Clinical Outcomes of NAFLD/NASH in HF-CKD-T2DM

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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 = 1,232,840*1* | **With NAFLD/NASH** N = 16,515*1* | **p-value***2* |
| --- | --- | --- | --- |
| Age, y | 68 (12) | 64 (11) | <0.001 |
| Sex |  |  | 0.014 |
| Female | 637,140 (52%) | 8,170 (49%) |  |
| Male | 595,700 (48%) | 8,345 (51%) |  |
| Race |  |  | <0.001 |
| White | 773,855 (63%) | 11,245 (68%) |  |
| Asian or Pacific Islander | 23,505 (1.9%) | 320 (1.9%) |  |
| Black | 292,480 (24%) | 2,825 (17%) |  |
| Hispanic | 111,010 (9.0%) | 1,680 (10%) |  |
| Native American | 7,570 (0.6%) | 100 (0.6%) |  |
| Other | 24,420 (2.0%) | 345 (2.1%) |  |
| Elixhauser comorbidity index | 8.22 (1.75) | 9.42 (1.77) | <0.001 |
| Residential income |  |  | 0.035 |
| $1 - $51,999 | 436,800 (35%) | 5,515 (33%) |  |
| $52,000 - $65,999 | 343,500 (28%) | 4,925 (30%) |  |
| $66,000 - $87,999 | 277,615 (23%) | 3,815 (23%) |  |
| $88,000 or more | 174,925 (14%) | 2,260 (14%) |  |
| Expected primary payer |  |  | <0.001 |
| Private | 160,640 (13%) | 2,965 (18%) |  |
| Medicaid | 119,115 (9.7%) | 2,030 (12%) |  |
| Medicare | 930,880 (76%) | 11,200 (68%) |  |
| Other | 22,205 (1.8%) | 320 (1.9%) |  |
| Hospital region |  |  | <0.001 |
| Midwest | 366,130 (30%) | 5,425 (33%) |  |
| Northeast | 191,195 (16%) | 1,985 (12%) |  |
| South | 488,105 (40%) | 6,065 (37%) |  |
| West | 187,410 (15%) | 3,040 (18%) |  |
| Hospital bedsize |  |  | 0.009 |
| Large | 613,710 (50%) | 8,710 (53%) |  |
| Medium | 354,220 (29%) | 4,520 (27%) |  |
| Small | 264,910 (21%) | 3,285 (20%) |  |
| Hospital location and teaching status |  |  | 0.5 |
| Rural | 104,480 (8.5%) | 1,295 (7.8%) |  |
| Urban, non-teaching | 236,055 (19%) | 3,250 (20%) |  |
| Urban, teaching | 892,305 (72%) | 11,970 (72%) |  |
| Hypertension | 1,201,435 (97%) | 16,010 (97%) | 0.064 |
| Hyperlipidemia | 792,610 (64%) | 11,355 (69%) | <0.001 |
| Coronary artery disease | 607,995 (49%) | 7,800 (47%) | 0.019 |
| Peripheral vascular disease | 169,000 (14%) | 2,245 (14%) | 0.8 |
| Chronic obstructive pulmonary disease | 535,775 (43%) | 7,585 (46%) | 0.005 |
| Dementia | 79,535 (6.5%) | 680 (4.1%) | <0.001 |
| Obstructive sleep apnea | 383,310 (31%) | 6,770 (41%) | <0.001 |
| Alcohol use disorder | 372,000 (30%) | 6,040 (37%) | <0.001 |
| Valvular heart disease | 211,195 (17%) | 2,800 (17%) | 0.8 |
| Atrial Fibrillation | 410,000 (33%) | 5,245 (32%) | 0.083 |
| Cancer | 47,235 (3.8%) | 520 (3.1%) | 0.046 |
| Obesity | 1,026,165 (83%) | 14,895 (90%) | <0.001 |
| *1*Mean (SD); n (%) | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | |

