UNIVERSITY OF MINNESOTA MORRIS

Truckers & Turnover Project

A Participating Research Group of the

ROADWAY SAFETY INSTITUTE

Advancing roadway safety with user-centered solutions

In collaboration with
Harvard Medical School,
Virginia Tech Transportation Research Institute,
Precision Pulmonary Diagnostics, and
Schneider, Inc.

Nonadherence with Employer-Mandated Sleep Apnea Treatment and Increased Risk of Serious Truck Crashes

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Why I Study Trucking Safety

Speaker's Background

Portrait of the Speaker as a Young Man

TL Steelhauler, Indianapolis, IN; 1977

LTL Road Driver, White Deer, PA; 1983

Truckers & Turnover Project, UMM: S.V.Burks Photo Collection

Skiing on 18 Wheels

Snowshoe, PA:
I-80 Eastbound,
Winter, 1983-4

One that didn’t make it . . .

Truckers & Turnover Project, UMM: photo by S.V. Burks

Large Scale Employer-Mandated OSA Program

Screening, Diagnosis, and Treatment for Obstructive Sleep Apnea

Schneider OSA Program

- Management decided on an internal program for drivers; went well beyond existing standards
- SomniSage® screening questionnaire
  - Precision Pulmonary Diagnostics (PPD)
  - Mandated by Schneider & administered via computer
- Drivers categorized as likely to have OSA queued as “high priority” to be sent for overnight PSG
- If diagnosed positive (generally at AHI ≥ 5) provided with APAP; adherence *a condition of continued employment*
- Treatment adherence actively monitored via APAP uploads
- Diagnosis and treatment preventive medicine under Schneider health insurance plan (no out-of-pocket cost)

Program Statistics

- Retrospective analysis period set as January, 2005 through December, 2009
- Pilot program exploration in 2005
- Major “production process” began April, 2006
- Initial coverage uneven, improved with time
- About 17,000 were screened (around half the drivers employed during study period)
- 2,200 drivers diagnosed during this period (due to exits this was about two thirds of those screened as high priority)
- Approximately 1,800 positives, 400 negatives (PPD)

The Data

Administrative Records

Data Elements

- Human resource data: demographics, hire and exit data
- Week-by-week operational data: miles, job type, domicile, trips
- Crash records: we select DOT-reportable preventable crashes as main focus
- Medical data: screening, diagnosis, treatment

