Clinical Outcomes of NAFLD/NASH in HF-CKD-T2DM (With Propensity Score Matching)

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## Preamble:

* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection**: Included all inpatient admissions with HF-CKD-T2DM.
* **HF-CKD-T2DM + NAFLD/NASH Categories**:
  + HF-CKD-T2DM with NAFLD/NASH
  + HF-CKD-T2DM without NAFLD/NASH
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* **Software:** All analyses were performed using R Version 4.4.1 (R Foundation for Statistical Computing, Vienna, Austria)

## Baseline Table:

| **Characteristic** | **Without NAFLD/NASH** N = 16,500*1* | **With NAFLD/NASH** N = 16,500*1* | **p-value***2* |
| --- | --- | --- | --- |
| Age, y | 65 (11) | 64 (11) | 0.3 |
| Sex |  |  | 0.8 |
| Female | 8,120 (49%) | 8,160 (49%) |  |
| Male | 8,380 (51%) | 8,340 (51%) |  |
| Race |  |  | 0.11 |
| White | 11,440 (69%) | 11,230 (68%) |  |
| Asian or Pacific Islander | 235 (1.4%) | 320 (1.9%) |  |
| Black | 2,870 (17%) | 2,825 (17%) |  |
| Hispanic | 1,660 (10%) | 1,680 (10%) |  |
| Native American | 50 (0.3%) | 100 (0.6%) |  |
| Other | 245 (1.5%) | 345 (2.1%) |  |
| Elixhauser comorbidity index | 9.46 (1.77) | 9.41 (1.76) | 0.3 |
| Residential income |  |  | 0.2 |
| $1 - $51,999 | 5,910 (36%) | 5,510 (33%) |  |
| $52,000 - $65,999 | 4,575 (28%) | 4,925 (30%) |  |
| $66,000 - $87,999 | 3,760 (23%) | 3,805 (23%) |  |
| $88,000 or more | 2,255 (14%) | 2,260 (14%) |  |
| Expected primary payer |  |  | 0.034 |
| Private | 2,580 (16%) | 2,960 (18%) |  |
| Medicaid | 1,970 (12%) | 2,030 (12%) |  |
| Medicare | 11,690 (71%) | 11,190 (68%) |  |
| Other | 260 (1.6%) | 320 (1.9%) |  |
| Hospital region |  |  | 0.057 |
| Midwest | 5,670 (34%) | 5,415 (33%) |  |
| Northeast | 2,075 (13%) | 1,985 (12%) |  |
| South | 6,160 (37%) | 6,060 (37%) |  |
| West | 2,595 (16%) | 3,040 (18%) |  |
| Hospital bedsize |  |  | 0.4 |
| Large | 8,405 (51%) | 8,705 (53%) |  |
| Medium | 4,650 (28%) | 4,515 (27%) |  |
| Small | 3,445 (21%) | 3,280 (20%) |  |
| Hospital location and teaching status |  |  | 0.019 |
| Rural | 1,355 (8.2%) | 1,295 (7.8%) |  |
| Urban, non-teaching | 2,770 (17%) | 3,250 (20%) |  |
| Urban, teaching | 12,375 (75%) | 11,955 (72%) |  |
| Hypertension | 16,130 (98%) | 16,005 (97%) | 0.057 |
| Hyperlipidemia | 11,535 (70%) | 11,350 (69%) | 0.3 |
| Coronary artery disease | 7,905 (48%) | 7,800 (47%) | 0.6 |
| Peripheral vascular disease | 3,245 (20%) | 2,235 (14%) | <0.001 |
| Chronic obstructive pulmonary disease | 7,520 (46%) | 7,575 (46%) | 0.8 |
| Dementia | 680 (4.1%) | 675 (4.1%) | >0.9 |
| Obstructive sleep apnea | 6,605 (40%) | 6,760 (41%) | 0.4 |
| Alcohol use disorder | 5,900 (36%) | 6,025 (37%) | 0.5 |
| Valvular heart disease | 4,215 (26%) | 2,795 (17%) | <0.001 |
| Atrial Fibrillation | 7,010 (42%) | 5,240 (32%) | <0.001 |
| Cancer | 855 (5.2%) | 520 (3.2%) | <0.001 |
| Smoking | 55 (0.3%) | 100 (0.6%) | 0.13 |
| Obesity | 14,510 (88%) | 14,880 (90%) | 0.004 |
| Irritable bowel disease | 30 (0.2%) | 40 (0.2%) | 0.6 |
| *1*Mean (SD); n (%) | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | |

