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Gender Differences in Takotsubo Cardiomyopathy as a Secondary Diagnosis: Higher Hospital Charges, More Procedures, and Longer Length of Stays

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Background

- The incidence of Takotsubo Cardiomyopathy (TC) has risen steadily over the past decade, with current estimates of 15-30 cases per 100,000 per year¹
- It has been previously reported that men diagnosed with TC have worse outcomes than women^{2,3}
- The relationship between total hospital charges, number of procedures performed, and length of stay (LOS) between genders has not been previously reported with TC as a secondary diagnosis.

Hypothesis

Under recognition of TC in males leads to increased number of procedures, higher hospital charges, longer length of stays, and worse outcomes.

Methods

- Retrospective cohort study using National Inpatient Sample (NIS) data from 2009-2016
- Inclusion criteria: encounters with age ≥ 18 who received a diagnostic coronary angiogram (CCS 47), with a secondary diagnosis of TC (ICD 9 code 429.83; ICD 10 code I51.81)
- Exclusion criteria: diagnostic angiography that was followed by percutaneous or surgical coronary revascularization (CCS 44 or 45)
- Demographics, comorbidities and outcomes including hospital mortality, total charges, and LOS were assessed and stratified by gender
- Continuous variables were described using means. Total charges and LOS were described using medians and interquartile ranges.
- TC encounters were propensity matched by age, number of chronic conditions, number of procedures performed, and severity of illness within each year and combined for the analysis.
- The performance of the matching approach was compared with inverse probability weighting approach.
- A discharge weight was included in all analyses to account for the complex sample design of the NIS

Table 1: Demographics and comorbidities

Variable	Male	Female
Unadjusted N	1448 (13%)	9404 (87%)
Weighted N	7124 \pm 197	46,163 \pm 562
Age >65, % \pm SE	47.4 \pm 1.3	61.4 \pm 0.5
Age, years	62.3 \pm 0.4	67.6 \pm 0.1
In-hospital death, % \pm SE	5.5 \pm 0.6	3.3 \pm 0.2
# Procedures	5.25 \pm 0.09	4.47 \pm 0.03
# Chronic conditions*	8.18 \pm 0.08	8.09 \pm 0.04
Severity**	2.94 \pm 0.03	2.64 \pm 0.01
LOS, median (IQR)	4.3 (2.1, 8.7)	3.6 (1.9, 6.9)
Total charges, median (IQR)	\$54,655 (32535, 110456)	\$45,455 (28716, 81213)
Comorbidities*, %		
Alcohol abuse	13.2%	3.4%
Congestive heart failure	18.8%	15.9%
Chronic pulmonary disease	31.7%	31.0%
Depression	10.7%	17.5%
Diabetes, uncomplicated	18.9%	20.3%
Diabetes with chronic complications	3.7%	3.0%
Drug abuse	7.5%	4.5%
Hypertension	62.8%	66.4%
Hypothyroidism	6.4%	20.1%
Obesity	9.6%	12.0%
Renal failure	10.9%	9.4%

Data presented as n (%) or mean \pm SE, unless otherwise indicated
 * Number of chronic conditions and comorbidity info not available within the NIS data set for Q4-2015 and 2016
 ** Severity of illness subclass within each base APR DRG, scale 0-4 (0=no class specified, 1=minor loss of function, 2=moderate loss of function, 3=major loss of function, 4=extreme loss of function)

Results 1

- During 2009-2016, 1,786 males and 11,204 females with secondary TC were identified, corresponding to a national estimate of 8,814 males and 55,163 females.
- Males had higher rates of alcohol and drug abuse, females had higher rates of depression and hypothyroidism (Table 1)
- Number of procedures performed, in-hospital death, hospital charges, and LOS was higher for men; average age was higher for women (Table 2)
- Total charges increased over time for both males and females, while number of procedures, LOS, and severity remained largely flat (Figure 1)
- Applying propensity matching for age and number of procedures (Model 4), the difference in median total charges between men and women decreased to \$1,658, difference in LOS decreased to 0.3 days, and difference in mortality decreased to 1.3% (Figure 2 and Table 2)

