

**Background**

- The understanding role of Sex Hormone Binding Globulin evolved from transport protein for sex steroids to be a part in multiple and complex physiological interactions with various targets. <sup>1</sup>
- Biological role in glucose metabolism has been explained through various mechanisms other than through sex hormones(testosterone and estrogen) on peripheral tissue.<sup>2</sup>
- Sex Hormone Binding Globulin(SHBG) independently associated with insulin resistance. <sup>3</sup>
- Studies indicated that low SHBG is associated with the increased risk of type 2 diabetes mellitus in men population. <sup>2,5</sup>
- In women, post-menopausal - European Ancestry and inconsistent. <sup>5</sup>
- NHANES - Generalizable sample from US population.
- SHBG - Clinical and public health implications in Type-2- Diabetes.

**Study Objective**

The objective of this study is to determine cross-sectional association between diabetes mellitus and the sex hormone binding globulin (SHBG) in US adult women of 20+ above years and to determine how it differs by menopausal status.

Hypotheses: -

- The odds of having diabetes mellitus is higher in women with low serum SHBG levels compared to the women with normal serum levels.
- The odds ratio for the association between the diabetes mellitus and serum SHBG levels would be higher in postmenopausal women than in premenopausal women.

- After adjusting for race and ethnicity, education, BMI, total testosterone, and menopause, the high SHBG was associated with a reduced risk of diabetes mellitus(adjusted OR 0.97, 95% CI 0.66-1.42 ) and increased risk for low SHBG (adjusted OR 3.40, 95% CI 1.86-6.21)
- Could not stratify the models based by menopause due to the lack of enough statistical power.

**Methods**

**Population** - Women of ages 20 and above.  
**Exclusion criteria** - Pregnant women

**Dependent variables - Diabetes Mellitus- Self-reported :**

“other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?”

**Independent variable - SHBG - Serum and plasma SHBG Immunoassay :**

Mayo Clinic’s Medical Laboratory Test Catalog.  
 Female (Non-pregnant) 18 – 144

**Statistical Analysis**

- SAS 9.4.
- Descriptive statistics : Compare the characteristics of NHANES study population and test for statistical significance based on the outcome diabetes mellitus. (Table 1)
- Multivariable logistic regression :
  - Full adjusted model
    - Age, race/ethnicity, smoking status, estrogen, testosterone, education and BMI. Stratified by menopause.
  - Final model
    - Race/ethnicity, testosterone, education, BMI and menopause, all the parameters were statistically significant in this model. (Table 2)

**Results**

Table 1. Characteristics of National Health and Nutritional Examination Survey (NHANES) 2013 -2016 female adult population between 20 years - 85 years by Diagnosis of Type2 Diabetes(T2DM); unweighted sample size, weighted proportions and statistical significance p-values from the chi square tests

	Without DM N = 4938		With DM N = 729		Significance test (chi-squared)
	n	%	n	%	
<b>Age groups</b>					<.0001
20-39-year-old	1789	36.7%	58	9.8%	
40-59-year-old	1724	36.5%	248	36.8%	
60-85-year-old	1425	26.7%	428	53.4%	
<b>Race/Ethnicity</b>					<.0001
Mexican American	733	8.2%	153	11.7%	
Other Hispanic	571	5.9%	101	6.3%	
Non-Hispanic White	1893	65.5%	214	56.8%	
Non-Hispanic Black	1007	11.6%	176	16.7%	
Non-Hispanic Asian	581	5.7%	65	5.9%	
Other race including multi-racial	153	3.0%	20	2.6%	
<b>Education</b>					<.0001
<High school	964	12.7%	250	24.3%	
>= High school	3967	87.3%	479	75.1%	
<b>Family income to poverty ratio</b>					<.0001
Less than 1	1010	15.4%	192	21.8%	
Between 1 and 4	2346	49.7%	372	36.2%	
4 and above	1095	34.9%	93	22.0%	
<b>Body Mass Index</b>					<.0001
Underweight	94	1.8%	2	0.1%	
Normal	1488	32.5%	80	10.0%	
Overweight	1342	27.6%	167	21.8%	
Obese	1965	38.1%	465	68.1%	
<b>Smoke</b>					<.0001
Current	883	17.8%	101	14.6%	
Past	799	19.0%	178	28.8%	
Never	3301	63.2%	450	56.6%	
<b>Sex Hormone Binding Globulin (SHBG)</b>					<.0001
low	63	1.5%	34	6.1%	
Normal	3852	88.9%	572	88.6%	
High	375	10.6%	31	5.2%	
<b>Menopause</b>					<.0001
Pre-menopausal	2161	49.1%	120	19.1%	
Post-menopausal	2222	50.9%	562	80.8%	
<b>Testosterone(ng/dL)</b>					<.0001
Low	1455	30.8%	330	50.2%	
Normal	2963	67.2%	323	48.3%	
High	73	2.0%	12	1.5%	

Table 2: Logistic Regression for the association of SHBG with DM in women of both postmenopausal and premenopausal status combined sample in NHANES 2013 - 2016

SHBG	Crude Model*		Adjusted Model**	
	OR	95% CI	OR	95% CI
Normal	Reference		1.00	
Low	4.15	2.67 – 6.46	3.40	1.86- 6.21
High	0.49	0.35- 0.68	0.97	0.66-1.42

\*Crude model with SHBG as a predictor.

\*\*Final adjusted model: controlled for race/ethnicity, BMI, education, and menopause.

**Discussion**

- The inverse association of diabetes in both men and women is consistent with the systematic literature review and meta-analysis of 43 case-control studies in both men and women. <sup>5-6</sup>

Limitations	Strengths
<ul style="list-style-type: none"> <li>• Unaccounted 20% missingness in the study sample.</li> <li>• Cross-sectional design – cannot establish temporal relationship</li> </ul>	<ul style="list-style-type: none"> <li>• Is the generalizability of the population in the study. Post-menopausal and pre-menopausal women. US women population.</li> </ul>

References

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