

Group Prenatal Care and Social Determinants of Health: A Retrospective Cohort
Study at a Federally Qualified Health Center

Simon Parker-Shames

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Ian Painter, Chair

Janice Bell

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University of Washington

Abstract

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Simon Parker-Shames

Chair of the Supervisory Committee:
Ian Painter, PhD, Clinical Assistant Professor
Department of Health Services, School of Public Health

Objective: Group prenatal care (GPC) models are increasingly a focus of observational studies of birth outcomes, yet there are limited data on the socio-demographic and health characteristics of women who elect GPC compared to traditional primary care (TPC). The purpose of this study was to identify and describe potential differences in pregnancy characteristics, social determinants of health (SDOH), prenatal complications, and behavioral risk factors between women who elect GPC compared to TPC in a Federally Qualified Health Clinic (FQHC) setting.

Study Design: This study was a retrospective cohort analysis of women who elected GPC compared to those who elected TPC, from a group of 2,376 patients entering prenatal care at the study site between 2011 and 2017. Cohort composition was examined with regards to pregnancy

characteristics, social determinants of health (SDOH), behavioral risk factors, and diagnosis of medical complications during prenatal care. Variables were compared between cohorts using bivariate statistics, stratified by trimester at intake in order to compare women who entered prenatal care at similar gestational ages.

Results: In the 1st trimester stratum, GPC was associated with 0.7 fewer prior pregnancies ($P<0.001$), 8.7% lower rate of Hispanic ethnicity ($P=0.010$), 5.7% higher rate of private insurance ($P=0.043$), 0.3 fewer people per family ($P=0.013$), and an average of 1.1 more years of education ($P=0.031$). GPC was associated with a higher rate of diagnosis with the following complications: 18.8% higher rate of anemia ($P<0.001$), 9.0% higher rate of uterine size-complicating pregnancy ($P=0.001$), a 7.6% higher rate of “other not elsewhere classified” complications ($P=0.024$). GPC was also associated with a 12.4% higher rate of parental alcohol or drug abuse ($P=0.028$), and, of those who reported illicit drug use, 2.4 fewer uses per week were reported ($P<0.001$). Conclusion: GPC and TPC cohorts differed significantly terms of pregnancy characteristics, SDOH, prenatal complications, and behavioral risk factors. The GPC cohort tended to have some indicators of higher socioeconomic status (SES), yet were more likely to be diagnosed with a complication or behavioral risk factor. These differences could be expected to influence the outcome findings of observational studies on GPC. Further research examining the maternal characteristics of subjects who elect GPC compared to TPC is recommended to confirm these findings and further explore the dynamics involved.

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Chapter 1. BACKGROUND

Group prenatal care (GPC) is becoming an increasingly common model for delivering prenatal care in the United States, as an alternative to the prevailing traditional model of prenatal care (TPC) (Carter et al., 2017; Krans & Davis, 2014). GPC consists of prenatal care delivered by providers in an extended session to a peer group of prenatal patients of similar gestational age, who receive all or most of their care in a group setting (Mazzoni & Carter, 2017).

Of the various models of group prenatal care in the United States, the CenteringPregnancy© model is the most studied and best known (Mazzoni & Carter, 2017). Although study of prevalence rates in the United States of GPC generally and CenteringPregnancy specifically is lacking, a 2017 review described TPC as the “prevailing model” of prenatal care in the United States (Catling et al., 2015). The CenteringPregnancy© model consists of structured group visits with a cohort of 8-12 pregnant women in close gestational age who participate in 90-minute group learning and sharing sessions facilitated by a certified Midwife and incorporate a brief one-on-one meeting with their OB provider (“CenteringPregnancy | Centering Healthcare Institute,” n.d.). In a 2017 review of GPC, Mazzoni and Carter describe TPC in the United States as consisting of “a single patient receiving unidirectional expertise from an obstetric provider during brief encounters...” (Mazzoni & Carter, 2017).

Development of GPC models, including the CenteringPregnancy model was motivated by a perception that TPC was not evidence-based, was disempowering women, and leading to poor prenatal outcomes, particularly in women of minority ethnicity and low income (S. S. Rising et al., 2004). Interest in GPC increased in the 1980s in part in response to the rapid rise in

preterm births (PTB) in the U.S. beginning in 1981, informed by early observational studies showing that GPC may have been associated with reductions in preterm birth and low birthweight (Devitt, 2013).

Many of the concerns with TPC that Rising described as motivating initial development of GPC models continue to be supported by more recent literature. Qualitative studies of women's experience of TPC in the U.S. reported low satisfaction with TPC, emphasizing poor communication and a sense of disempowerment (Aparecida Maciel Cardelli, Li Marrero, Aparecida Pimenta Ferrari, Trevisan Martins, & Serafim, 2016; Sword et al., 2012). Although TPC remains the "prevailing model" of prenatal care in the U.S. (Carter et al., 2017), birth outcomes remain poor in comparison to other industrialized nations, with a study of worldwide PTB found that the U.S. accounted for 42% of all preterm births among selected high-income nations while accounting for only 30% of all births, with black women experiencing a 6.6% higher rate than white women (Blencowe et al., 2012), while a 2010 study found that the U.S. had the highest rate of PTB and infant mortality among the other industrialized nations included in the study (MacDorman, Matthews, Mohangoo, & Zeitlin, 2014).

Although GPC is advanced as a means to improve women's experiences of care and improve birth outcomes, the literature on GPC's impact on perinatal outcomes shows mixed results of GPC on perinatal outcomes compared to TPC. A 2015 Cochrane review which included both randomized control trials (RCT) as well as cohort and case-control studies concluded that there was no significant difference between GPC and TPC in the perinatal outcomes of preterm birth (PTB), low birthweight (LBW), nor perinatal demise (Catling et al., 2015). In a subsequent review in 2016, Carter et al found that RCT trials tended to find no difference in outcomes, while observational studies tended to find a difference (Carter et al.,

2016), a pattern of outcomes could be consistent with selection bias, in which women at lower risk tend to elect GPC, leading to an overestimate in the impact of GPC on perinatal outcomes in observational studies. It is also possible that effect modification could be present, that GPC may lead to different levels of improvements depending on the sub-population. At least one RCT comparing GPC to TPC found a significant improvement in risk of PTB among African American women (Ickovics et al., 2007a), and observational studies have found improved perinatal outcomes in African American populations (Picklesimer et al., 2012;), Hispanic populations (Schellinger et al., 2017; Trudnak et al., 2013; Tandon et al., 2012), and low-income populations (Tandon et al., 2013; Ickovics et al., 2003). Additionally, further study of the prenatal complications associated with selection of GPC or TPC is needed: an expert review in 2017 found a lack of published literature describing the effect of GPC in the presence of medical complications including obesity, substance use, and hypertension (Mazzoni & Carter, 2017). This study was designed with the intent of assisting in characterizing maternal socio-demographic and health-related characteristics that may affect the relationship between GPC and perinatal outcomes observed in prior studies.