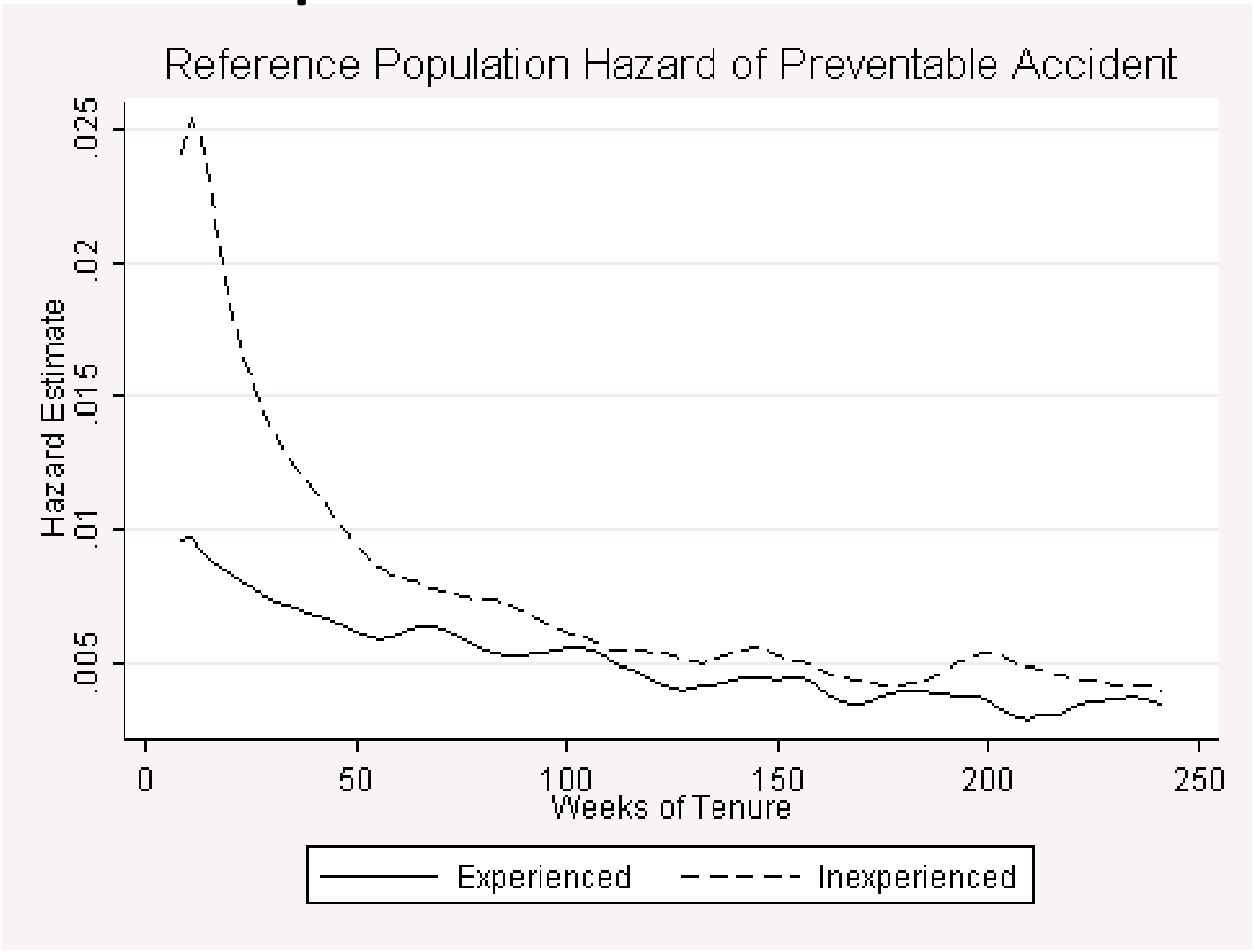
Treatment Adherence

- Basic standard for adherence:
- 4 hrs/night ≥ 70% of nights
- Fully Adherent always meet this
- Partially Adherent do not always meet this
- Nonadherent never record treatment

Analytical Issue: Crashes Affect who is Diagnosed & Treated

Safety Selection in Diagnosis and Treatment

Hazard of Preventable Crash by Experience Level at Hire



Source: "Non-Adherence with Employer-Mandated Sleep Apnea Treatment and Increased Risk of Serious Truck Crashes," *Sleep*, 39:5 (May, 2016), pp. 967-975.