## Outcomes Table:

| **Characteristic** | **Without NAFLD/NASH** N = 16,500*1* | **With NAFLD/NASH** N = 16,500*1* | **p-value***2* |
| --- | --- | --- | --- |
| Died during hospitalization | 970 (5.9%) | 530 (3.2%) | <0.001 |
| Length of stay (days) | 8.1 (7.8) | 7.0 (6.8) | <0.001 |
| Inflation-adjusted total charge ($) | 99,302 (148,741) | 82,411 (98,863) | 0.003 |
| *1*n (%); Mean (SD) | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | |

## Multivariable Logistic Regression:

### All-Cause Mortality:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Without NAFLD/NASH | — | — |  |
| With NAFLD/NASH | 0.50 | 0.39, 0.65 | <0.001 |
| Age, y | 1.01 | 1.00, 1.03 | 0.048 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.92 | 0.71, 1.18 | 0.5 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.15 | 0.49, 2.72 | 0.7 |
| Black | 0.85 | 0.59, 1.23 | 0.4 |
| Hispanic | 1.04 | 0.68, 1.59 | 0.9 |
| Native American | 0.61 | 0.07, 5.34 | 0.7 |
| Other | 0.61 | 0.19, 1.93 | 0.4 |
| Elixhauser comorbidity index | 1.49 | 1.38, 1.61 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.12 | 0.82, 1.51 | 0.5 |
| $66,000 - $87,999 | 1.01 | 0.72, 1.41 | >0.9 |
| $88,000 or more | 1.52 | 1.04, 2.22 | 0.032 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.98 | 0.62, 1.55 | >0.9 |
| Medicare | 0.73 | 0.52, 1.03 | 0.073 |
| Other | 1.09 | 0.46, 2.58 | 0.8 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.77 | 0.48, 1.22 | 0.3 |
| South | 0.83 | 0.62, 1.13 | 0.2 |
| West | 0.74 | 0.50, 1.10 | 0.13 |
| Hospital region |  |  |  |
| Large | — | — |  |
| Medium | 0.75 | 0.56, 1.02 | 0.068 |
| Small | 0.94 | 0.68, 1.30 | 0.7 |
| Hospital region |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.20 | 0.71, 2.02 | 0.5 |
| Urban, teaching | 1.20 | 0.75, 1.90 | 0.4 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.34 | 0.20, 0.60 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.54, 0.90 | 0.006 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.96 | 0.74, 1.25 | 0.8 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.57 | 0.40, 0.82 | 0.002 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.55 | 0.42, 0.72 | <0.001 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 0.57 | 0.29, 1.10 | 0.10 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.65 | 0.50, 0.86 | 0.002 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.96 | 0.73, 1.26 | 0.8 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.60 | 0.44, 0.83 | 0.002 |
| Atrial Fibrillation |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.64, 1.08 | 0.2 |
| Cancer |  |  |  |
| No | — | — |  |
| Yes | 1.02 | 0.61, 1.69 | >0.9 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.43 | 0.31, 0.60 | <0.001 |
| Smoking |  |  |  |
| No | — | — |  |
| Yes | 1.94 | 0.45, 8.39 | 0.4 |
| Irritable bowel disease |  |  |  |
| No | — | — |  |
| Yes | 0.00 | 0.00, 0.00 | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Without NAFLD/NASH | — | — |  |
| With NAFLD/NASH | -1.1 | -1.5, -0.79 | <0.001 |
| Age, y | -0.01 | -0.03, 0.01 | 0.4 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.35 | 0.00, 0.70 | 0.053 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | -0.95 | -2.3, 0.36 | 0.2 |
| Black | 0.52 | -0.04, 1.1 | 0.068 |
| Hispanic | -0.33 | -0.90, 0.23 | 0.3 |
| Native American | 0.92 | -1.5, 3.3 | 0.5 |
| Other | -0.36 | -1.4, 0.65 | 0.5 |
| Elixhauser comorbidity index | 1.1 | 0.96, 1.3 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.14 | -0.56, 0.29 | 0.5 |
| $66,000 - $87,999 | -0.13 | -0.62, 0.36 | 0.6 |
| $88,000 or more | 0.12 | -0.54, 0.78 | 0.7 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | -0.02 | -0.85, 0.82 | >0.9 |
| Medicare | -0.87 | -1.4, -0.36 | <0.001 |
| Other | -1.1 | -2.2, -0.07 | 0.036 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.42 | -0.19, 1.0 | 0.2 |
| South | -0.03 | -0.48, 0.43 | >0.9 |
| West | -1.4 | -2.0, -0.89 | <0.001 |
| Hospital region |  |  |  |
| Large | — | — |  |