A difficulty in assessing the effectiveness of GPC at improving perinatal outcomes is the logistical and ethical difficulty of conducting large-scale RCTs, yet observational studies may be subject to selection bias (Catling et al., 2015; Mazzoni & Carter, 2017). In observational studies, women who elect GPC care tend to be of higher SES and are less likely to be of minority ethnicity or race (Benediktsson et al., 2013; Kominiarek, Crockett, Covington-Kolb, Simon, & Grobman, 2017; Tanner-Smith, Steinka-Fry, & Lipsey, 2014). It remains unusual, however for studies to include extensive data across multiple socio-demographic domains—such as race, ethnicity, language, insurance status, and income—in a single study population, limiting

understanding of the dynamics between variables. Social Determinants of Health (SDOH) is a term used to describe the impact of variables such as those that describe SES, economic, racial, ethnic, and linguistic factors on health outcomes; this definition is in keeping with the World Health Organization (WHO) SDOH sub-category of “structural determinants and socioeconomic position” ((Solar O, 2010). There is strong evidence that SDOH variables are predictors of PTB (Becker-Grünig et al., 2016; Snelgrove & Murphy, 2015; Spriggs, 2007), LBW (Lekea-Karanika, Tzoumaka-Bakoula, & Matsaniotis, 1999; Vettore, Gama, Lamarca, Schilithz, & Leal, 2010), and other perinatal outcomes (Willis, McManus, Magallanes, Johnson, & Majnik, 2014). While observational studies may attempt to match or adjust for some SDOH factors, there remains the possibility that an unmeasured confounder is responsible for both a woman’s enrollment in GPC and some amount of observed reduced risk of adverse perinatal outcomes (Picklesimer, Billings, Hale, Blackhurst, & Covington-Kolb, 2012), and that pattern of results is consistent with the difference in reported outcomes between RCT and observational studies noted above.

An additional potential source of selection bias in GPC studies of outcomes arises from a woman’s medical risks for adverse outcomes. Women who are at higher risk for adverse outcomes may select GPC or TPC at a differential rate, biasing the analysis of outcomes (Catling et al. 2015). Although studies have examined the impact of GPC within select high-risk sub-populations (Kominiarek et al., 2017; Schellinger et al., 2017), few studies have examined the rate of medical complications between cohorts (Picklesimer et al., 2012), making it difficult to assess the existence, extent, or direction of potential selection bias due to medical risk factors.

Finally, behavioral risk factors may also be correlated both with a woman’s selection of GPC, as well as perinatal outcomes. Reported tobacco, alcohol, and drug use have been found to

occur in higher rates in GPC cohorts than TPC (Kominiarek et al., 2017), and these behaviors are strongly associated with negative perinatal outcomes. Few studies have examined rates of substance use or other behavioral risk factors on cohort composition.

Given the poor performance of TPC in the U.S. in improving perinatal outcomes, GPC appears to be an attractive alternative model. However it is difficult to assess its effectiveness in improving perinatal outcomes, given the difficulty of conducting RCTs and the potential presence of unquantified selection bias in observational studies. This also poses a challenge to clinics serving low-income and ethnic minority populations, who may be interested in implementing or modifying a GPC program, yet lack reliable evidence for its effectiveness in improving perinatal outcomes.

This study aims to identify some of the pregnancy characteristics, SDOH, behavioral risk factors, and medical complications associated with selection of GPC. It is hoped that this work may support future research to characterize the presence, magnitude, and direction of selection bias in observational studies of the impact of GPC on perinatal outcomes, to more reliably assess the effectiveness of GPC on perinatal outcomes.

Chapter 2. MATERIALS AND METHODS

This study retrospectively compared maternal characteristics of women electing GPC or TPC at a single study site between January 2011 and July 2017. The study was reviewed by the University of Washington Human Subjects Division and qualified for exempt (category 4) status on July 10, 2017 (IRB ID: 00002884).

2.1 SETTING:

The study site was La Clinica del Valle, a medium-sized, Federally-Qualified Health Center (FQHC) with clinic sites located in Jackson County, Oregon. In 2016, the most recent year data were available, the study site served 26,272 patients overall, of whom 35.7% were a racial or ethnic minority, 28.2% were Hispanic, 20.1% spoke a non-English language, 90.1% were below 200% of the Federal Poverty Line, and 57.0% received Medicaid (HRSA, 2017). The clinic received additional grants from the Health Resources and Services Administration (HRSA) to serve migrant or seasonal farmworkers, homeless patients, and those receiving public housing (HRSA, 2017). Clinic staff receive annual trainings on collecting expanded demographic information to support annual reporting requirements set by HRSA. La Clinica was founded in 1988 with a focus on underserved migrant and seasonal populations (“About Us | La Clinica,” n.d.), and the organization continues to provide both group and traditional prenatal care in Spanish as well as English. During the study period, La Clinica had 4 clinic sites offering prenatal care in the greater Medford, Oregon metro area. Group prenatal care (GPC) classes were offered to patients at any site; GPC classes were conducted only at one centrally-located site, the Women’s Health Center in Medford, Oregon; the furthest site delivering prenatal care was 3.1 miles from the Women’s Health center. The study site uses EHR software Epic; the study site is a member of the OCHIN collaborative, which administers Epic software to centers across the nation, with a focus on safety-net clinics (“About Us | OCHIN.org,” 2017). The OCHIN build of Epic contains additional demographic variables of related to social determinants of health that are not included in Epic’s standard build.

2.2 DATA SOURCES

Data were extracted by SQL query from the study site's clinical data warehouse, which contained data drawn from the site's Electronic Health Record (EHR), which included practice management, medical record, and billing sources. The query was designed to include study variables on all completed pregnancy episodes meeting inclusion criteria between January 2011 through July 2017. Data were deidentified using standard protocols, with the study site retaining lookup keys.

2.3 SAMPLE

Inclusion criteria was maternal age greater than or equal to 18 at intake date, completion of at least one prenatal office visit linked to the pregnancy episode at any clinic belonging to the study site. When subjects had multiple completed pregnancy episodes with the study site during the study period, only data related to the subject's initial pregnancy episode with the study site was included, to avoid repeated measurement of the same individual in the study dataset. Subjects with missing or invalid maternal age, visit site, or visit date were not included in the query. No subjects meeting the inclusion criteria were subsequently excluded.

2.4 VARIABLES

GPC cohort status was defined as completing one-or-more group prenatal visits, all other subjects were considered to have received TPC. GPC at the study site was based on the CenteringPregnancy© model, and consisted of 90-minute interactive group sessions among women of comparable gestational age, facilitated by a Certified Nurse Midwife (CNM), and incorporated a brief one-on-one meeting with the patients' OB provider. Women also participated in taking or assisting in taking their own blood pressure and weight. TPC at the study site consisted of 30 to 60 minute one-on-one visits with a single OB provider, supported by

a support team of Medical Assistants and Registered Nurses. All postpartum care was delivered in a traditional setting regardless of cohort, and Maternal Child Health Workers (MCH) provide case management and screening services to all prenatal patients, regardless of cohort, throughout their pregnancy episode.

The variables of interest collected were related to basic pregnancy information, social determinants of health of the mother, diagnoses, and screenings for behavioral risk factors. Income was not adjusted for year because the percent of Federal poverty level (FPL) is adjusted for year, as well as family size.

Social determinant variables race, ethnicity, language, household income, family size, FPL, insurance status, migrant/seasonal status, homelessness, public housing, employment status, and student status were collected by front desk staff using standardized forms and verbal interviews. Insurance status, employment status, household income, and family size were used by the clinic for billing purposes, and evidence of income was required, in keeping with requirements set by the Oregon Health Plan's implementation of Medicaid.

Diagnosis codes were drawn from the medical record and the billing record from codes documented during the pregnancy episode. Diagnosis code variables were defined using both ICD 9 and ICD 10 codes recorded during the pregnancy episode; the study site transitioned from ICD 9 to ICD 10 from 2014 to 2015, and entries were often dual-coded in both ICD 9 and ICD 10. Diagnosis variables were defined based on codebook descriptions of code ranges. Appendix A lists the specific code ranges used for each variable.