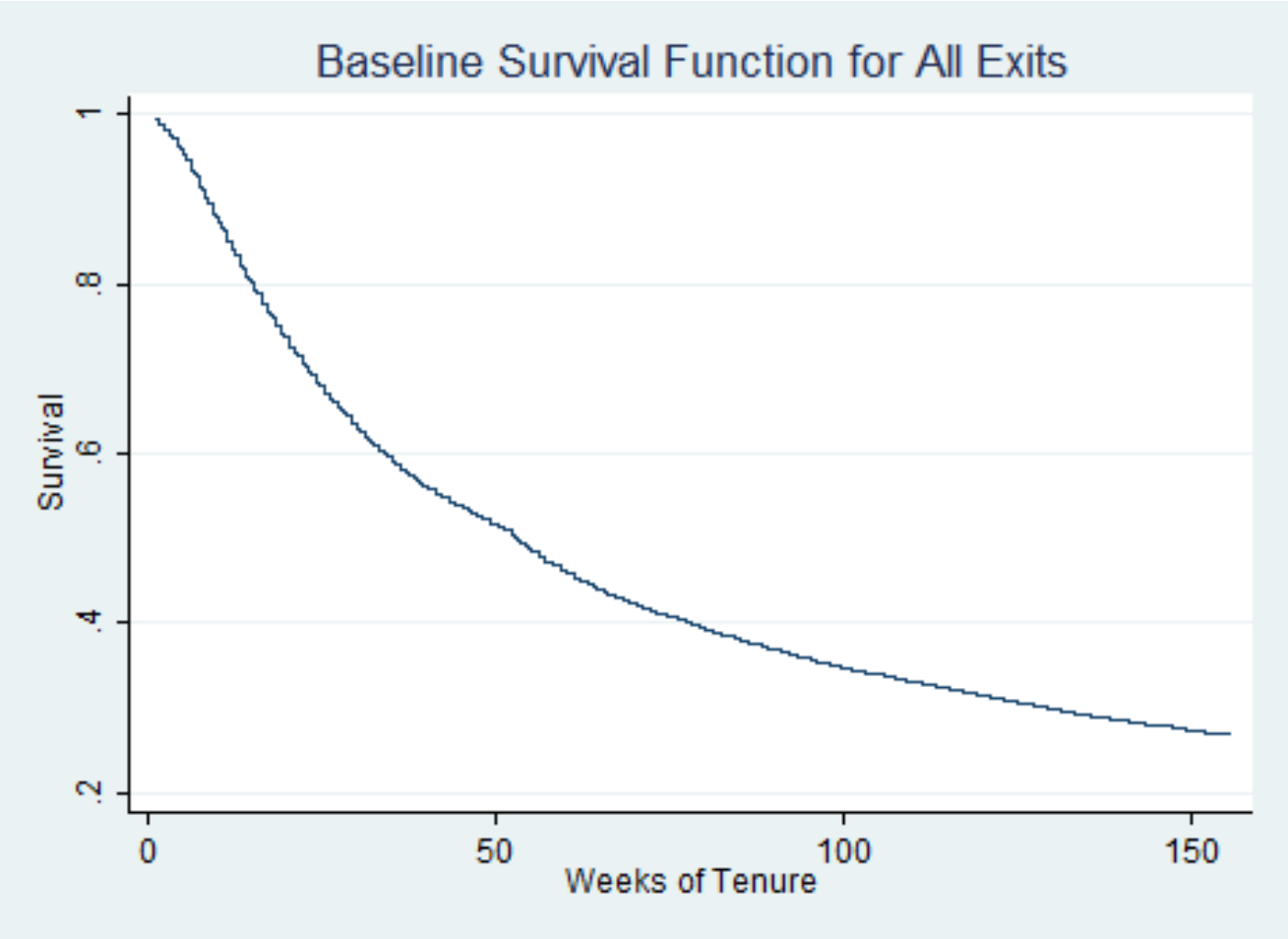
The Challenge

- Study firm turnover is lower than industry averages, but still significant
- Long tenure drivers with high-priority were high proportion of those diagnosed at program inception
- New drivers generally waited for insurance to become effective (90 days)
- **Thus, tenure length of those receiving a PSG is higher at all percentiles than that of the overall driver population**

“Safety Selection” Increases with Tenure

- Most exits are quits (75%), but a significant fraction (25%) are discharges
- A driver with an unacceptable preventable crash record is very likely to be fired
- Having a DOT-Reportable preventable crash during current two week period raises the risk of discharge by a large proportion (result from a Cox-type multivariate panel time-to-event model)
- HR=30.83, $p < .0001$, 95% CI: 27.01 to 35.18

Proportion of Entering Drivers Remaining, by Tenure Week



Source: "Non-Adherence with Employer-Mandated Sleep Apnea Treatment and Increased Risk of Serious Truck Crashes," *Sleep*, 39:5 (May, 2016), pp. 967-975.

