Undiagnosed Obstructive Sleep Apnea in Commercial Motor Vehicle Drivers: Application of STOP-Bang

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Obstructive Sleep Apnea (OSA)

- Sleep disorder

- Associated with several health risk factors
  - Excess weight
  - Hypertension
  - Metabolic syndrome (obesity, hypertension, insulin resistance, impaired glucose tolerance, and dyslipidemia)
  - Depression

- Increases in crash risk due to sleepiness

OSA Treatment and Prevalence

- Treatment
  - Mandibular advancement devices, upper respiratory surgery, weight reduction, positive airway pressure (PAP) therapy
- Tx effective in reducing risk factors and sleepiness
  - Lowers crash risk to those of non-OSA drivers
- Truck drivers susceptible to OSA
  - Long work hours, limited physical activity and healthy food options = excessive weight gain
- Prevalence difficult to pin down
  - ~30% of truck drivers

OSA Screening

- Largely self-report
  - Only one self-report question on CDME
  - Epworth Sleepiness Scale (ESS)
  - Berlin Questionnaire (BQ)
  - Multivariable Apnea Prediction Index
- Objective measures preferred
  - STOP-Bang (SB) is an eight-item OSA screening tool that incorporates subjective symptoms and objective OSA risk factors
  - Scoring is a mix of these factors

Study Objective

- Commercial Driver Safety Risk Factors (CDSRF) study

- Only 7.2% of the drivers were diagnosed with OSA on their CDME
  - BMI greater than 35 have an 80% likelihood of moderate-to-severe OSA
  - 30.7% of drivers in the CDSRF study had a BMI of 35 or greater
  - ~24% of those drivers should be diagnosed with OSA
  - Generally,
    - OSA drivers w/Tx were safer than non-OSA drivers
    - OSA drivers w/out Tx were riskier than non-OSA drivers

- Study Goals
  - Estimate prevalence of potential OSA in non-OSA drivers
  - Re-calculate risk estimates

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Study Sample

- Exiting data from CDSRF study

- 20,745 truck drivers recruited from a large for-hire trucking company
  - Completed various questionnaires
    - ESS & BQ
  - CDME

- 981 w/OSA

- 879 Potential OSA group

- 18,198 drivers were labeled as "No OSA" or "not enough data"

STOP-Bang Analysis

Snoring / BQ

Tiredness / BQ and ESS

Observed apneas (BQ and ESS)

Pressure (high blood) / self-report and CDME

BMI (> 35 kg/m^2) / CDME (height and weight)

Age (> 50) = CDME and Driver Survey

~~**N**eck circumference~~

Gender (male) = CDME and Driver Survey

- High sensitivity of detecting OSA
- Simple scoring algorithm

- Modified Scoring
  - Neck circumference not available
    - "NO" default response-conservative
  - New OSA Risk Groups
    - OSA Potential (high-risk)
    - OSA Not Indicated (low-risk)

Results: OSA Prevalance

- 8,504 drivers identified as OSA Potential that were formerly (CDSRF):
  - "OSA Not Indicated" (n=6,462) or
  - "Not Enough Data" (n=2,042)

- 4,236 drivers recategorized from "Not Enough Data" to "OSA Not Indicated"

OSA Group	Driver Counts: CDME	Driver Counts: STOP Bang
OSA Not Indicated	11,864	9,639
OSA Potential	879	9,382
OSA Diagnosed: Treated	724	724
OSA Diagnosed: Untreated	139	139
OSA Diagnosed: Unsure Treatment	118	118
Total Drivers	13,724	20,002
Not Enough Data	*6,334*	*56*

Re-Calculate Risk Estimates

- Replicate CDSRF analysis

- Age quartiles
  - 21 to 33, 34 to 42, 43 to 51, and 52 years and older

- Groupings by Tx
  - Non-OSA, OSA w/TX, OSA w/out TX, OSA Tx unknown, Potential OSA

- Poisson regression models

- Crash Severity
  - FMCSA-Reportable, carrier crashes (all, preventable), moving violations

- Exposure
  - Tenure at carrier, under observation

Results: Safety risk by OSA

Total Carrier Crashes

Predictor Variables	Risk Ratio	Lower CI	Upper CI
OSA Diagnosed: Treated	0.78*	0.64	0.95
OSA Diagnosed: Untreated	1.08	0.74	1.57
OSA Diagnosed: Unsure of Treatment	0.74	0.41	1.34
OSA Potential	0.93	0.86	1.00

FMCSA-Reportable Crashes

Predictor Variables	Risk Ratio	Lower CI	Upper CI
OSA Diagnosed: Treated	0.83	0.63	1.11
OSA Diagnosed: Untreated	1.66*	1.06	2.59
OSA Diagnosed: Unsure of Treatment	0.69	0.31	1.54
OSA Potential	1.10	0.99	1.23

Carrier Preventable Crashes

Predictor Variables	Risk Ratio	Lower CI	Upper CI
OSA Diagnosed: Treated	0.50*	0.36	0.70
OSA Diagnosed: Untreated	1.24	0.76	2.00
OSA Diagnosed: Unsure of Treatment	0.89	0.42	1.87
OSA Potential	0.90	0.81	1.00

Moving Violations

Predictor Variables	Risk Ratio	Lower CI	Upper CI
OSA Diagnosed: Treated	0.53*	0.39	0.73
OSA Diagnosed: Untreated	1.25	0.79	1.96
OSA Diagnosed: Unsure of Treatment	0.64	0.30	1.34
OSA Potential	1.04	0.94	1.14

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Conclusions

- SB is quick, has objective and subjective elements

- 47% of the drivers were grouped as OSA Potential

- 57% of the drivers SB positive = OSA from polysomnography
  - the current sample ≈ 31.6% diagnosed with OSA
  - Like other national studies estimated OSA in this population

- Risk estimates like CDSFR
  - Several age quartiles increased risk OSA Diagnosed: Untreated compared to the No OSA group.
  - Significantly reduced risk between the OSA Diagnosed: Treated group and the No OSA group

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