The 5Ps screening tool, also known as the "Behavioral Health Risks Screening Tool", is based on a validated instrument used for screening pregnant women for behavioral risk factors related to substance use and history by the subject, her family, or partner (Chasnoff, et al, 2007; Kennedy, et al, 2004); the version used by the study site, provided to the site by the Oregon Health Authority who is encouraging its use Statewide, was adapted by Virginia Department of Behavioral Health and Developmental Services, Virginia Department of Medical Assistance Services and Virginia Department of Health ("OHA: HSD-Approved Evidence-Based Screening Resources/Tools," n.d.). See appendix B for full text of the instrument. The screening was administered by Maternal Child Health case managers (MCH) during subjects' initial intake at the study site, in one-on-one interviews in the exam room or a private office; MCH were provided training on its use. Tobacco use status, alcohol use status, illicit drug use status, days

drinking, and tobacco pack years were collected from the social history section of the vitals entry in the EHR by trained staff at any phase during the pregnancy using a combination of standardized forms as well as verbal interview in the exam room; if multiple values were recorded, the highest risk value was retained--highest reported frequency or highest quantity of use. Values were checked for plausibility and any implausible values set to missing. Subject's city of residence and zip code were not collected due to deidentification requirements in order to maintain IRB exempt status.

2.5 STATISTICAL ANALYSIS

Data were analyzed using IBM SPSS Statistics software package, version 20. Data were prepared for analysis using Microsoft SQL Management Studio 2016, and Microsoft Excel 2016. Variables were further recoded and prepared for analysis within SPSS. Descriptive statistics were generated for all continuous and discrete variables; no data were further transformed. Bivariate statistics were calculated for each cohort and significance was assessed using Chi-square, Fischer's exact test, independent samples T-tests, and Mann-Whitney U tests where appropriate. Chi-square tests were used for categorical variables with Fischer's exact test applied in cases of insufficient predicted cell sizes for Chi-square. T-tests were used for continuous variables with Mann-Whitney U tests applied to variables with Skewness below -1.0 or above 1.0 or Kurtosis below -2.0 or above 2.0. P-values less than 0.05 were considered significant. Variables were stratified by trimester at intake, with strata set as all cases or women entering care before the end of their first trimester.

Chapter 3. RESULTS

2,796 patients met initial eligibility requirements; 5 patients without ages listed were excluded, 415 patients were missing a completed prenatal visit, resulting in an N of 2,376. One implausible value for alcohol use was set to missing, no other implausible values were detected.

Pregnancy Characteristics:

GPC enrollment in the all trimesters stratum was significantly higher among women entering care in their 1st trimester than those entering care in their 2nd or 3rd trimester (18.4%, 16.6%, and 2.2% respectively, $p < 0.001$); within the 2nd or 3rd trimester strata, GPC enrollment was significantly higher for women entering care in their 2nd trimester than those who entered in their 3rd trimester (16.6% vs 2.2% $p < 0.001$). Mean gestational age was somewhat lower in the GPC cohort than the TPC cohort across all strata, and this difference was highly significant in all strata except the 1st trimester strata (101.8 vs. 79.7 $p < 0.001$ for all subjects; 59.6 vs. 58.5 $p = 0.199$ for women entering care in their 1st trimester; 159.7 vs. 125.4 $p < 0.001$ for women entering care in their 2nd or 3rd trimester). Mean number of prior pregnancies was slightly lower in the GPC than the TPC cohort across all strata, and this difference was significant or highly significant for all strata (1.8 vs. 1.0 $p < 0.001$ for all subjects; 1.7 vs. 1.0 $p < 0.001$ for women entering care in their 1st trimester; 1.9 vs. 1.2 $p = 0.009$ for women entering care in their 2nd or 3rd trimester).

Table 1. Pregnancy Characteristics by Cohort, Stratified by Trimester at Intake

Variable	All Trimesters at Intake			1st Trimester at Intake			2nd and 3rd Trimester at Intake		
	Traditional	Group		Traditional	Group		Traditional	Group	
	<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>	<u>p-value</u>	<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>	<u>p-value</u>	<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>	<u>p-value</u>
Pregnancy Start Year			0.134			0.254			0.787
2011	221 (81.5%)	50 (18.5%)		131 (79.9%)	33 (20.1%)		90 (84.1%)	17 (15.9%)	
2012	352 (82.6%)	74 (17.4%)		191 (78.6%)	52 (21.4%)		161 (88.0%)	22 (12.0%)	
2013	373 (83.1%)	76 (16.9%)		235 (81.6%)	53 (18.4%)		138 (85.7%)	23 (14.3%)	
2014	377 (85.1%)	66 (14.9%)		225 (82.7%)	47 (17.3%)		152 (88.9%)	19 (11.1%)	
2015	296 (82.0%)	65 (18.0%)		171 (79.2%)	45 (20.8%)		125 (86.2%)	20 (13.8%)	
2016	272 (86.9%)	41 (13.1%)		141 (85.5%)	24 (14.5%)		131 (88.5%)	17 (11.5%)	
2017	103 (91.2%)	10 (8.8%)		57 (90.5%)	6 (9.5%)		46 (92.0%)	4 (8.0%)	
Trimester at Intake			<0.001***			N/A ^a			<0.001***
1	1151 (81.6%)	260 (18.4%)		1151 (81.6%)	260 (18.4%)		0 (0.0%)	0 (0.0%)	
2	578 (83.4%)	115 (16.6%)		0 (0.0%)	0 (0.0%)		578 (83.4%)	115 (16.6%)	
3	262 (97.8%)	6 (2.2%)		0 (0.0%)	0 (0.0%)		262 (97.8%)	6 (2.2%)	
Parity			0.052			0.097			0.312 ^b
Nulliparous	931 (84.4%)	172 (15.6%)		562 (83.0%)	115 (17.0%)		369 (86.6%)	57 (13.4%)	
Multiparous	41 (74.5%)	14 (25.5%)		26 (72.2%)	10 (27.8%)		15 (78.9%)	4 (21.1%)	
Maternal Age	28.0 (6.0)	27.5 (6.0)	0.166	28.3 (6.1)	27.7 (5.6)	0.127	27.5 (5.9)	27.2 (6.7)	0.571
Gestational Age at Intake	101.8 (62.1)	79.7 (38.3)	<0.001***	59.6 (12.1)	58.5 (13.1)	0.199	159.7 (56.0)	125.4 (34.4)	<0.001***
Prior Pregnancies	1.8 (1.9)	1.0 (1.4)	<0.001***	1.7 (1.9)	1.0 (1.4)	<0.001***	1.9 (2.0)	1.2 (1.6)	0.009**

a. Strata are defined by trimester at intake, p-value is not applicable.
b. Fischer's exact test used.
* p<0.05; **p<0.01; ***p<0.001

Table 2. Social Determinants of Health by Cohort, Stratified by Trimester at Intake