Implications

- Diagnosed driver group has been subjected to more safety selection than has the overall driver population
- Diagnosed driver group is missing many drivers that had poor safety performance
- Solution: compare diagnosed drivers with control drivers of similar tenure and experience-at-hire so that both groups have experienced similar amounts of safety selection

Retrospective Cohort/Case-Control Study

- Key idea: construct artificial cohorts using case-control approach
- Match each case with a control that has the same experience-level at hire and job tenure as of the week of the PSG
- Select controls from those at “low priority” for a PSG (i.e. unlikely to have OSA)

Results

Comparison of Study Subgroups BEFORE and AFTER PSG/Comparison Date

Before the PSG/Comparison Date

- Retrospective analogue of “wait-list control” study
- **Results: no statistically significant differences** in DOT-reportable preventable crash rates
- **Reason: safety selection has wiped out differences** for DOT-reportable preventable crashes
- Drivers with untreated OSA likely had preventable DOT-reportable crashes at much higher rates than controls during this period
- Not observed since too many of the drivers who had those crashes did not survive on the job long enough to receive a diagnosis

After the PSG/Comparison Date

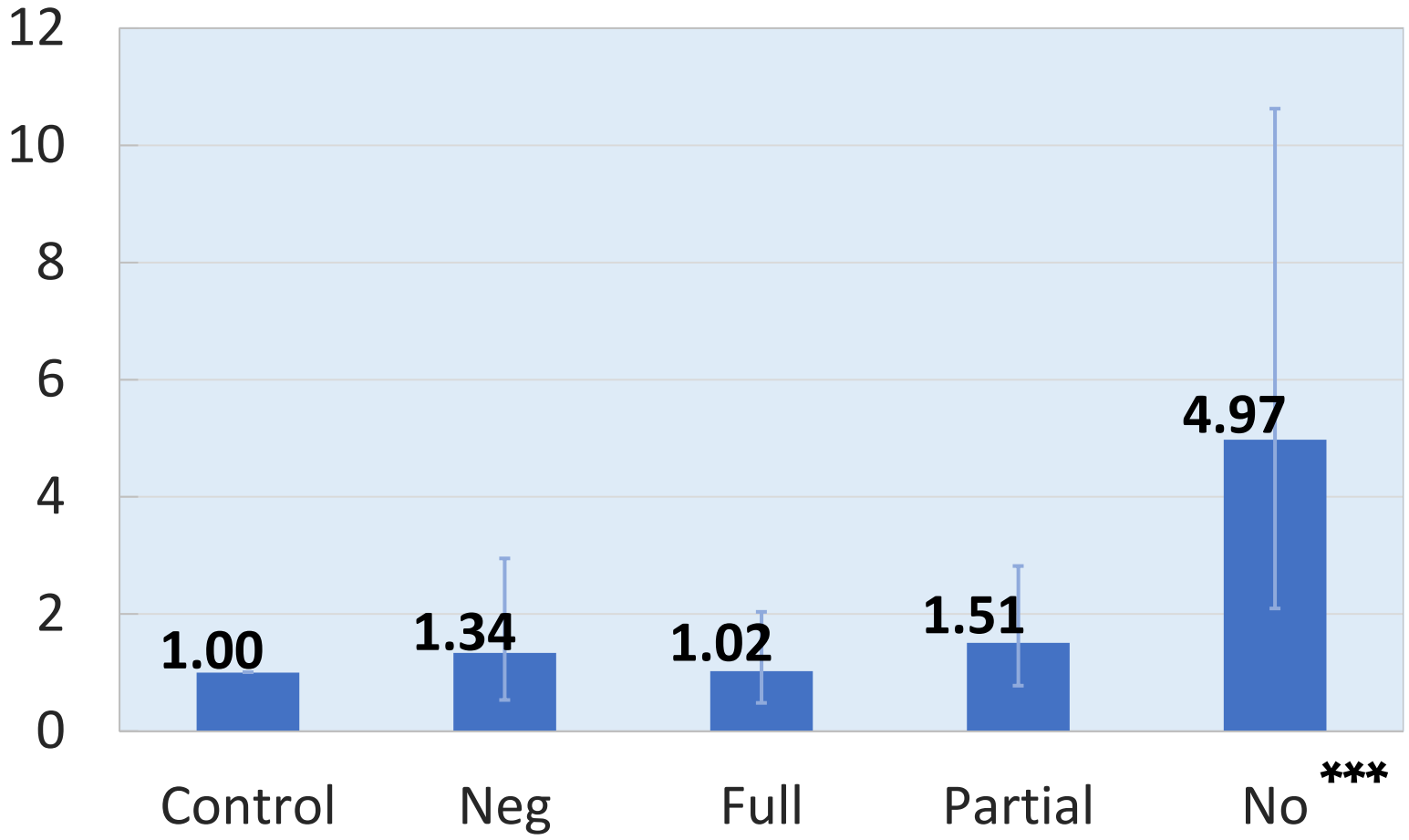
- Compare relative crash rates (i.e. controlling for exposure) across study subgroups
- Drivers nonadherent to APAP treatment have significantly higher risk of a DOT-reportable preventable crash
- No other sub-groups are statistically different from controls

