Obesity and the Medical Costs of Workers Compensation Claims

Frank Schmid
NCCI, Inc.

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Source: Chris Laws and Frank Schmid, *Reserving in the Age of Obesity*, Last revised October 25, 2010, ncci.com

Overview

- Objective

- Previous Research

- The Data

- Descriptive Statistics

- The Multilevel Model

- Main Findings

- Impact of Utilization Reviews and Bill Reviews

- Conclusion

- Appendix

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Objective

- Recent studies have shown that obesity contributes to a large and increasing proportion of health care costs
  - In particular, a 2007 study from Duke University demonstrates that obesity contributes significantly to the cost of workers compensation claims
- What follows is a study of the effect of obesity on workers compensation medical severity
  - We use a matched-pairs methodology that compares "obese" claims to "non-obese" claims

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Previous Research

- Duke University studied 11,728 of its health care and university employees over the period 1/1/1997 through 12/31/2004
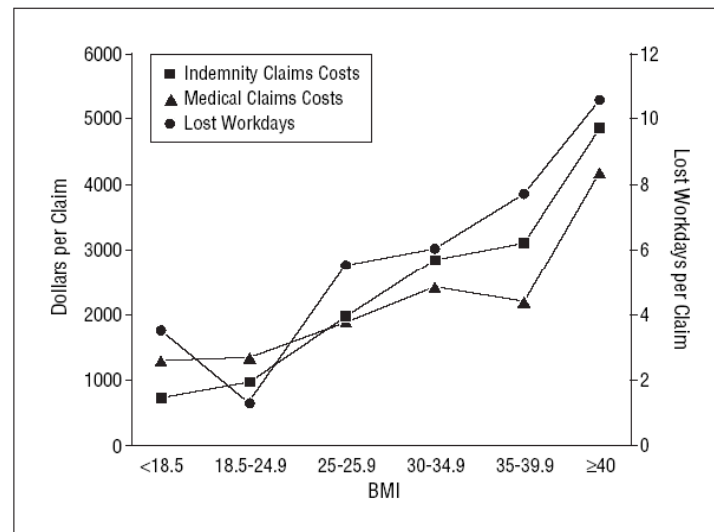

Figure 1. Mean indemnity claims costs, medical claims costs, and number of lost workdays per claim by body mass index (BMI) category. Body mass index is calculated as weight in kilograms divided by height in meters squared.

Source: Truls, Østbye, John M. Dement, and Katrina M. Krause (2007) "Obesity and Workers' Compensation: Results from the Duke Health and Safety Surveillance System," *Archives of Internal Medicine* **167**, 766-773

The Data

- We use a set of medical claims provided by carriers

  - The data set covers injury years 1997-2006

  - We study three maturities

    - 12, 36, and 60 months

      - The 12 month-maturity claims, for instance, range from injury years 1997 through 2005

  - The data set comprises 36 U.S. states

    - AL, AK, AZ, AR, CO, CT, DC, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MS, MO, MT, NE, NV, NH, NM, NC, OK, OR, RI, SC, SD, TN, UT, VT, VA

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The Data

- We form matched pairs
  - An "obese" claim is matched with a "non-obese" claim, using the following claim characteristics
    - Injury year
    - State
    - Gender
    - NCCI industry group (of which there are five)
    - ICD9 code
    - Age at injury (we exclude claimants that are 15 years of age or younger)

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The Data

- Claims are excluded once a lump-sum payment is observed

  - For instance, a claim that is included in the analysis for the 12-month maturity is excluded for the 36-month maturity (and the 60-month maturity) if a lump sum payment occurs after 12 months, but no later than 36 months

- A claim is categorized as "obese" if for any diagnostic field other than the primary one, the first three digits of the ICD9 code equal 278

  - A claim belonging to the set of the non-obese claims at the 12-month maturity moves to the set of the obese claims at the 36-month maturity if the ICD9 code 278 is observed after 12 (but no later than 36) months

  - Once a claim is categorized as obese at a given maturity, this claim cannot revert to being non-obese at a later maturity

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The Data

- To maintain data quality, we exclude claims with ICD9 codes that are not pertinent to workers compensation

- For the purpose of statistical analysis, we aggregate the set of pertinent ICD9 codes into 22 injury groups (see the appendix to this presentation)