Variable	All Trimesters at Intake			1st Trimester at Intake			2nd and 3rd Trimester at Intake		
	Traditional	Group	p-value	Traditional	Group	p-value	Traditional	Group	p-value
	<u>N (%) or Mean</u> (Std Dev)	<u>N (%) or Mean</u> (Std Dev)		<u>N (%) or Mean</u> (Std Dev)	<u>N (%) or Mean</u> (Std Dev)		<u>N (%) or Mean</u> (Std Dev)	<u>N (%) or Mean</u> (Std Dev)	
Race			0.245			0.785			0.036*
White	1747 (83.6%)	342 (16.4%)		1013 (81.2%)	234 (18.8%)		734 (87.2%)	108 (12.8%)	
Non-white	177 (86.8%)	27 (13.2%)		89 (80.2%)	22 (19.8%)		88 (94.6%)	5 (5.4%)	
Ethnicity			0.656			0.010*			0.009**
Non-Hispanic	1244 (83.7%)	243 (16.3%)		676 (79.3%)	176 (20.7%)		568 (89.4%)	67 (10.6%)	
Hispanic	744 (84.4%)	138 (15.6%)		470 (84.8%)	84 (15.2%)		274 (83.5%)	54 (16.5%)	
Language			0.399			0.129			0.001**
English	1560 (84.3%)	290 (15.7%)		863 (80.8%)	205 (19.2%)		697 (89.1%)	85 (10.9%)	
Non-English	433 (82.8%)	90 (17.2%)		288 (84.5%)	53 (15.5%)		145 (79.7%)	37 (20.3%)	
Insurance Status			0.025*			0.043*			0.153
Uninsured	374 (84.2%)	70 (15.8%)		231 (84.3%)	43 (15.7%)		143 (84.1%)	27 (15.9%)	
Public	1355 (84.8%)	242 (15.2%)		758 (82.0%)	166 (18.0%)		597 (88.7%)	76 (11.3%)	
Private	261 (78.9%)	70 (21.1%)		159 (75.7%)	51 (24.3%)		102 (84.3%)	19 (15.7%)	
Homeless Status			0.052			0.229			0.016*
Not homeless	1617 (84.6%)	294 (15.4%)		979 (82.1%)	214 (17.9%)		638 (88.9%)	80 (11.1%)	
Homeless	373 (80.9%)	88 (19.1%)		169 (78.6%)	46 (21.4%)		204 (82.9%)	42 (17.1%)	
Migrant/Seasonal Status			0.226			0.339			0.001**
Not Migrant/Seasonal	1727 (84.2%)	325 (15.8%)		977 (81.1%)	228 (18.9%)		750 (88.5%)	97 (11.5%)	
Migrant/Seasonal	250 (81.4%)	57 (18.6%)		167 (83.9%)	32 (16.1%)		83 (76.9%)	25 (23.1%)	
Public Housing			0.868			0.507			1.000 ^a
Not Public Housing	1096 (84.2%)	205 (15.8%)		645 (82.4%)	138 (17.6%)		451 (87.1%)	67 (12.9%)	
Public Housing	29 (85.3%)	5 (14.7%)		9 (75.0%)	3 (25.0%)		20 (90.9%)	2 (9.1%)	

Employment Status			0.151			0.709			0.030*
Unknown	53 (91.4%)	5 (8.6%)		32 (88.9%)	4 (11.1%)		21 (95.5%)	1 (4.5%)	
Unemployed	444 (82.8%)	92 (17.2%)		250 (80.9%)	59 (19.1%)		194 (85.5%)	33 (14.5%)	
Part Time	171 (78.8%)	46 (21.2%)		129 (81.6%)	29 (18.4%)		42 (71.2%)	17 (28.8%)	
Full Time	268 (81.5%)	61 (18.5%)		200 (81.3%)	46 (18.7%)		68 (81.9%)	15 (18.1%)	
Student Status			0.021*			1.000			1.000 ^a
Not Student	902 (82.1%)	197 (17.9%)		593 (81.6%)	134 (18.4%)		309 (83.1%)	63 (16.9%)	
Student	34 (82.9%)	7 (3.4%)		18 (81.8%)	4 (18.2%)		16 (84.2%)	3 (15.8%)	
Percent FPL	92.5 (125.7)	98.8 (111.3)	0.175	98.6 (102.2)	109.3 (115.9)	0.268	83.9 (152.3)	76.6 (97.6)	0.896 ^b
Family Size	2.9 (1.5)	2.7 (1.4)	0.050	3.0 (1.5)	2.7 (1.3)	0.013*	2.8 (1.5)	2.8 (1.6)	0.766 ^b
		\$23,667			\$25,834		\$24,796		
Income	\$25,519 (\$38,938)	(27,787)	0.948	\$26,029 (40,204)	(28,547)	0.883	(37,089)	\$19,542 (26,456)	0.433 ^b
Years Education	11.8 (3.8)	12.9 (3.0)	0.014*	11.5 (4.2)	12.6 (3.0)	0.031*	12.2 (2.9)	13.7 (3.0)	0.160 ^b

Note. Unless otherwise indicated, T-test was used for all continuous variables, Chi-square for all discrete variables.

a. Fischer's exact test used.

b. Mann-Whitney U test used.

* p<0.05; **p<0.01; ***p<0.001

Social Determinants of Health:

Enrollment in GPC was significantly higher among white than non-white women entering care in their 2nd or 3rd trimester (12.8% vs. 5.4% $p=0.036$); enrollment in GPC by white women was higher but not significantly so among all subjects (16.4% vs. 13.2% $p = 0.245$) and slightly but not significantly lower among women entering care in their 1st trimester (18.8% vs. 19.8% $p = 0.785$). Enrollment in GPC was slightly but not significantly higher among Non-Hispanic compared to Hispanic women entering care in any trimester (16.3% vs. 15.6% $p = 0.656$); GPC enrollment significantly higher among non-Hispanic compared to Hispanic women entering care in their 1st trimester (20.7% vs. 15.2% $p = 0.10$), and was significantly lower among non-Hispanic compared to Hispanic women entering care in their 2nd or 3rd trimester (10.6% vs. 16.5% $p = 0.009$). GPC enrollment was slightly but not significantly lower among English compared to non-English speaking women entering care in any trimester (16.3% vs. 15.6% $p = 0.399$), slightly but not significantly higher among women in the 1st trimester stratum (19.2% vs. 15.5% $p = 0.129$), and significantly lower among English compared to non-English speaking women entering care in their 2nd or 3rd trimester (10.9% vs. 20.3% $p = 0.001$). Rates of GPC enrollment by insurance type varied by strata: among the all subjects strata, GPC enrollment was highest among privately insured women (21.1%), followed by uninsured women (15.8%), with a slightly lower rate among publicly insured women (15.2%) and this was significant ($p = 0.025$); among women entering care in their 1st trimester, GPC enrollment was highest among privately-insured women (24.3%), followed by publicly insured women (18.0%), followed by uninsured women (15.7%) and this was significant ($p = 0.043$); among women entering care in their 2nd or 3rd trimester, GPC enrollment was highest among uninsured women (15.9%), followed closely by privately-insured women (15.7%), followed by publicly-insured

women (11.3%) but this finding was not significant (0.153). GPC enrollment was slightly higher among homeless compared to not homeless women across all strata, but was only significantly higher for women entering care in their 2nd or 3rd trimester (19.1% vs. 15.4% $p = 0.052$ for all subjects; 21.4% vs. 17.9% $p = 0.229$ for women entering care in their 1st trimester; and 17.1% vs. 11.1% $p = 0.016$ for women entering care in their 2nd or 3rd trimester). Women who entered trimester in their 2nd or 3rd trimester and were migrant/seasonal workers enrolled in GPC at higher rates compared to women who were not migrant/seasonal workers (23.1% vs. 11.5%, $p < 0.001$) and this difference was significant. Among women entering prenatal care in their 2nd or 3rd trimester, being unemployed was associated with a significantly higher rate of GPC enrollment compared to part-time, full-time, or unknown employment status (14.5% vs. 28.8%, 18.1%, or 4.5%, $p = 0.030$). Being a student was associated with a lower rate of GPC enrollment, compared to non-students; this difference was significant for the all patient stratum (3.4% vs. 17.9%, $p = 0.21$), but was not significant for women in the first trimester stratum (18.4% vs. 18.2%, $p = 1.000$), nor the 2nd or 3rd trimester stratum (15.8% vs. 16.9%). Among women entering care in their first trimester, enrollees in the GPC cohort had significantly lower mean family size than TPC (2.7 vs. 3.0, $p = 0.013$); among women in the all subjects stratum the GPC cohort had lower but not significant mean family size compared to TPC (2.7 vs. 2.9, $p = 0.050$); family size was not significantly different between cohorts for women entering care in their 2nd or 3rd trimester (2.8 vs. 2.8, $p = 0.766$). Mean years of education was higher among women in the GPC cohort, across all strata (11.8 vs. 12.9 $p = 0.014$ for all subjects; 11.5 vs. 12.6 $p = 0.031$ for women entering care in their 1st trimester, and 12.2 vs. 13.7 $p = 0.160$ for women entering care in their 2nd or 3rd trimester) and was significant for women in the all subjects and 1st trimester strata.