Subgroup Statistics: Exposure and Crashes in AFTER Period

	Number of Drivers	Avg. Miles per Driver	Avg. Weeks per Driver	Avg. Miles per Driver-Week	Preventable DOT Crashes
Control	2,016	116,988	64	1,817	33
Negative	403	106,270	57	1,853	8
Full Adh	682	122,747	65	1,893	12
Partial Adh	571	132,807	73	1,825	16
No Adh	360	35,916	21	1,699	9

Source: "Non-Adherence with Employer-Mandated Sleep Apnea Treatment and Increased Risk of Serious Truck Crashes," *Sleep*, 39:5 (May, 2016), pp. 967-975.

DOT-reportable Preventable Crash Rates per 100,000 Miles Driven after PSG/Comparison Date by Subgroup



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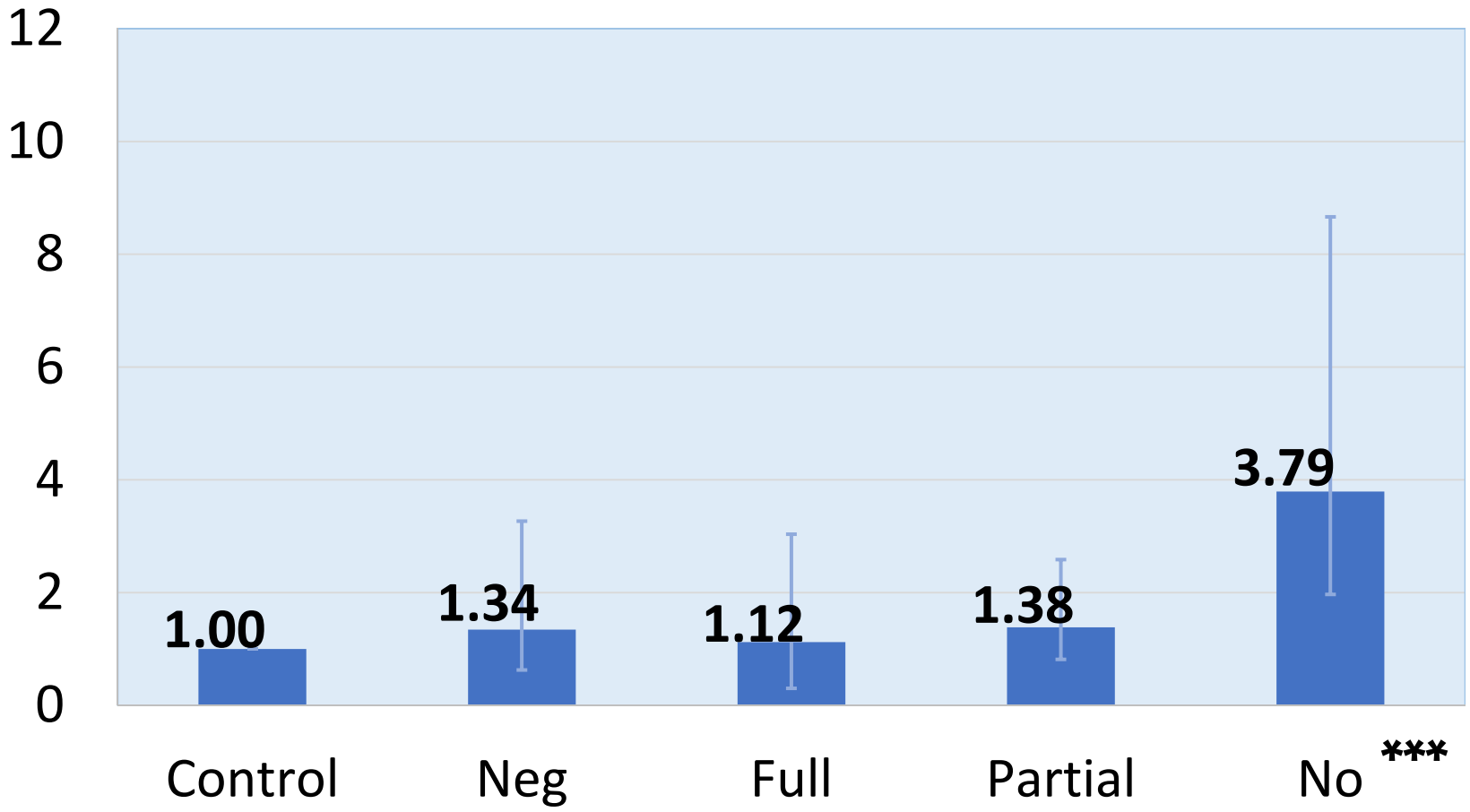
Robustness Check: Potential Confounding Factors

