



Collecting pregnancy data in the Strong Heart Study



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Background

- Pregnancy complications such as hypertensive disorders of pregnancy (gestational hypertension and pre-eclampsia; HDP) and gestational diabetes (GDM) predict cardiovascular morbidity and mortality
- Most studies addressing the relationship between CVD and pregnancy have been conducted in White populations, even though studies suggest racial variation in likelihood of progression from GDM to type 2 diabetes or from prehypertension to hypertension
- American Indian women are at high risk for pregnancy complications and adverse birth outcomes, although there is substantial variation by state and tribe
- AIAN women are at particularly higher risk for complications linked to higher BMI: GDM, pre-eclampsia, and macrosomia
- Few or no large-scale studies that address reproductive health in this population



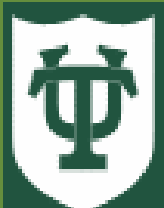
The Strong Heart Study

- A study of cardiovascular disease and its risk factors among American Indian men and women
- Started in 1988, NHLBI-supported
- The largest epidemiologic study of American Indians ever undertaken
- Designed to estimate cardiovascular disease mortality and morbidity and the prevalence of cardiovascular disease risk factors in American Indians and to assess the significance of these risk factors in a longitudinal analysis.
- Included 12 American Indian tribes and communities in three geographic areas: an area near Phoenix, Arizona; the southwestern area of Oklahoma; and western and central North and South Dakota.



The Strong Heart Study - methods

- Initial stages (Phase I: 1989-1991; Phase II: 1993-1995; Phase III: 1998-1999)
 - Survey to determine cardiovascular disease mortality rates from 1984 to 1994 among tribal members aged 35-74 years of age residing in the 3 study areas (the community mortality study).
 - Clinical examination of 4,549 eligible tribal members
 - Morbidity and mortality surveillance of these participants
- Phase III study included a pilot family study of approximately 30 families
- Phase IV recruited additional 18 to 25 extended families from each of the field centers (2001-2003)
 - 3,776 individuals from 94 families, of whom 825 were re-examined Phase III participants
- Phase V completed the second exam on over 90% of the living family cohort and continued surveillance of the original cohort.
 - Phase IV and V included echocardiograms
- Phase VI: morbidity and mortality surveillance of the family cohort and the original cohort (no physical exam; completed 2019)
 - Cardiovascular disease, cancer, liver disease, and inflammatory disease
- Phase VII is currently underway: continued surveillance; basic clinical follow-up examination of approximately 3,500 participants
- The present authors received an IDeA women's health supplement to examine pregnancy data in this cohort



Women's health supplement aims

- To assess quality of self-report of reproductive health in an American Indian cohort
- To characterize pre-eclampsia and gestational diabetes in an American Indian cohort
 - The combined burden of pre-existing diabetes and GDM will be substantially higher than comparable numbers in other ethnic groups.
 - HDP and GDM will predict later cardiovascular disease and type 2 diabetes.
 - Pre-pregnancy cardiovascular risk factors will predict pregnancy complications.



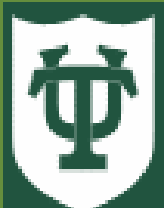
The Strong Heart Study – pregnancy data

- In phases 1, 2, 4, and 5, female participants were asked about the number of times they had given birth, living children, and “lost pregnancies” (miscarriage and stillbirth)
- When participants were asked about high blood pressure and diabetes, “only during pregnancy” was one option
- Phase 3 – participants asked about high blood pressure during pregnancy
- Phase 4 – participants asked if currently pregnant/breastfeeding
- Phase 5 – participants asked about history of hypertension during pregnancy and preeclampsia
- Phase 6 – medical history included parity, gravidity, stillbirth, pre-eclampsia in first or later pregnancies, GDM in first or later pregnancies (also dates of first pregnancy and complicated pregnancies)



