Is Sleep-Disordered Breathing a Risk Factor for Hospitalizations Related to Cardiometabolic Conditions?

Hlynur Hlynsson[1], Jason C. Ong[1], Joseph Day[1], Thomas Kauss[1], Kristófer Montazeri[1], Jeffrey Hertzberg[2], Emerson Wickwire [3,4], Rebecca M. Hankla [1], Eysteinn Finnsson[1], Jón Skírnir Ágústsson[1], & Heidi Riney[1]

1. *Nox Research, Nox Health, Inc*
2. *Medformatics, Inc*
3. *Division of Pulmonary, Critical Care, and Sleep Medicine, Department of Medicine, University of Maryland School of Medicine, Baltimore, MD, USA*
4. *Department of Psychiatry, University of Maryland School of Medicine, Baltimore, MD, USA*

Introduction

Previous research has established that sleep-disordered breathing (SDB) is associated with cardiometabolic conditions but there is a paucity of real-world data examining the consequences of these comorbidities on key health care resource utilization (HCRU) such as hospitalizations. The purpose of this study was to investigate the relationship between SDB diagnosis and future hospitalization rates related to diabetes mellitus (DM) and/or atherosclerotic disease (AD) using a large claims dataset.

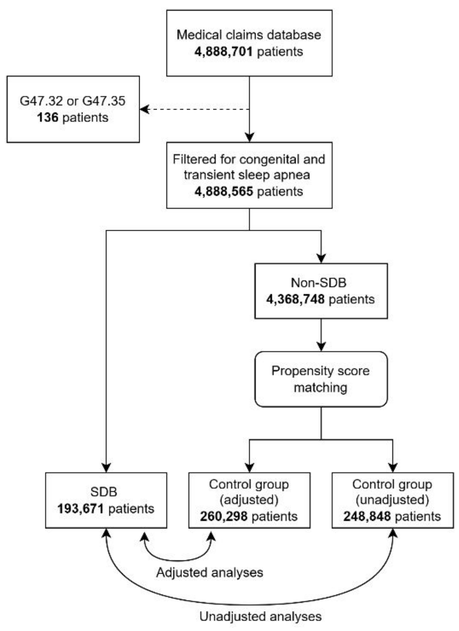
Methods

Study Design and Data Source

This study used a retrospective cohort design from the Merative MarketScan Research Commercial Database, a large medical claims database. For this study, we included individuals who were continuously enrolled between 2018-2022 and at least 18 years of age as of January 1, 2018 and less than 65 years of age as of December 31, 2022.

Identification of SDB was based on ICD-10 code G47.3 and CPT code 94660. Identification of DM (Type 1, Type 2, and gestational diabetes) and AD (e.g., cerebrovascular diseases, CHF, CAD) were based on a classification schema using ICD-10 and CPT codes relevant to each condition. A similar schema was used to identify other medical conditions used in the matching procedure. Hospitalizations related to DM and AD were identified primarily using Place of Service (POS) code 21. All overlapping claims were then gathered into a single event, and the claims were sorted by claim amounts in descending order and the largest dollar claims were assigned as the hospitalization condition or reason. For details see Hlynsson et al., 2024[1].

Figure 1. Patient Flow Diagram



Data Analysis

Data from year 1 (2018) were used to identify those diagnosed with SDB (n=193,671) and to conduct propensity-score matching[2]. A logistic regression model including age, sex, and comorbid medical conditions was used to estimate the propensity scores for each individual based on the probability of having a diagnosis of SDB.

Using separate models, the SDB group was compared to: 1) an unadjusted comparison group (n=248,848) excluding a history of DM and AD in the propensity-score matching and 2) an adjusted comparison group (n=260,298), which included a history of DM and AD in the propensity score matching. Standardized mean differences (SMD) were calculated to assess the balance between the SDB group and the corresponding control groups (see Table 1 for baseline characteristics). The observation period for hospitalizations was the subsequent 4-year period (2019-2022) for both models. Post-hoc analyses with males and females separately were conducted to explore patterns for each sex. The significance between SDB and hospitalization outcomes was evaluated by calculating odds ratios with bootstrap sampling using a 95% confidence interval (CI).