Prenatal Complications:

Women diagnosed with gestational hypertension had significantly higher rates of GPC enrollment among all subjects (23.2% vs. 15.3% $p=0.001$), higher but not significant rates of GPC enrollment among women in the 1st trimester stratum (23.4% vs. 17.8% $p=0.093$), and significantly higher rates of GPC enrollment among women who entered care in their 2nd or 3rd trimester. Among women diagnosed with anemia complicating pregnancy GPC enrollment was highly significantly higher across all strata compared to women without that diagnosis (23.1% vs. 12.4% $p<0.001$; 27.1% vs. 14.2% $p<0.001$; and 18.0% vs. 9.4% $p<0.001$ respectively). Among women diagnosed with uterine size-date discrepancy complicating pregnancy, GPC enrollment was significantly higher among women who entered care in any trimester or those who entered in their 1st trimester (21.6% vs. 14.7% $p<0.001$, and 25.5% vs. 16.8% $P=0.001$, respectively); GPC enrollment was higher but not significant among women entering care in their 2nd or 3rd trimester (16.1% vs. 11.8% $p=0.110$). Among women diagnosed with other NEC condition complicating pregnancy, GPC enrollment was significantly higher across all strata compared to women without that diagnosis (19.9% vs. 14.0% $p < 0.001$, 21.3% vs. 16.6% $p=0.024$, and 17.2% vs. 10.7% $p=0.005$, respectively).

Risk Screening:

Among women screening positive for tobacco use in the past 3 months compared to those screening negative, GPC enrollment was lower across all strata, and significantly lower among all subjects and among women entering prenatal care in their 2nd or 3rd trimester (9.8% vs. 17.7% $p = 0.008$ among all subjects; 14.4% vs. 18.4% $p=0.345$ among women entering care in

their 1st trimester, and 4.3% vs. 16.7% $p=0.003$ among women in the 2nd or 3rd trimester stratum). Among women who screened positive for history of parental drug use, GPC enrollment was higher but not significantly among all subjects (16.4% vs. 15.1% $p=0.665$), higher among women entering care in their 1st trimester (24.1% vs. 15.0% $p=0.028$), and significantly lower among women entering care in their 2nd or 3rd trimester (4.3% vs. 16.7% $p=0.003$). Mean reported weekly frequency of illicit drug use, among those reporting any illicit drug use, was highly significantly lower among women in the GPC cohort who entered care in their 1st trimester (1.0 vs. 3.4 $p<0.001$), and highly significantly higher among women in the GPC cohort who entered care in their 2nd or 3rd trimester (10.0 vs. 5.7 $p<0.001$), and higher but not significantly so among women in the GPC cohort in the all patients stratum (4.8 vs. 5.5 $p=0.827$).

Table 3. Prenatal Complication Diagnoses by Cohort, Stratified by Trimester at Intake

Variable	All Trimesters at Intake			1st Trimester at Intake			2nd and 3rd Trimester at Intake		
	Traditional N (%) or Mean (Std Dev)	Group N (%) or Mean (Std Dev)	p-value	Traditional N (%) or Mean (Std Dev)	Group N (%) or Mean (Std Dev)	p-value	Traditional N (%) or Mean (Std Dev)	Group N (%) or Mean (Std Dev)	p-value
Alcohol Use									
During									
Pregnancy			0.583			0.154			0.377 ^a
Not	1974			1142					
Diagnosed	(84.0%)	377 (16.0%)		(81.7%)	255 (18.3%)		832 (87.2%)	122 (12.8%)	
Diagnosed	20 (80.0%)	5 (20.0%)		9 (64.3%)	5 (35.7%)		11 (100.0%)	0 (0.0%)	
Drug Use									
During									
Pregnancy			0.759			0.093			0.055
Not	1828			1082					
Diagnosed	(83.9%)	352 (16.1%)		(82.0%)	237 (18.0%)		746 (86.6%)	115 (13.4%)	
Diagnosed	166 (84.7%)	30 (15.3%)		69 (75.0%)	23 (25.0%)		97 (93.3%)	7 (6.7%)	
Tobacco Use									
During									
Pregnancy			0.234			0.810			0.208
Not	1680								
Diagnosed	(83.5%)	331 (16.5%)		994 (81.5%)	226 (18.5%)		686 (86.7%)	105 (13.3%)	
Diagnosed	314 (86.0%)	51 (14.0%)		157 (82.2%)	34 (17.8%)		157 (90.2%)	17 (9.8%)	
High Risk									
Pregnancy			0.104			0.193			0.065
Not	702								
diagnosed	(85.6%)	118 (14.4%)		462 (83.2%)	93 (16.8%)		240 (90.6%)	25 (9.4%)	
Diagnosed	1292 (83.0%)	264 (17.0%)		689 (80.5%)	167 (19.5%)		603 (86.1%)	97 (13.9%)	
GDM									
Not	1956		0.054	1126		0.069			1.000 ^a
Diagnosed	(83.7%)	380 (16.3%)		(81.3%)	259 (18.7%)		830 (87.3%)	121 (12.7%)	

Diagnosed	38 (95.0%)	2 (5.0%)		25 (96.2%)	1 (3.8%)		13 (92.9%)	1 (7.1%)	
GHTN Pre-existing			0.001**			0.093			0.002**
Not Diagnosed	1809 (84.7%)	326 (15.3%)		1033 (82.2%)	224 (17.8%)		776 (88.4%)	102 (11.6%)	
Diagnosed	185 (76.8%)	56 (23.2%)		118 (76.6%)	36 (23.4%)		67 (77.0%)	20 (23.0%)	
Preeclampsia			0.503			0.938			0.305
Not diagnosed	1948 (84.0%)	371 (16.0%)		1121 (81.6%)	253 (18.4%)		827 (87.5%)	118 (12.5%)	
Diagnosed	46 (80.7%)	11 (19.3%)		30 (81.1%)	7 (18.9%)		16 (80.0%)	4 (20.0%)	
Obesity Complicating Pregnancy			0.454			0.513			0.877
Not diagnosed	1770 (84.1%)	334 (15.9%)		1013 (81.8%)	225 (18.2%)		757 (87.4%)	109 (12.6%)	
Diagnosed	224 (82.4%)	48 (17.6%)		138 (79.8%)	35 (20.2%)		86 (86.9%)	13 (13.1%)	
Anemia Complicating Pregnancy			<0.001**			<0.001**			<0.001***
Not diagnosed	1361 (87.6%)	192 (12.4%)	*	814 (85.8%)	135 (14.2%)	*	547 (90.6%)	57 (9.4%)	
Diagnosed	633 (76.9%)	190 (23.1%)		337 (72.9%)	125 (27.1%)		296 (82.0%)	65 (18.0%)	
Uterine Size-Date Discrepancy Complicating Pregnancy			<0.001**			0.001**			0.110
Not diagnosed	1630 (85.3%)	282 (14.7%)	*	949 (83.2%)	191 (16.8%)		681 (88.2%)	91 (11.8%)	
Diagnosed	364 (78.4%)	100 (21.6%)		202 (74.5%)	69 (25.5%)		162 (83.9%)	31 (16.1%)	
Other NEC Condition Complicating Pregnancy			<0.001**			0.024**			0.005**
Not diagnosed	1319 (86.0%)	214 (14.0%)	*	716 (83.4%)	142 (16.6%)		603 (89.3%)	72 (10.7%)	