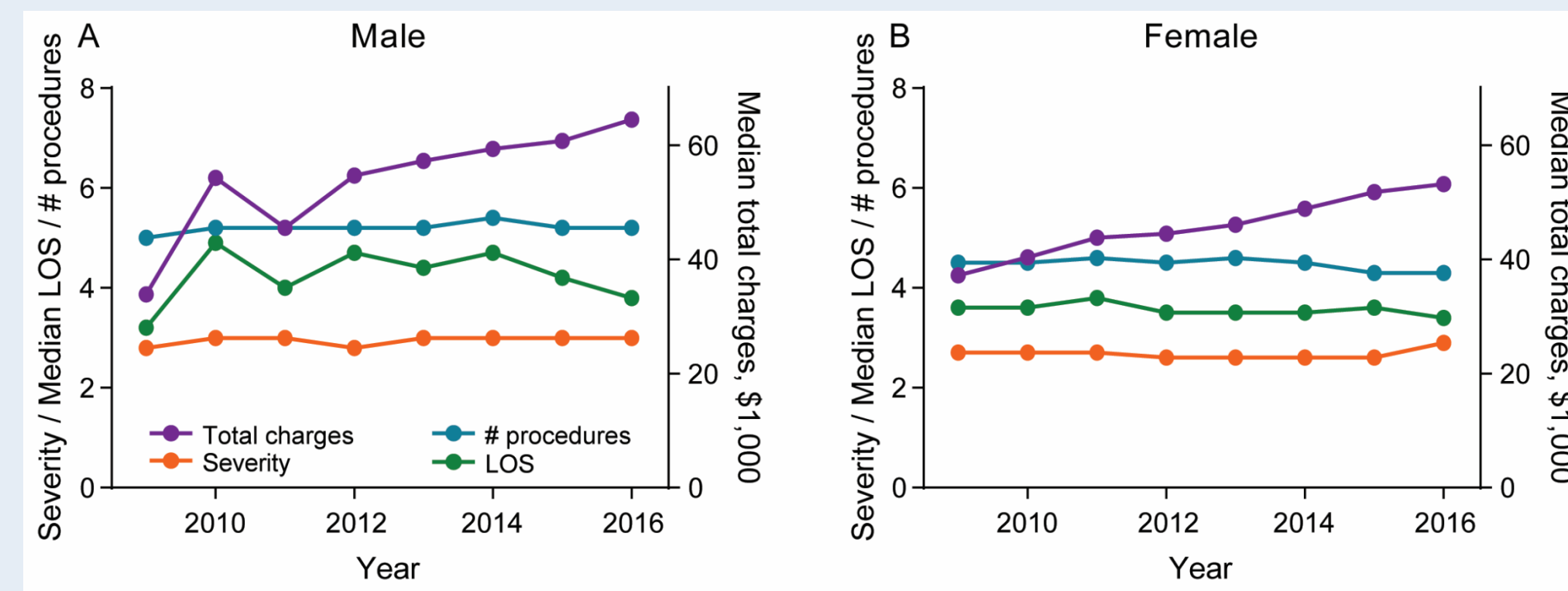


Figure 1 – Gender differences in secondary TC. For both males (A) and females (B), there was an increase in total charges over time. LOS, number of procedures, and total charges were overall higher for males compared to females.

Table 2: Outcomes before and after propensity matching

Variable	Unmatched		Model 1 (age, # chronic conditions)		Model 2 (age, severity)		Model 3 (age, # chronic conditions, # procedures)		Model 4 (age, # procedures)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
N	1448	9404	1448	1429	1448	1432	1448	1429	1448	1432
Age	62.3	67.6	62.3	63.8	62.3	63.4	62.3	63.5	62.3	62.7
# Chronic conditions*	8.2	8.1	8.2	8.1	8.2	8.4	8.2	8.0	8.2	8.2
Severity**	2.9	2.6	2.9	2.6	2.9	3.0	2.9	2.7	2.9	2.8
In-hospital death, %	5.5	3.3	5.5	2.2	5.5	3.7	5.5	3.7	5.5	4.2
# Procedures	5.2	4.5	5.2	4.5	5.2	5.0	5.2	5.0	5.2	5.2
LOS, median	4.3	3.6	4.3	3.5	4.3	4.6	4.3	3.6	4.3	4.0
Total charges, median	54,655	45,455	54,655	43,987	54,655	54,248	54,655	48,187	54,655	52,997
Δ in charges		+9,200		+10,668		+407		+6,468		+1,658
Δ in LOS		+0.7		+0.8		-0.3		+0.7		+0.3