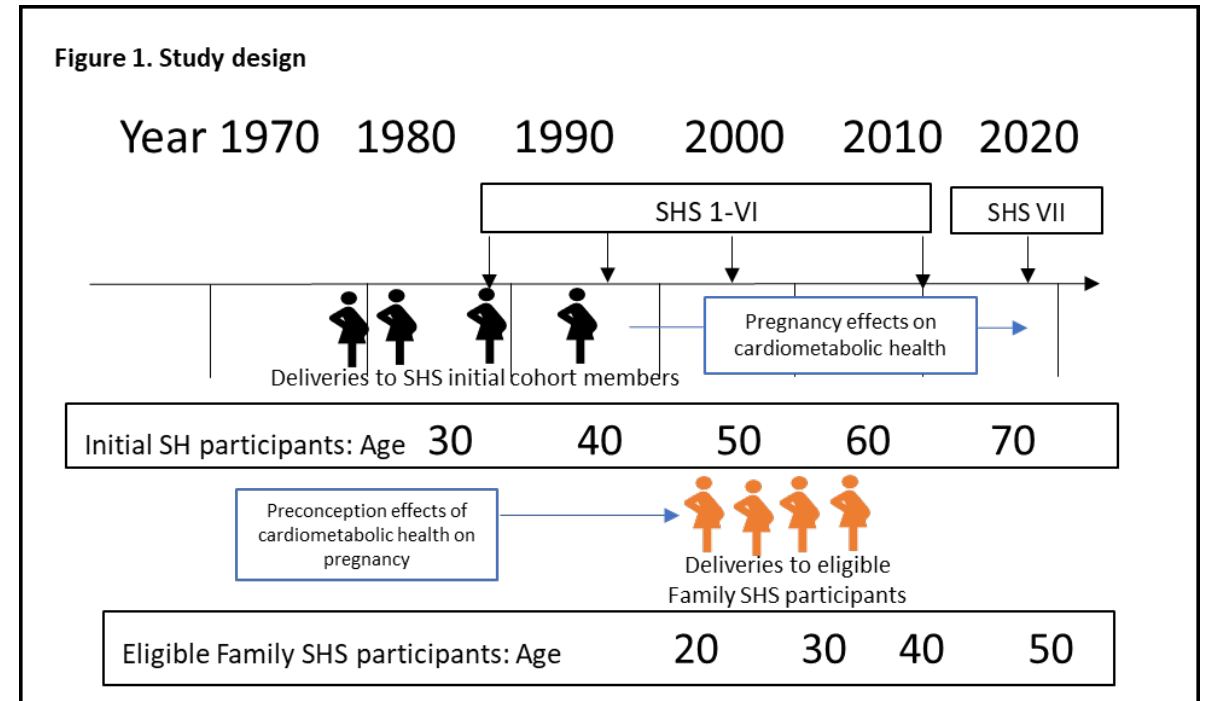
The Strong Heart Study – other sources of pregnancy data

- Medical records – requested for cases of PE and a subset as controls
 - Previous study included some members of the cohort
 - Requested based on data provided in phase VI
 - Abstracted and reviewed
- National Data Warehouse of Indian Health Service
- Birth certificates



Integrating Strong Heart Study and pregnancy data

- Retrospective report – all female members
- Prospective – women of reproductive age
 - Pregnancies occur randomly relative to study visits



The Strong Heart Study – validation of pre-eclampsia data

- Self-report vs. NDW data

		Pre-eclampsia IHS Code		
		Yes	No	Total
Pre-eclampsia self-report	Yes	7	26	33
	No	15	1733	1748
	Total	22	1759	1781

Kappa=0.24

		Pre-eclampsia/HTN/Proteinuria IHS Code		
		Yes	No	Total
Pre-eclampsia self-report	Yes	11	22	33
	No	39	1709	1754
	Total	50	1731	1781

Kappa=0.25

- Self-report vs. medical records (study 1)

		Medical records		
		Yes	No	Total
Pre-eclampsia self-report	Yes	13	1	14
	No	6	3	9
	Total	19	4	23

Kappa=0.29

- Self-report vs. medical records (study 2)

		Medical records		
		Yes	No	Total
Pre-eclampsia self-report	Yes	8	18	25
	No	1	7	9
	Total	9	25	34