Table 1. Sample Characteristics

Demographics	SDB Group (n=193,671)	Unadjusted Control Group (n=248,848)	SMD	Adjusted Control Group (n=260,298)	SMD
Age (mean ± std)	48.02 ± 8.49	47.88 ± 8.91	0.02	48.03 ± 8.85	-0.002
18–24 yrs % (n)	1.28% (2,471)	1.59% (3,949)	-0.03	1.52% (3,960)	-0.021
25–34 yrs	6.63% (12,843)	7.08% (17,628)	-0.02	6.90% (17,965)	-0.011
35–44 yrs	21.99% (42,580)	21.83% (54,328)	0.00	21.32% (55,495)	0.016
45–54 yrs	43.17% (83,611)	40.99% (102,006)	0.04	41.34% (107,605)	0.037
55–64 yrs	26.94% (52,166)	28.51% (70,937)	-0.04	28.92% (75,273)	-0.044
Female	35.45% (68,660)	47.55% (118,330)	-0.25	46.47% (120,970)	-0.225
History of comorbidities					
Cancer	10.48% (20,300)	12.61% (31,368)	-0.07	12.38% (32,217)	-0.059
Gastrointestinal disease	42.71% (82,710)	46.10% (114,708)	-0.07	45.29% (117,899)	-0.052
Infectious Disease	37.33% (72,296)	37.44% (93,168)	-0.00	37.64% (97,970)	-0.006
Mental Health	35.63% (69,014)	37.86% (94,216)	-0.05	36.65% (95,390)	-0.021
Musculoskeletal	79.96% (154,852)	83.24% (207,153)	-0.09	82.60% (214,997)	-0.068
Maternity and Perinatal	1.70% (3,288)	2.43% (6,040)	-0.05	2.37% (6,159)	-0.047
Neurologic Disease	26.41% (51,139)	30.37% (75,564)	-0.09	29.56% (76,945)	-0.070
Other	98.18% (190,137)	98.89% (246,092)	-0.06	98.76% (257,058)	-0.048
Respiratory	69.61% (134,807)	74.33% (184,964)	-0.11	73.40% (191,060)	-0.084
Cardiometabolic Conditions					
DM	28.13% (54,481)	16.23% (40,394)	0.29	22.49% (58,553)	0.131
AD	14.33% (27,759)	12.15% (30,225)	0.07	14.00% (36,435)	0.010
DM or AD	36.51% (70,701)	24.90% (61,956)	0.26	31.53% (82,078)	0.105

Results

In both the unadjusted and adjusted models, odds ratios (OR) revealed a pattern of significant association between SDB diagnosis and hospitalization rates relative to controls (see Table 2).

Table 2. Hospitalization Outcomes

Outcome	SMD	SDB Group	Control Group	OR (95% CI)
Unadjusted		(n=193,671)	(n=248,848)	
DM hospitalization % (n)	0.10	4.23% (8,186)	2.52% (6,274)	1.71* (1.65–1.76)
AD hospitalization % (n)	0.03	2.73% (5,288)	2.34% (5,821)	1.17* (1.13–1.22)
DM/AD hospitalization % (n)	0.09	6.55% (12,688)	4.60% (11,442)	1.45* (1.42–1.49)
Adjusted		(n=193,671)	(n=260,298)	
DM hospitalization % (n)	0.04	4.23% (8,186)	3.46% (9,018)	1.23* (1.19–1.27)
AD hospitalization % (n)	0.01	2.73% (5,288)	2.54% (6,620)	1.08* (1.04–1.12)
DM/AD hospitalization % (n)	0.04	6.55% (12,688)	5.68% (14,774)	1.17* (1.14–1.19)

Unadjusted model: The odds ratio for the SDB group was significant for DM-related hospitalizations (OR: 1.71), AD-related hospitalizations (OR: 1.17) and for hospitalizations due to DM or AD (OR: 1.45). Post-hoc analysis (see Table 3) revealed a similar pattern for females with significant odds ratios on each of the outcome variables. However, for males the odds ratio was significant for DM-related and DM or AD-related hospitalizations, but not for AD-related hospitalizations (OR: 1.00. 95% CI: 0.96-1.05).