## Outcomes Table:

| **Characteristic** | **Without NAFLD/NASH** N = 1,232,840*1* | **With NAFLD/NASH** N = 16,515*1* | **p-value***2* |
| --- | --- | --- | --- |
| Died during hospitalization | 50,915 (4.1%) | 530 (3.2%) | 0.009 |
| Length of stay (days) | 7.1 (7.5) | 7.0 (6.8) | 0.6 |
| Inflation-adjusted total charge ($) | 83,797 (123,979) | 82,383 (98,827) | <0.001 |
| *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 | 0.60 | 0.49, 0.73 | <0.001 |
| Age, y | 1.02 | 1.01, 1.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.13 | 1.08, 1.18 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.03 | 0.90, 1.18 | 0.6 |
| Black | 0.92 | 0.86, 0.97 | 0.003 |
| Hispanic | 1.06 | 0.98, 1.14 | 0.12 |
| Native American | 1.28 | 1.01, 1.62 | 0.038 |
| Other | 1.07 | 0.93, 1.24 | 0.3 |
| Elixhauser comorbidity index | 1.48 | 1.46, 1.51 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.92 | 0.87, 0.97 | 0.003 |
| $66,000 - $87,999 | 0.91 | 0.86, 0.97 | 0.002 |
| $88,000 or more | 0.93 | 0.87, 0.99 | 0.032 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.81 | 0.73, 0.89 | <0.001 |
| Medicare | 0.90 | 0.84, 0.96 | 0.003 |
| Other | 1.34 | 1.15, 1.55 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.12 | 1.04, 1.21 | 0.003 |
| South | 0.91 | 0.86, 0.97 | 0.003 |
| West | 0.94 | 0.87, 1.01 | 0.10 |
| Hospital region |  |  |  |
| Large | — | — |  |
| Medium | 0.94 | 0.89, 0.99 | 0.019 |
| Small | 0.86 | 0.81, 0.92 | <0.001 |
| Hospital region |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.22 | 1.10, 1.35 | <0.001 |
| Urban, teaching | 1.29 | 1.17, 1.41 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.54 | 0.48, 0.60 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.59, 0.65 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.81, 0.89 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.64, 0.72 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.63 | 0.60, 0.66 | <0.001 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.90, 1.04 | 0.4 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.73 | 0.69, 0.77 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.76 | 0.72, 0.80 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.60 | 0.57, 0.64 | <0.001 |
| Atrial Fibrillation |  |  |  |
| No | — | — |  |
| Yes | 0.91 | 0.87, 0.96 | <0.001 |
| Cancer |  |  |  |
| No | — | — |  |
| Yes | 0.81 | 0.74, 0.89 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.44 | 0.42, 0.46 | <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 | -1.3, -0.86 | <0.001 |
| Age, y | -0.03 | -0.03, -0.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.13 | 0.07, 0.20 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.19 | -0.08, 0.46 | 0.2 |
| Black | 0.17 | 0.08, 0.26 | <0.001 |
| Hispanic | -0.05 | -0.18, 0.08 | 0.4 |
| Native American | 0.03 | -0.34, 0.39 | 0.9 |
| Other | 0.34 | 0.11, 0.58 | 0.004 |
| Elixhauser comorbidity index | 1.0 | 0.98, 1.0 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.10 | -0.18, -0.01 | 0.021 |
| $66,000 - $87,999 | -0.05 | -0.14, 0.04 | 0.3 |
| $88,000 or more | 0.02 | -0.09, 0.14 | 0.7 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.11 | -0.05, 0.27 | 0.2 |
| Medicare | -0.35 | -0.45, -0.25 | <0.001 |
| Other | -0.09 | -0.33, 0.15 | 0.5 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.83 | 0.67, 0.99 | <0.001 |
| South | 0.26 | 0.14, 0.37 | <0.001 |
| West | -0.62 | -0.77, -0.46 | <0.001 |
| Hospital region |  |  |  |
| Large | — | — |  |
| Medium | -0.80 | -0.90, -0.69 | <0.001 |
| Small | -1.3 | -1.4, -1.2 | <0.001 |
| Hospital region |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.99 | 0.85, 1.1 | <0.001 |
| Urban, teaching | 1.8 | 1.7, 1.9 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -0.55 | -0.75, -0.35 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -1.0 | -1.1, -0.95 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -0.49 | -0.55, -0.43 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -0.94 | -1.0, -0.84 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -1.2 | -1.3, -1.1 | <0.001 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 0.03 | -0.10, 0.15 | 0.7 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | -0.44 | -0.50, -0.37 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | -1.3 | -1.4, -1.2 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | -0.98 | -1.1, -0.90 | <0.001 |
| Atrial Fibrillation |  |  |  |
| No | — | — |  |
| Yes | -0.30 | -0.36, -0.23 | <0.001 |
| Cancer |  |  |  |
| No | — | — |  |
| Yes | -0.22 | -0.38, -0.05 | 0.012 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | -2.3 | -2.4, -2.2 | <0.001 |
| *1*CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Without NAFLD/NASH | — | — |  |
| With NAFLD/NASH | -16,860 | -20,223, -13,496 | <0.001 |
| Age, y | -632 | -689, -574 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 6,839 | 5,805, 7,873 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 9,206 | 1,785, 16,627 | 0.015 |
| Black | -1,321 | -3,071, 429 | 0.14 |
| Hispanic | 15,750 | 12,711, 18,789 | <0.001 |
| Native American | -8,387 | -14,462, -2,312 | 0.007 |
| Other | 26,111 | 19,707, 32,515 | <0.001 |
| Elixhauser comorbidity index | 12,940 | 12,270, 13,610 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -503 | -2,088, 1,082 | 0.5 |
| $66,000 - $87,999 | -731 | -2,666, 1,205 | 0.5 |
| $88,000 or more | 3,495 | 660, 6,331 | 0.016 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | -8,345 | -11,113, -5,577 | <0.001 |
| Medicare | -6,217 | -8,293, -4,141 | <0.001 |
| Other | -674 | -5,671, 4,322 | 0.8 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 20,514 | 16,461, 24,567 | <0.001 |
| South | 15,052 | 12,535, 17,569 | <0.001 |
| West | 39,263 | 34,052, 44,474 | <0.001 |
| Hospital region |  |  |  |
| Large | — | — |  |
| Medium | -13,244 | -16,240, -10,248 | <0.001 |
| Small | -23,156 | -26,102, -20,209 | <0.001 |
| Hospital region |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 28,366 | 25,711, 31,022 | <0.001 |
| Urban, teaching | 40,399 | 38,031, 42,767 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -6,861 | -10,245, -3,476 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -10,564 | -11,824, -9,305 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 2,297 | 1,248, 3,347 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -10,433 | -12,232, -8,633 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -16,155 | -17,523, -14,788 | <0.001 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | -10,033 | -11,748, -8,319 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | -8,770 | -9,818, -7,723 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | -12,249 | -15,332, -9,167 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | -3,103 | -4,681, -1,526 | <0.001 |
| Atrial Fibrillation |  |  |  |
| No | — | — |  |
| Yes | -2,662 | -3,879, -1,445 | <0.001 |
| Cancer |  |  |  |
| No | — | — |  |
| Yes | -2,656 | -5,260, -52 | 0.046 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | -25,350 | -27,550, -23,151 | <0.001 |
| *1*CI = Confidence Interval | | | |