* Number of chronic conditions not available within the NIS data set for Q4-2015 and 2016
 ** Severity of illness subclass within each base APR DRG, scale 0-4 (0=no class specified, 1=minor loss of function, 2=moderate loss of function, 3=major loss of function, 4=extreme loss of function)
 Data combined from 2009-2015

Results 2

- Model IV has a better overlap between female and male distribution compared to model II indicating a better comparison between the 2 groups (Figure 3).
- Performance of one-to-one matching and inverse probability weighting for model IV is comparable (Table 3).

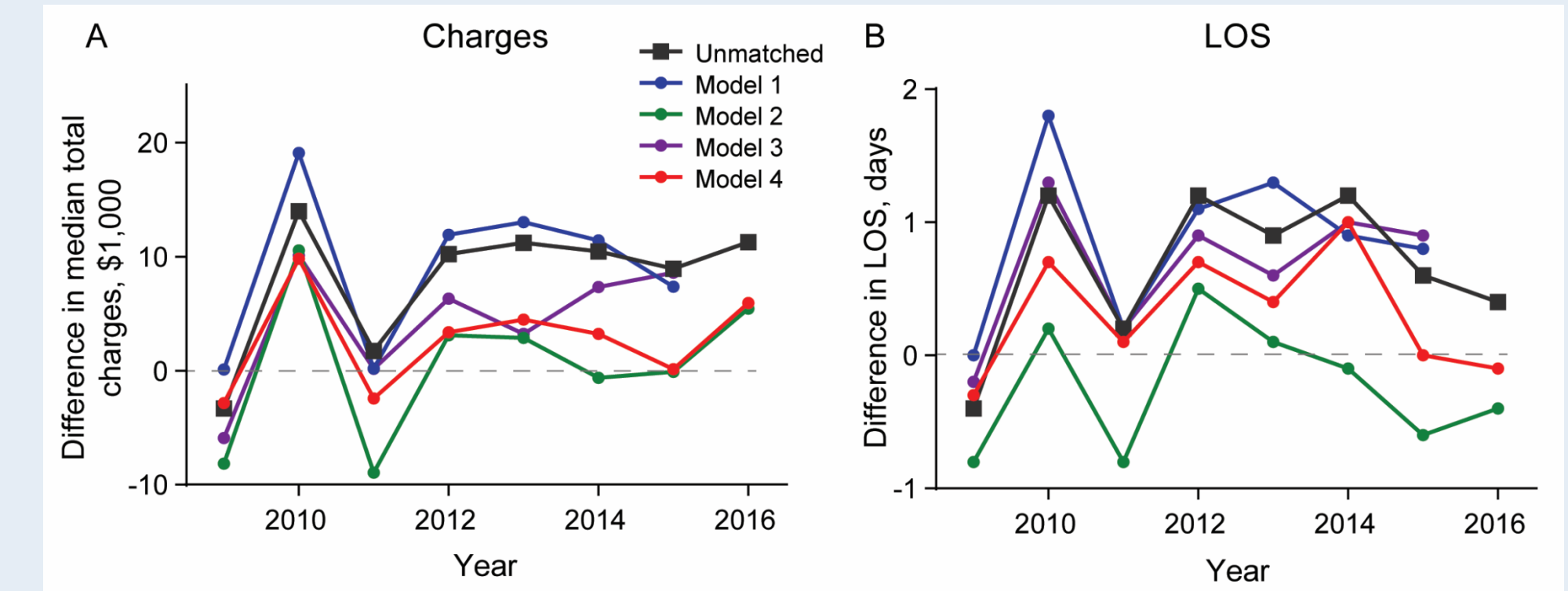


Figure 2 – Propensity-matched models: Difference in median charges (A) and median LOS (B) between males and females, unmatched and propensity-matched by four separate models. Matching variables for each model provided in Table 3.