	675					
Diagnosed	(80.1%)	168 (19.9%)	435 (78.7%)	118 (21.3%)	240 (82.8%)	50 (17.2%)

Note. Unless otherwise indicated, Chi-square was used.
a. Fischer's exact test used.
* p<0.05; **p<0.01; ***p<0.001

Table 4. Risk Screenings by Cohort, Stratified by Trimester at Intake

Variable	All Trimesters at Intake			1st Trimester at Intake			2nd and 3rd Trimester at Intake		
	Traditional	Group	p-value	Traditional	Group	p-value	Traditional	Group	p-value
	<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>		<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>		<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>	
5Ps Screen Administered			0.626			0.484			71.5%
Not administered	1358 (83.7%)	265 (16.3%)		798 (81.1%)	186 (18.9%)		560 (87.6%)	79 (12.4%)	
Administered	636 (84.5%)	117 (15.5%)		353 (82.7%)	74 (17.3%)		283 (86.8%)	43 (13.2%)	
5Ps Tobacco			0.008**			0.345			0.003**
Negative	452 (82.3%)	97 (17.7%)		258 (81.6%)	58 (18.4%)		194 (83.3%)	39 (16.7%)	
Positive	184 (90.2%)	20 (9.8%)		95 (85.6%)	16 (14.4%)		89 (95.7%)	4 (4.3%)	
5Ps Parents			0.665			0.028*			0.030*
Negative	472 (84.9%)	84 (15.1%)		267 (85.0%)	47 (15.0%)		205 (84.7%)	37 (15.3%)	
Positive	163 (83.6%)	32 (16.4%)		85 (75.9%)	27 (24.1%)		78 (94.0%)	5 (6.0%)	
5Ps Peers			0.501			0.825			0.408
Negative	562 (84.3%)	105 (15.7%)		327 (82.8%)	68 (17.2%)		235 (86.4%)	37 (13.6%)	
Positive	74 (87.1%)	11 (12.9%)		26 (81.3%)	6 (18.8%)		48 (90.6%)	5 (9.4%)	
5Ps Partner			0.128			0.402			0.551 a
Negative	590 (83.9%)	113 (16.1%)		331 (82.1%)	72 (17.9%)		259 (86.3%)	41 (13.7%)	
Positive	46 (92.0%)	4 (8.0%)		22 (91.7%)	2 (8.3%)		24 (92.3%)	2 (7.7%)	
5Ps Past			0.351			0.996			0.196
Negative	543 (83.9%)	104 (16.1%)		310 (82.7%)	65 (17.3%)		233 (85.7%)	39 (14.3%)	

Positive	91 (87.5%)	13 (12.5%)		43 (82.7%)	9 (17.3%)		48 (92.3%)	4 (7.7%)	
5Ps Present			0.335			0.607			0.305
Negative	550 (84.0%)	105 (16.0%)		302 (82.3%)	65 (17.7%)		248 (86.1%)	40 (13.9%)	
Positive	86 (87.8%)	12 (12.2%)		51 (85.0%)	9 (15.0%)		35 (92.1%)	3 (7.9%)	
5Ps Emotional Health			0.333			0.687			0.419
Negative	537 (83.9%)	103 (16.1%)		308 (82.4%)	66 (17.6%)		229 (86.1%)	37 (13.9%)	
Positive	98 (87.5%)	14 (12.5%)		44 (84.6%)	8 (15.4%)		54 (90.0%)	6 (10.0%)	
5Ps Violence			0.134			0.782			0.089
Negative	565 (83.7%)	110 (16.3%)		324 (82.4%)	69 (17.6%)		241 (85.5%)	41 (14.5%)	
Positive	66 (90.4%)	7 (9.6%)		27 (84.4%)	5 (15.6%)		39 (95.1%)	2 (4.9%)	
Tobacco Status Vitals			0.256			0.851			0.182 a
Never	194 (84.7%)	35 (15.3%)		132 (83.5%)	26 (16.5%)		62 (87.3%)	9 (12.7%)	
Former	70 (80.5%)	17 (19.5%)		41 (80.4%)	10 (19.6%)		29 (80.6%)	7 (19.4%)	
Current (any frequency)	63 (90.0%)	7 (10.0%)		27 (84.4%)	5 (15.6%)		36 (94.7%)	2 (5.3%)	
Alcohol Status Vitals			0.460			0.483			1.000 a
No	222 (86.0%)	36 (14.0%)		128 (84.8%)	23 (15.2%)		94 (87.9%)	13 (12.1%)	
Yes	88 (83.0%)	18 (17.0%)		60 (81.1%)	14 (18.9%)		28 (87.5%)	4 (12.5%)	
Illicit Drug Status Vitals			0.627			0.967			0.780 a
No	253 (84.6%)	46 (15.4%)		162 (83.5%)	32 (16.5%)		91 (86.7%)	14 (13.3%)	
Yes	66 (86.8%)	10 (13.2%)		31 (83.8%)	6 (16.2%)		35 (89.7%)	4 (10.3%)	
5Ps Days Drink	0.1 (0.3)	0.3 (0.5)	0.240	0.2 (0.4)	0.3 (0.5)	0.332	0.1 (0.2)	0.3 (0.5)	0.503
5Ps Drinks per Day	0.2 (0.4)	0.2 (0.4)	0.890	0.2 (0.4)	0.2 (0.4)	0.818	0.1 (0.3)	0.0 (0.0)	0.598
5Ps Days Binge	0.1 (0.2)	0.2 (0.4)	0.142	0.1 (0.3)	0.2 (0.4)	0.180	0.0 (0.2)	0.0 (0.0)	0.806 b
Tobacco Pack Years Vitals	3.5 (2.8)	4.5 (5.0)	0.936	3.3 (2.5)	3.8 (3.1)	0.851	3.5 (3.1)	5.8 (8.0)	0.862 b
Alcohol Oz per week vitals	0.2 (0.7)	0.3 (0.7)	0.151	0.1 (0.4)	0.4 (0.8)	0.073	0.3 (0.9)	0.0 (0.0)	0.515 b

Illicit Drug Use per Week	4.8 (3.9)	5.5 (6.4)	0.827	3.4 (2.6)	1.0 (0.0)	<0.001***	5.7 (4.4)	10.0 (0.0)	<0.001***
Note. Unless otherwise indicated, T-test was used for all continuous variables, Chi-square for all discrete variables.									
a. Fischer's exact test used.									
b. Mann-Whitney U test used.									
* p<0.05; **p<0.01; ***p<0.001									

Table 5. Recency of Demographic Update by Cohort, Stratified by Trimester at Intake

