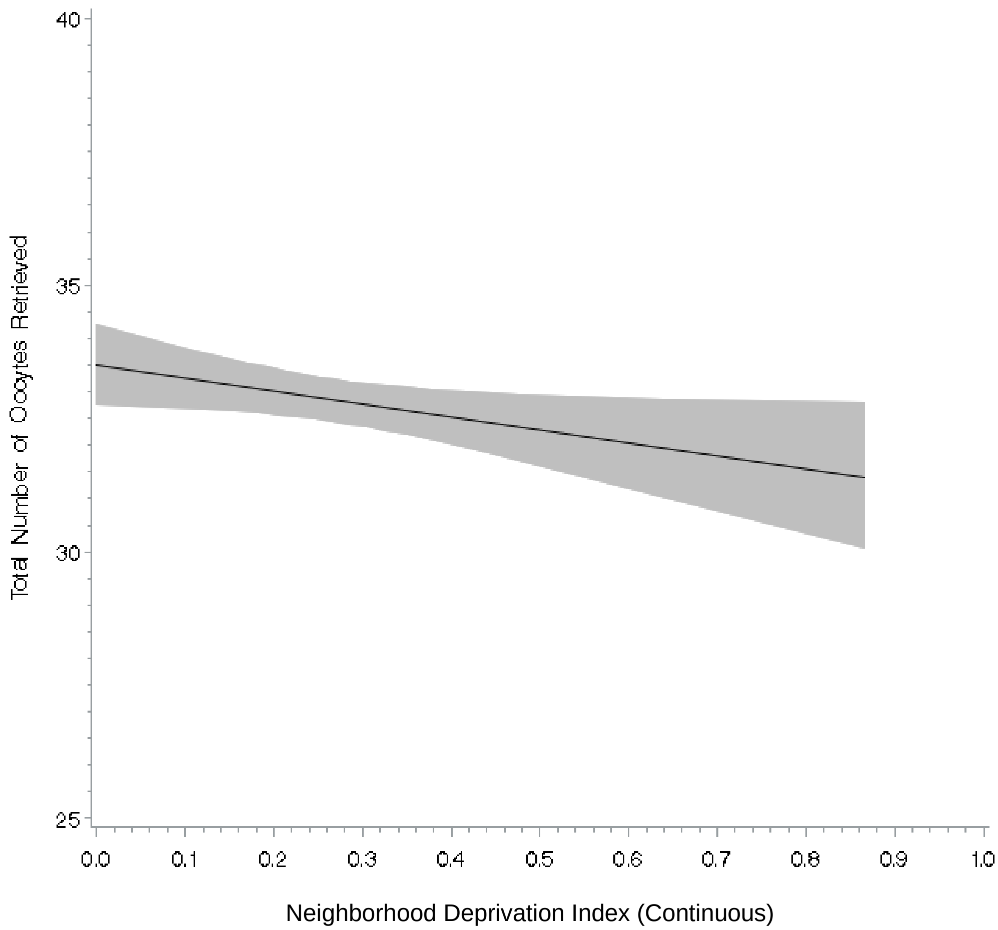
*Adjusted for: BMI, age, year of retrieval

Table 3: Association between donor neighborhood deprivation index and outcomes of controlled ovarian stimulation.

	Total Oocytes Retrieved				Mature Oocytes Retrieved			
	No. of Women	**No. of Cycles**	**Unadjusted Mean (95% CI)**	**Adjusted Mean (95% CI)***	**No. of Women**	**No. of Cycles**	**Unadjusted Mean (95% CI)**	**Adjusted Mean (95% CI)***
Donor NDI								
Q1 (lowest deprivation)	118	181	34.7 (32-37.6)	34.7 (32.2-37.5)	118	181	26.0 (24.0-28.1)	26.1 (24.1-28.2)
Q2	106	181	33.4 (31.0-36.0)	33.6 (31.4-36.0)	106	181	24.6 (22.8-26.5)	24.7 (23.0-26.5)
Q3	101	181	33.2 (30.9-35.7)	33.2 (30.9-35.6)	101	181	24.9 (23.1-26.8)	24.9 (23.1-26.7)
Q4	104	181	35.1 (32.4-38.0)	34.4 (31.9-37.1)	104	181	26.0 (23.9-28.3)	25.6 (23.5-27.8)
Q5 (highest deprivation)	118	181	33.3 (31.3-35.3)	32.9 (31.0-34.9)	118	181	26.0 (24.0-28.1)	24.9 (23.4-26.6)
P-trend			.62	.36			.93	.59

*Adjusted for: BMI, age, year of retrieval

Figure 1: Association between neighborhood deprivation index (continuous) and number of oocytes retrieved



There was no evidence of a non-linear association between total oocyte count and NDI modelled continuously (p for linearity = 0.034, **Figure 1**). In the adjusted model, for every IQR increase in NDI, there was 1.5% (95% CI -5.0%, 2.0%) fewer total oocytes retrieved.

Table 4: Association between donor neighborhood deprivation index and markers of ovarian reserve and controlled ovarian stimulation by race

	AMH		AFC		Number of Oocytes Retrieved		
						Total	Mature
	Number of cycles	**% Change (95% CI) per IQR***	**Number of cycles**	**% Change (95% CI) per IQR***	**Number of cycles**	**% Change (95% CI) per IQR***	**% Change (95% CI) per IQR***
Black donors	64	2 (-9, 14)	98	-3 (-11, 5)	104	7 (-1, 16)	7 (-2, 17)
White donors	420	1 (-3, 5)	605	3 (-2, 7)	639	-5 (-9, -0.01)	-6 (-10, -0.01)
P for interaction		.50		.42		0.31	0.34

*Adjusted for BMI, age, year of retrieval