| Medium | -0.78 | -1.2, -0.38 | <0.001 |
| Small | -1.2 | -1.7, -0.70 | <0.001 |
| Hospital region |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.4 | 0.75, 2.0 | <0.001 |
| Urban, teaching | 2.2 | 1.6, 2.7 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -1.5 | -2.7, -0.35 | 0.011 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -1.1 | -1.5, -0.67 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -0.13 | -0.49, 0.23 | 0.5 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -1.3 | -1.8, -0.85 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -1.5 | -2.0, -1.1 | <0.001 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 0.42 | -0.50, 1.3 | 0.4 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | -0.55 | -0.91, -0.20 | 0.002 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | -1.3 | -1.7, -0.90 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | -0.80 | -1.3, -0.34 | <0.001 |
| Atrial Fibrillation |  |  |  |
| No | — | — |  |
| Yes | -0.28 | -0.65, 0.09 | 0.14 |
| Cancer |  |  |  |
| No | — | — |  |
| Yes | -1.3 | -2.1, -0.47 | 0.002 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | -2.7 | -3.4, -1.9 | <0.001 |
| Smoking |  |  |  |
| No | — | — |  |
| Yes | -1.7 | -3.1, -0.18 | 0.028 |
| Irritable bowel disease |  |  |  |
| No | — | — |  |
| Yes | 3.3 | -1.6, 8.3 | 0.2 |
| *1*CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Without NAFLD/NASH | — | — |  |
| With NAFLD/NASH | -18,358 | -24,330, -12,386 | <0.001 |
| Age, y | -421 | -726, -116 | 0.007 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 11,585 | 5,112, 18,059 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 9,007 | -30,499, 48,513 | 0.7 |
| Black | 535 | -7,270, 8,340 | 0.9 |
| Hispanic | 8,263 | -2,182, 18,707 | 0.12 |
| Native American | 3,762 | -48,174, 55,697 | 0.9 |
| Other | 1,874 | -14,442, 18,190 | 0.8 |
| Elixhauser comorbidity index | 15,343 | 12,725, 17,962 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -1,416 | -8,789, 5,956 | 0.7 |
| $66,000 - $87,999 | -985 | -9,502, 7,532 | 0.8 |
| $88,000 or more | 912 | -9,610, 11,434 | 0.9 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | -15,654 | -28,845, -2,462 | 0.020 |
| Medicare | -14,888 | -24,847, -4,930 | 0.003 |
| Other | -4,442 | -28,333, 19,450 | 0.7 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 9,919 | -448, 20,286 | 0.061 |
| South | 12,258 | 5,049, 19,466 | <0.001 |
| West | 33,677 | 20,132, 47,221 | <0.001 |
| Hospital region |  |  |  |
| Large | — | — |  |
| Medium | -15,320 | -22,686, -7,954 | <0.001 |
| Small | -21,607 | -30,248, -12,965 | <0.001 |
| Hospital region |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 28,835 | 19,822, 37,849 | <0.001 |
| Urban, teaching | 42,537 | 34,837, 50,237 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -12,755 | -30,369, 4,859 | 0.2 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -10,133 | -16,855, -3,411 | 0.003 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 6,717 | 886, 12,548 | 0.024 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -18,226 | -26,629, -9,823 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -21,700 | -28,022, -15,379 | <0.001 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | -13,430 | -25,568, -1,292 | 0.030 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | -11,592 | -17,578, -5,606 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | -11,741 | -19,185, -4,298 | 0.002 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | -5,267 | -13,465, 2,931 | 0.2 |
| Atrial Fibrillation |  |  |  |
| No | — | — |  |
| Yes | 2,789 | -3,765, 9,343 | 0.4 |
| Cancer |  |  |  |
| No | — | — |  |
| Yes | -21,748 | -34,354, -9,142 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | -32,666 | -48,892, -16,440 | <0.001 |
| Smoking |  |  |  |
| No | — | — |  |
| Yes | -23,098 | -57,534, 11,338 | 0.2 |
| Irritable bowel disease |  |  |  |
| No | — | — |  |
| Yes | 46,517 | -40,233, 133,267 | 0.3 |
| *1*CI = Confidence Interval | | | |