Variable	All Trimesters at Intake			1st Trimester at Intake			2nd and 3rd Trimester at Intake		
	Traditional	Group	p- value	Traditional	Group	p-value	Traditional	Group	p-value
	<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>		<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>		<u>N (%) or Mean (Std Dev)</u>	<u>N (%) or Mean (Std Dev)</u>	
Race Updated	17.3 (19.7)	19.6 (19.4)	0.040*	17.7 (19.9)	20.5 (19.1)	0.035*	16.7 (19.4)	17.5 (19.9)	0.680
Ethnicity Updated	17.2 (19.7)	19.4 (19.3)	0.048*	17.7 (19.9)	20.3 (19.1)	0.049*	16.6 (19.5)	17.5 (19.7)	0.667
Language Updated	15.6 (19.2)	17.8 (18.8)	0.040*	16.0 (19.4)	18.7 (18.6)	0.046*	15.0 (18.9)	16.0 (19.0)	0.595
Note. T-test was used for all variables.									
* p<0.05; **p<0.01; ***p<0.001									

Chapter 4. DISCUSSION

4.1 PRINCIPAL FINDINGS

The pregnancy characteristics that were significantly associated with higher GPC enrollment are also associated with lower risk of adverse perinatal outcomes. GPC enrollment was consistently higher among women entering care in earlier trimesters across relevant strata, gestational age tended to be lower, as were the average number of prior pregnancies. Earlier gestational age and trimester upon entry to care are associated with improved perinatal outcomes, as are lower gestational age and fewer prior pregnancies. These results are consistent with a pattern of women who may be at lower risk of adverse outcomes based on their baseline pregnancy characteristics electing GPC at higher rates.

Based on the results of the literature review, the author anticipated that cohorts would differ substantially in terms of SDOH and that variables would cluster, with indicators of higher socioeconomic status (SES), associated in the literature with improved perinatal outcomes, consistently found in GPC. This study found that women in the GPC cohort had some indicators of higher SES than TPC, yet did not have other markers; the level heterogeneity observed was unexpected by the author. For example, despite reporting on average significantly more years of education and higher rates of private insurance coverage, which are associated with higher SES, women who elected GPC were not more likely to report significantly higher income, FPL, lower rates of homelessness, nor lower rates of unemployment, which are associated with lower SES. This pattern of results was consistent across strata, though more pronounced in the 1st trimester stratum. These results suggest the potential for multiple types and directions of selection bias in observational studies of GPC outcomes.

Differences in GPC enrollment between trimester of care strata highlight a potentially interesting finding among Hispanic women. The differences in strata suggest that GPC enrollment rates were higher for Hispanic women relative to non-Hispanic women who entered care in their 2nd or 3rd trimester. As Spanish-speaking is often associated with Hispanic ethnicity in the study site's population, it is possible that this result could be explained by some difference

in scheduling of Spanish language cohorts. These findings may suggest the potential of a subpopulation of Hispanic women who enter care later in pregnancy and may have different needs and characteristics from the general population.

Of the diagnostic results, rates of some complication diagnoses were significantly higher among GPC women. GPC women had higher rates of anemia, uterine size-date discrepancy, as well as the diagnosis of “other complications not elsewhere classified,” which were highly significant and persisted across strata. It is not possible from this study design to determine whether these associations were due to higher risk women attending GPC, differences in diagnostic accuracy between cohorts, or some characteristic of the way care is delivered in the two settings. The author speculates that these findings may be generally consistent with the study site’s stated policy of encouraging women who are perceived as at elevated risk for complications to enroll in GPC. The uterine size-date discrepancy finding is particularly noteworthy as it has potential impacts on clinical care and birth outcomes potentially resulting in dating inaccuracies; moreover, it is possible differences in the way fundal height measurements were taken in the group care setting could have led to a higher rate of discrepancies in that cohort. This finding has implications for future research.

Overall, the category of factors examined suggest the potential of selection bias acting in different directions. Pregnancy characteristics of women who elect GPC may be consistent with reduced risk of adverse perinatal outcomes, and, although somewhat heterogenous, the SDOH and behavioral risk factors are also consistent with reduced risk; however, the medical complication data may be consistent with higher risk of adverse outcomes. Further research is needed to clarify explore the causal relationships between these classes of variables, in order to gain a clearer understanding of the types and magnitude of selection biases at play, and make a more reliable determination of the impact of GPC on perinatal outcomes.

4.2 RELATION TO PREVIOUS STUDIES

Although literature examining the effect of GPC in populations with medical complications other than GDM is lacking (Mazzoni & Carter, 2017), cohort studies that included GHTN found higher rates among TPC than GPC patients (Kominiarek et al, 2017; Schellinger et al., 2017). In contrast, this study found complication rates that were not significantly different

between cohorts, or significantly higher in GPC populations. Given the limited literature on the subject--to the author's knowledge, this may be the first study to consider uterine size-date discrepancy in GPC--more study is needed to determine for which clinical complications, which populations, and under what circumstances GPC may be associated with higher rates of diagnosed prenatal complications. There is also a need for literature exploring the impact of site-specific practices that may be associated with higher diagnosis or prevalence of medical complications.

Hispanic women are a well-studied population in literature on GPC. Previous cohort studies of GPC on Hispanic women have focused on outcomes (Schellinger et al., 2017; Tandon, Colon, Vega, Murphy, & Alonso, 2012; Trudnak, 2014). Many studies have described the well-documented phenomenon referred to as the "Latina Paradox", in which Hispanic women tend to have similar birth outcomes to white women, despite SES disadvantages (Fuentes-Afflick & Lurie, 1997). The findings in this study of variance in Hispanic representation across trimester of care strata are not inconsistent with that "paradox," and suggests the potential for complex selection bias interactions within a potentially heterogeneous subpopulation. Finally, a 2017 review of GPC concluded that African-American and Hispanic women may be more likely to be satisfied with GPC than white non-Hispanic women (Mazzoni et al. 2017), a finding which may help explain the rates of GPC participation by ethnicity and race in this study. Additional study of Hispanic women entering care in their 2nd and 3rd trimester seeking GPC may be warranted.

4.3 STRENGTHS AND LIMITATIONS

A strength of this study was the inclusion of variables relating to pregnancy characteristics, SDOH, risk, and diagnosis. Taken together, this set of variables allows for detailed description of both cohorts throughout prenatal care. An additional strength of the study is that the author was previously employed at the study site for 7 years, during which time he assisted in developing the data warehouse that was queried for this study; this experience informed the study design, variable selection process, and query procedures.

An inherent limitation of cohort studies is the limited ability to make causal inferences. While this is less of a concern for SDOH variables that are unlikely to be impacted by cohort selection, it is a serious limitation for variables related to diagnosis. It is not possible to determine from this study whether the association between cohort and pregnancy complication

diagnoses were causal, or even if causal, whether complication diagnosis influenced cohort selection or if the cohort selection influenced diagnosis of complication.

The findings from the “other complications not elsewhere classified” variable also has limitations. That code is used to indicate a concern of complications without specifying what the nature of the complication is. The author speculates that the relatively high frequency with which this code was used may reflect a lack of incentive for providers in FQHCs to use more explicit coding, as compensation is typically not impacted by more explicit coding as it may be in other settings.