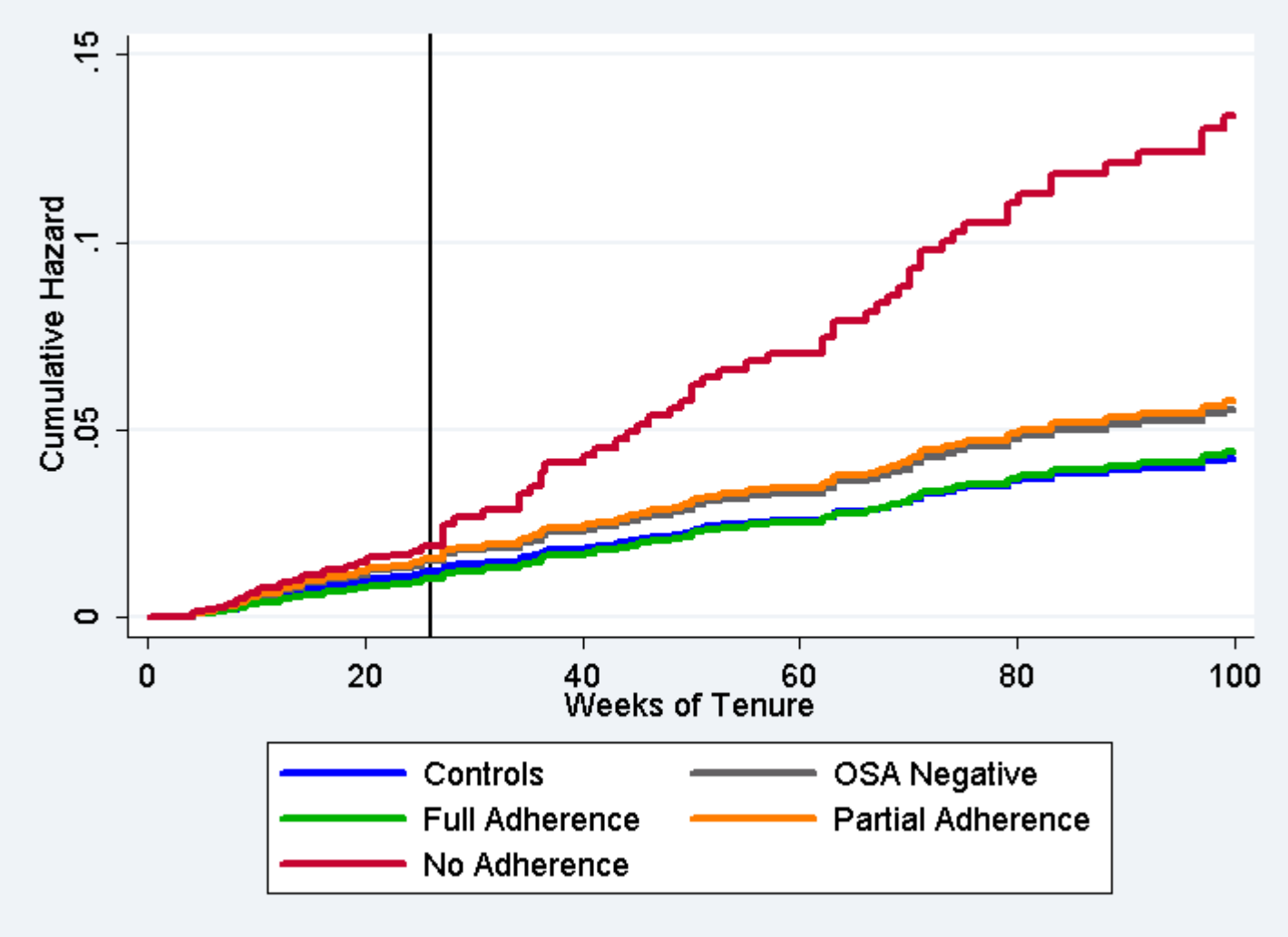
- These may vary across subgroups
  - Demographic characteristics
  - Job type
  - Dispatches per week
  - Miles per week
  - Geographic location of home terminal
- We adjust for these using an Andersen-Gill time-to-event multivariate model on week-by-week operational data