Kappa=0.11



GDM and pre- and post-pregnancy CVD – study population

	women with a pre-pregnancy visit (n=294)		women with a post-pregnancy visit (n=1710)	
	mean	SD	mean	SD
age at first visit	22.0	5.7	41.6	13.4
age at first birth	21.9	4.4	21.1	4.1
BMI at first visit	29.1	8.0	31.2	7.1
	N	%	N	%
highest reported education				
<HS	58	19.7	300	17.6
HS	122	41.5	627	36.7
AA, some college	89	30.3	535	31.3
college+	25	8.5	246	14.4
income				
<\$5K	64	28.2	362	24.4
\$5K-15K	66	29.1	416	28.1
>\$15K	97	42.7	705	47.5
missing/refused/don't know	67		227	



GDM and pre- and post-pregnancy CVD – study population

parity	women with a pre-pregnancy visit (n=294)		women with a post-pregnancy visit (n=1710)	
0	152	52.1	20	1.2
1	43	14.7	227	13.3
2	58	19.9	325	19.0
3	19	6.5	371	21.7
4-5	15	5.1	445	26.1
6+	5	1.7	320	18.7
smoking				
Current	107	36.4	674	39.5
Former	46	15.7	412	24.1
Never	141	48.0	622	36.4
alcohol visit				
Current	210	71.4	921	54.0
Former	45	15.3	579	34.0
Never	39	13.3	205	12.0



Pre-pregnancy risk factors predicting GDM

GDM at any pregnancy – pre-pregnancy sample – 23, 7.8%; additional 6.8% with DM prior to pregnancy

	OR*	95% CI
BMI	1.03	0.98-1.09
systolic blood pressure	1.01	0.96-1.05
diastolic blood pressure	1.02	0.98-1.08
cholesterol	1.00	0.98-1.02
LDL	1.00	0.98-1.02
HDL	1.00	0.97-1.04
glucose	1.06	1.01-1.12
triglycerides	1.00	0.99 -1.01
*adjusted for age, BMI (non-BMI models), smoking, alcohol use, parity, education, income at pre-pregnancy visit.		



GDM predicting later cardiovascular health

	N	%		mean age of occurrence/ onset	aHR	95% CI
coronary heart disease	203	12.1		59.4	1.47	0.85-2.53
cardiovascular disease	269	16.0		59.2	1.32	0.81-2.17
myocardial infarction	118	7.0		59.8	1.17	0.58-2.46
stroke	63	3.7		59.9	1.67	0.58-4.82
diabetes*	741	44.0		53.5	1.98	1.51-2.59
adjusted for time on study, smoking, BMI, education, income, menopausal status, age at birth for GDM						
*Hazards were not proportional for diabetes. HR provided is for age 50.						



Covariates predicting progression from GDM to T2DM

	Progressed to DM (N=100)		Did not progress (n=42)		
	mean	SD	mean	SD	p
age at first birth	21.5	4.5	21.8	5.6	0.73
BMI at first visit	33.5	7.0	30.2	6.8	0.01
BMI at post-pregnancy visit	33.8	6.8	31.5	7.4	0.08
SBP at post-pregnancy visit (n=125)	119.1	13.6	114.6	10.7	0.08
total cholesterol at post-pregnancy visit (n=111)	184.2	37.7	189.4	34.4	0.50
LDL at post-pregnancy visit (n=111)	103.7	29.2	105.0	22.5	0.82
HDL at post-pregnancy visit (n=111)	47.8	9.2	48.0	11.1	0.91
HbA1c at post-pregnancy visit (n=73)	6.9	2.2	5.1	0.5	<0.01
glucose at post-pregnancy visit (n=100)	139.2	70.3	93.3	9.6	<0.01
triglycerides at post-pregnancy visit (n=111)	138.5	74.8	181.2	130.8	0.09



Limitations

- Self-report of GDM
- Limited number of cases
- Limited pre-pregnancy data
- Incomplete pregnancy history



Conclusions

- Accessing pregnancy data, even with records and appropriate permissions, is difficult
- Developing an accurate retrospective diagnosis of pre-eclampsia is difficult
- Major predictors and consequences of GDM relate to glucose and BMI
 - Limited associations with other CV risk factors
- High prevalence of diabetes
 - Early-life studies may be necessary



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