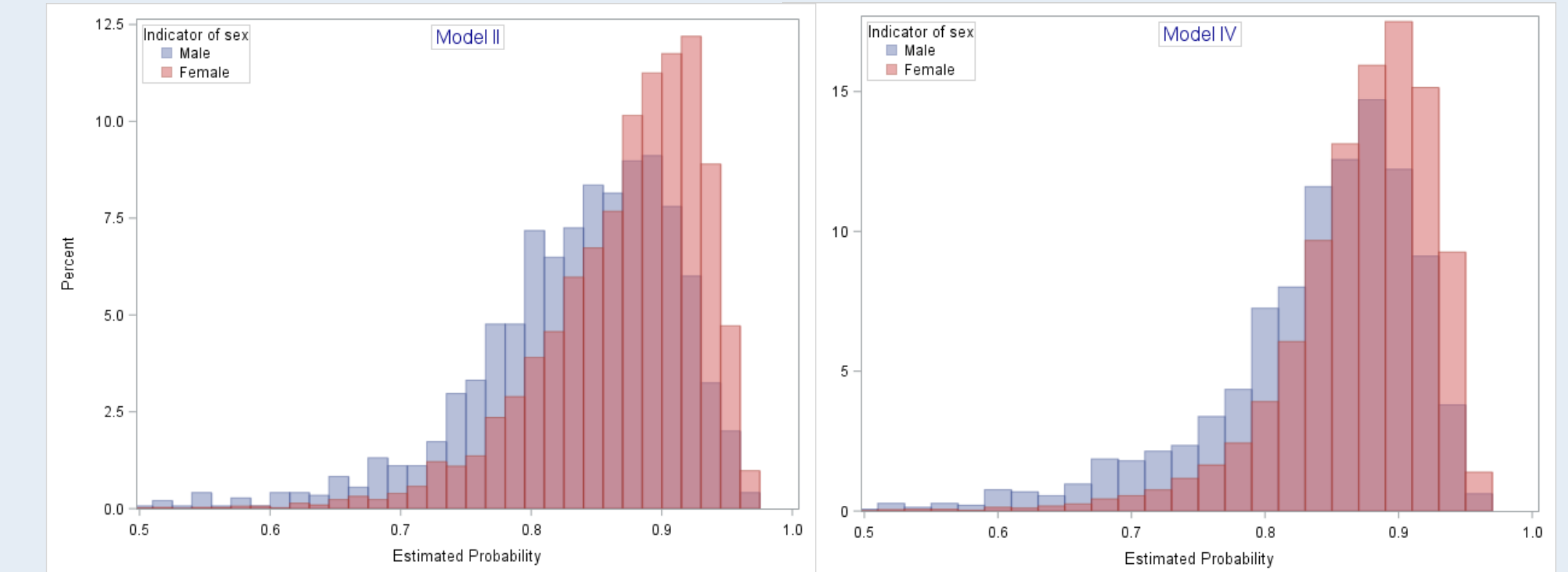


Figure 3 – Distribution of propensity scores for Model II and Model IV

Table 3: Propensity Score Methods by Matching and Inverse Probability Weights (IPW)

Variable	Unmatched		1 to 1		IPW	
	Male	Female	Male	Female	Male	Female
LOS, median	4.3	3.6	4.3	4.0	4.4	4.1
Total charges, median	54,655	45,455	54,655	52,997	56,142	54,452
Diff. in charges		+9,200		+1,658		+1690
Diff. in LOS		+0.7		+0.3		+0.3

* Matching variables: age, # procedures (Model 4)

Conclusions

- Compared to women, men with a secondary diagnosis of TC are more likely to have a greater number of procedures, leading to a longer LOS and ~\$9,000 more in hospital charges
- Propensity matching on age and # of procedures reduced the gender gap
- For the top 10 procedures performed, males experienced a delay in receiving the procedure
- Greater awareness of TC as a potential secondary diagnosis is warranted among men