DOT-reportable Preventable Crash Hazard Ratios from Andersen-Gill Model after PSG/Comparison Date by Subgroup



Source: "Non-Adherence with Employer-Mandated Sleep Apnea Treatment and Increased Risk of Serious Truck Crashes," *Sleep*, 39:5 (May, 2016), pp. 967-975.

Predicted Cumulative Risk of DOT-Reportable Preventable Crash



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Interpretation

- Consider 1,000 drivers, each driving for one year (100,000 miles)
- Controls would have **14** preventable DOT-reportable crashes
- Adherent drivers would also have **14** preventable DOT-reportable crashes
- Nonadherent drivers would have **70** such crashes

Conclusions

Summary and Implications

Summary

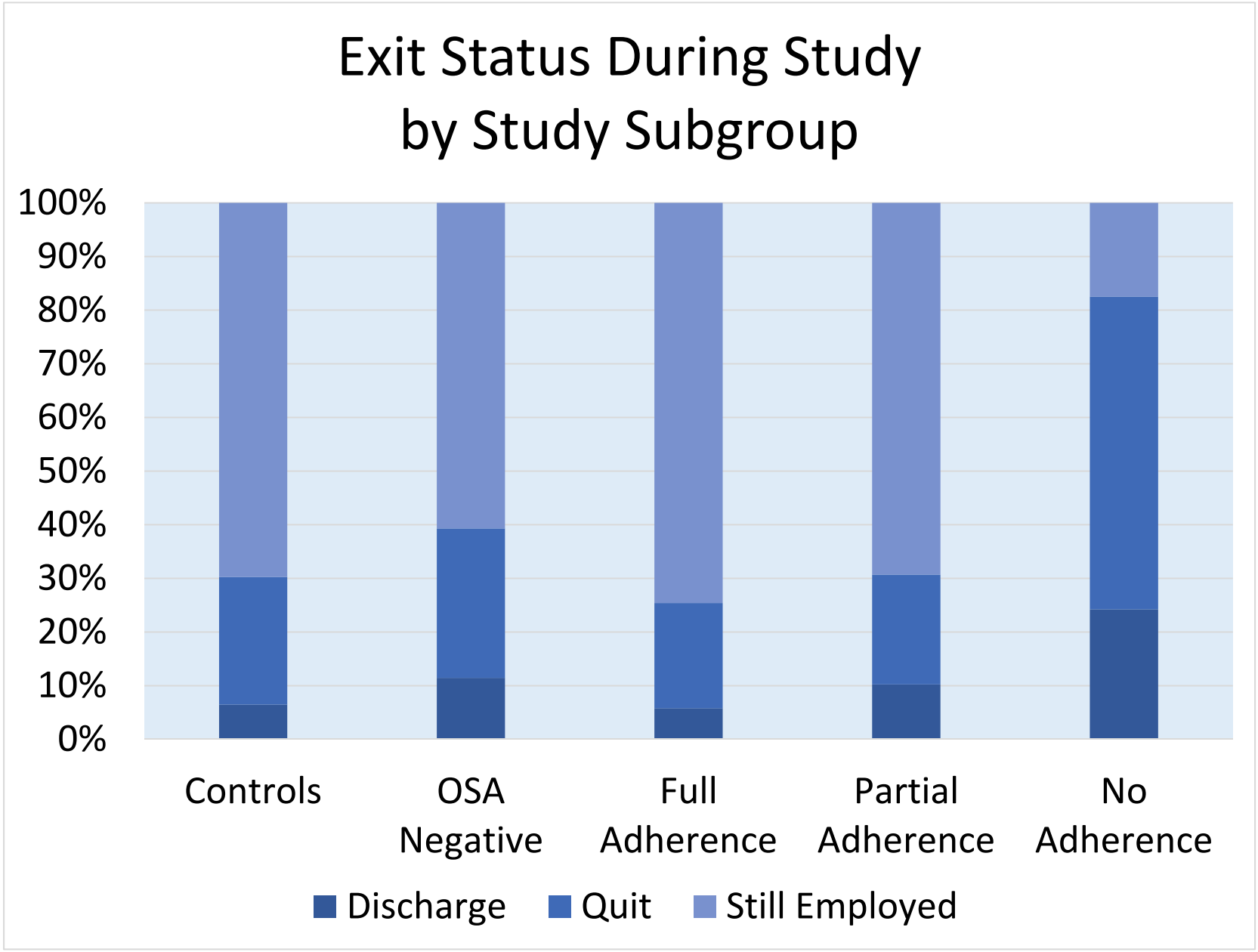
- Comparing crash rates adjusted for exposure across study subgroups
  - Drivers adherent with treatment are statistically indistinguishable from controls
  - Nonadherent drivers have a five-fold increase in crash risk ($p<.0001$)
- Checking for robustness with a multivariate model
  - With all controls mentioned
  - With AHI ≥ 15 as standard for positive diagnosis
  - With all DOT-reportable crashes
- All versions reproduce the same pattern of crash risk differences (the excess risk of the nonadherent varies a bit with the model)

Limitations

- We cannot uniquely attribute the higher risk of Non-adherent drivers to untreated OSA
- Adherence is self-selected (it would be illegal and unethical to do otherwise)
- Implication: other differences between the nonadherent and the rest, e.g. “those who fail to comply with treatment also fail to comply with other safe driving practices”, may also be part of the cause

Employer Implications

- An employer-mandated OSA program that includes required treatment adherence sorts the workforce
- It *retains* those who are adherent and safer
- It *filters out* those who are not adherent and very much riskier
- It therefore improves the DOT-reportable preventable crash performance of the affected fleet



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Public Policy Implication

- Under current screening regulations, a driver with OSA who are nonadherent can work at a firm that does not have an OSA program by keeping his/her diagnosis private
- This suggests that the FMCSA should consider mandating screening in the CMV drivers' biennial medical exam

Further Directions

- We are currently analyzing the savings to the study firm associated with the OSA program due to
  - Lower costs for preventable crashes
  - Lower costs for medical insurance usage for all reasons other than OSA treatment
- Initial results show large medical insurance cost savings from the OSA program

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