Adjusted model: Similar to the unadjusted model, the odds ratio for the SDB group was significant for DM-related hospitalizations (OR: 1.23), AD-related hospitalizations (OR: 1.08), and hospitalization due to DM or AD (OR: 1.17). Post-hoc analysis (see Table 3 and Figure 2b) revealed a similar pattern for females with significant odds ratios on each of the outcome variables, but for males, the odds ratio was only significant for DM-related hospitalizations (OR: 1.10) and not for AD-related (OR: 0.94) or hospitalizations due to DM or AD (OR: 1.03)

Figure 2. Adjusted Model Odds Ratios

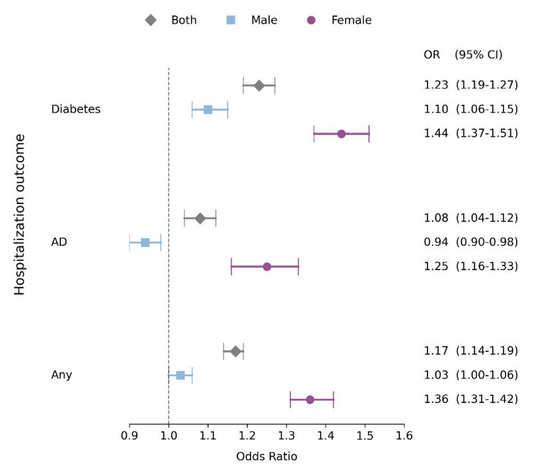


Table 3. Hospitalization Outcomes by Sex

	Male			Female		
Outcome	SDB Group	Control Group	OR (95% CI)	SDB Group	Control Group	OR (95% CI)
Unadjusted	(n= 125,011)	(n= 130,518)		(n=68,660)	(n=118,330)	
DM hospitalization	4.00% (4,997)	2.69% (3,506)	1.51* (1.44-1.57)	4.64% (3,189)	2.34% (2,768)	2.03* (1.93-2.14)
AD hospitalization	3.02% (3,771)	3.01% (3,926)	1.00 (0.96-1.05)	2.21% (1,517)	1.60% (1,895)	1.39* (1.29-1.48)
DM/AD hospitalization	6.61% (8,261)	5.36% (6,997)	1.25* (1.21-1.29)	6.45% (4,427)	3.76% (4,445)	1.77* (1.69-1.84)
Adjusted	(n= 125,011)	(n= 139,328)		(n=68,660)	(n=120,970)	
DM hospitalization	4.00% (4,997)	3.63% (5,062)	1.10* (1.06-1.15)	4.64% (3,189)	3.27% (3,956)	1.44* (1.37-1.51)
AD hospitalization	3.02% (3,771)	3.20% (4,464)	0.94 (0.90-0.98)	2.21% (1,517)	1.78% (2,156)	1.25* (1.16-1.33)
DM/AD hospitalization	6.61% (8,261)	6.43% (8,952)	1.03 (1.00-1.06)	6.45% (4,427)	4.81% (5,822)	1.36* (1.31-1.42)

Conclusions

The findings provide real-world evidence that comorbid SDB increases the risk for future hospitalizations related to chronic cardiometabolic conditions. Specifically, SDB in the first year was associated with a 23% increased risk of future DM-related hospitalizations and an 8% increased risk of future AD-related hospitalizations in the following four years relative to matched controls adjusted for a history of DM and AD.

The findings also indicate that sex is a potential moderator of this relationship. Compared to males, females had a more consistent pattern of significant association between SDB and hospitalizations in both models, particularly with SDB and AD-related hospitalizations.

Limitations: 1) This observational study cannot determine causality; 2) coding and/or diagnostic inaccuracies may exist in claims data; 3) SDB onset cannot be determined with diagnostic codes; 4) potential impact of SDB treatment cannot be ruled out.

These findings indicate that the presence of SDB increases the risk of serious medical events and costly HCRU. Sex differences could be an avenue for future research.

References:

1. Hlynsson, HD, Ong, JC, Day, J, Kauss, T, Montazeri, K, Hertzberg, J, Wickwire, E, Hankla, RM, Finnsson, E, Ágústsson, JS, & Riney, H. (2024). The Impact of Comorbid Sleep-Disordered Breathing on Hospitalization Risk Related to Diabetes and Atherosclerotic Disease: A Retrospective Cohort Analysis. *Journal of Clinical Medicine,* 13(24), 7715.
2. Austin, PC. The performance of different propensity-score methods for estimating differences in proportions (risk differences or absolute risk reductions) in observational studies. *Stat Med*. Sep 10 2010;29(20):2137-48.

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