There are several limitations to this study related to data collection and reliability. Variables related to financial information are self-reported; proof-of-income and supporting documents were required by the study site for all reported income, however patients with private insurance were not required to report income. Given that rates of private insurance were found to be higher in GPC subjects, it is possible that the apparent lack of significant income or FPL difference between cohorts could instead be due to systematic under-reporting of privately insured women with higher incomes. As previously discussed, among the variables unable to be collected was physical site of care; it is possible that GPC participation rates, provider diagnostic accuracy, SDOH variables, or other variables varied systematically by site, confounding findings of the study. Site effects could also take the form of selection bias, as traveling to the GPC site could have been a barrier to subjects typically receiving their care at other sites. This effect may be mitigated somewhat by the fact that the furthest prenatal care site was 3 miles away from the site at which GPC classes were held. An additional limitation is that many variables had missing data for more than half of subjects, introducing the possibility of systematic bias between cohorts. In particular, while screening rates for the 5Ps survey did not vary significantly between cohorts, the large number of missing values raises the possibility of response bias or other systematic bias.

Due to technical limitations of the study site’s build of the EHR and design of the data warehouse, language, race, and ethnicity values listed in the study are those listed at the most recent date updated at the time the query was run; all other variables reflect the state of the EHR at the time of the last completed visit during the pregnancy.

Finally, significant differences were found between cohorts in the date at which demographic fields race, ethnicity, and language were last reviewed or updated in the EHR, with

GPC patients significantly more likely to have had those values reviewed or updated more recently relative to their EDD than TPC patients. The author speculates that this pattern could be a result of patients electing GPC potentially receiving more follow-up care or being more likely to have continuing contact with the study site after the end of their pregnancy episode. This pattern of differential update dates presents a theoretical threat to validity for findings related to race, ethnicity, and language, to the extent that they may have systematically changed over time. However, while this finding represents a limitation for this study, it may be of potential value to other researchers making use of demographic information collected from EHRs; it demonstrates an association between the format of prenatal care and how recently some demographic records are reviewed or updated. This has implications for other studies that may rely on similar datasets.

4.4 CONCLUSION AND IMPLICATIONS:

Findings from this study may be useful for FQHCs or similar clinics serving low-income populations in designing or modifying GPC programs. These results suggest an association between private insurance and lower rates of GPC participation; clinics could use this information to explore barriers Medicaid patients may face to receiving GPC. This study's results also imply the possibility of a subgroup of Hispanic women who enter late in prenatal care yet seek to join GPC groups, which could be worth exploration for the formation of more targeted groups, or devising marketing and enrollment strategies for such a subpopulation.

Maternal characteristics are associated both with prenatal outcomes as well as women's selection of GPC. In the absence of abundant large-scale RCTs, characterizing the relationship between pregnancy characteristics, SDOH, behavioral risks, and medical complications is likely to be important in order to identify the dynamics of selection bias at work, and ultimately to gain an improved understanding of the impact of GPC on perinatal outcomes. This study found that some variables relating to pregnancy characteristics and SDOH are associated with women's selection of GPC. Additionally, it found an association between some behavioral risk factors and pregnancy complications that were higher in the GPC cohort. Of particular interest are higher rates of uterine size-date discrepancies, which suggests an area for further research. Finally, interactions between Hispanic ethnicity, trimester of intake, and GPC cohort status were

observed that warrant further research to better understand the dynamics in this population. These findings may be of practical utility for clinics designing or modifying GPC programs for low-income populations, as well as informing future research on the association between maternal characteristics and the selection of group prenatal care.

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APPENDIX A: DIAGNOSIS CODE VARIABLE DEFINITIONS

Table 1A. Diagnosis Code Variable Definitions

Variable	ICD 9 Codes	ICD 10 Codes	Comment
High Risk Pregnancy	V23.x	Z34.x	
Gestational Diabetes (GDM)	648.0x	O24.x	
Gestational Hypertension (GHTN) Pre-existing	642.x	O10.0x, O10.3x, O10.5x, O10.6x	Pre-existing HTN complicating pregnancy. Excludes codes relating to delivery; excludes preeclampsia.
Preeclampsia	642.4x, 642.5x, 642.7x	O14.x	Excludes pre-existing hypertension
Alcohol use during pregnancy	305.00, 305.01, 305.02, 303.0x, 303.90, 303.91, 303.92	O99.31, F10.19, F10.2x (except F10.21)	Includes nondependent alcohol abuse, acute intoxication, alcohol use complicating pregnancy, and other/unspecified acute intoxication, but excludes abuse in remission.
Tobacco use during pregnancy	305.1x, 649.0x	O99.32	Current use, complicating pregnancy
Obesity complicating pregnancy	649.1x	O99.21x	
Anemia complicating pregnancy	648.2x	O99.0x	
Uterine size-date discrepancy	649.6x	O26.84x	
Other complication not elsewhere classified	646.8x	O99.89x	

Diagnoses were included if they matched either the ICD 9 or the ICD 10 code range.

APPENDIX B: 5P'S QUESTIONNAIRE

Patient/Client Name: _____ Date: _____
 Screener Name: _____ Date: _____
 Reviewed by Qualified Provider: _____ Date: _____

Behavioral Health Risks Screening Tool for Pregnant Women and Women of Childbearing Age Provider Tool

Women and their children's health can be affected by emotional problems, alcohol, tobacco, other drug use and violence. Women and their children's health are also affected when these same problems are present in people who are close to them. Alcohol includes beer, wine, wine coolers, liquor and spirits. Tobacco products include cigarettes, cigars, snuff and chewing tobacco.

1. Have you smoked any cigarettes or used any tobacco products in the past three months? TOBACCO		YES <input type="checkbox"/>		NO <input type="checkbox"/>
2. Did any of your parents have a problem with alcohol or other drug use? PARENTS	YES <input type="checkbox"/>			NO <input type="checkbox"/>
3. Do any of your friends have a problem with alcohol or other drug use? PEERS	YES <input type="checkbox"/>			NO <input type="checkbox"/>
4. Does your partner have a problem with alcohol or other drug use? PARTNER		YES <input type="checkbox"/>		NO <input type="checkbox"/>
5. In the past, have you had difficulties in your life due to alcohol or other drugs, including prescription medications? PAST		YES <input type="checkbox"/>		NO <input type="checkbox"/>
6. Check YES if she agrees with any of these statements. In the past month, have you drunk any alcohol or used other drugs? - How many days per month do you drink? _____ - How many drinks on any given day? _____ - How often did you have 4 or more drinks per day in the last month? _____ PRESENT		YES <input type="checkbox"/>		NO <input type="checkbox"/>
7. Check YES if she agrees with any of these statements. In the past 7 days, have you: - Blamed yourself unnecessarily when things went wrong? - Been anxious or worried for no good reason? - Felt scared or panicky for no good reason? EMOTIONAL HEALTH			YES <input type="checkbox"/>	NO <input type="checkbox"/>
8. Are you currently or have you ever been in a relationship where you were physically hurt, choked, threatened, controlled, or made to feel afraid? VIOLENCE			YES <input type="checkbox"/>	NO <input type="checkbox"/>

PROVIDER USE ONLY

Review risk.

Review substance use, set healthy goals.

Review and/or administer full AAS or Relationship Assessment Tool / WEB screening. See instructions.

Review and/or administer PHQ-9 if not pregnant / Edinburgh PDS-10 if pregnant. See instructions.

Develop a follow up plan with patient.

Brief Intervention/Brief Treatment			
Did you State your medical concern?	Y	N	NA
Did you Advise to abstain or reduce use?			
Did you Check patient's reaction?			
Did you Refer for further assessment?			
Did you Provide written information?			

Moderate drinking for non-pregnant women is one drink per day. Women who are pregnant or planning to become pregnant should not use alcohol, tobacco, illicit drugs or prescription medication other than as prescribed.

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