  - Our aggregation rule rests on groupings suggested by the WHO (World Health Organization), yet maintains a finer grid for ICD9 codes common in workers compensation

  - Note that this aggregation is solely for the purpose of statistical modeling—the matching of claims rests on the actual ICD9 codes (as mentioned)

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The Data

- After applying exact matching by injury year, state, gender, industry group, and ICD9 code, we match by age using the concept of fuzzy sets

  - This is because exact matching by age greatly reduces the resulting number of matched pairs (for instance, an obese 63-year old only matches to a non-obese 63-year old of the same injury year, state, gender, industry group, and ICD9 code)

  - Using multi-year age brackets (such as 55-59, 60-64, and so on) lacks accuracy, as a 60-year old is likely to be a closer match to a 59-year old than a 64-year old

The Data

- We identify the nearest non-obese neighbor by the shortest Euclidean distance
  - The distance is computed on the claimants' degree of "oldness"—the fuzzy set "oldness" (and its complement, "youngness") is determined using a sigmoid function
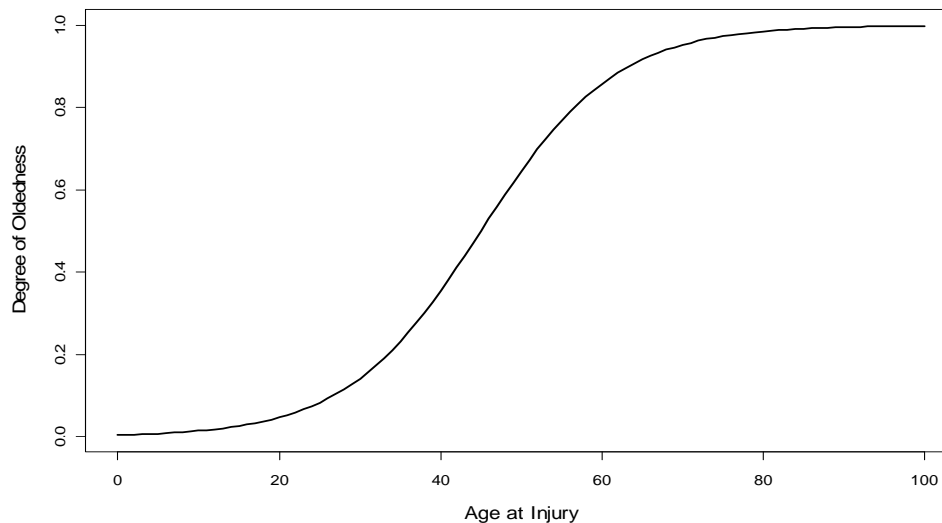
The Data

- The matching by nearest neighbor is done with replacement, which means that the same non-obese claims may serve as a match to more than one obese claim

- Matching by age may result in ties

  - Some obese claims may have more than one nearest neighbor among the relevant set of non-obese claims

    - If there is more than one nearest neighbor, we speak of "tying neighbors"

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The Data

- Non-exact matching of age (by means of multi-year age brackets or by means of fuzzy sets) causes "matching toward the center"

    - Younger claimants have more neighbors to the right than to the left, and older claimants have more neighbors to the left than to the right

        - Hence, a young obese claimant is more likely to be matched with a non-obese claimant that is older

        - Conversely, an old obese claimant is more likely to be matched with a non-obese claimant that is younger

    - As a result, if claim costs increase with age, so will the measured cost difference between obese and non-obese claims, even if obesity has no causal impact on the difference in claim costs

        - For young claimants, this difference would be negative, and for old claimants, it would be positive

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The Data

- We control for the "matching toward the center" effect using a semi-parametric regression approach

  - Generically, a semi-parametric regression model consists of a standard regression component and a non-parametric component:

    $$y_i = \beta_0 + \beta_1 x_{1,i} + \ldots + \beta_1 x_{K,i} + f(z_i) \ , \ \ i = 1, \ldots, N$$

    - The non-parametric component $f(z_i)$ models the influence of age (as gauged by the age of the *obese* claimant) using a linear spline with an endogenous number of knots—the spline is estimated by means of Reversible Jump MCMC

    - The inclusion of the "age" variable serves primarily the purpose of controlling for the "matching toward the center" effect, and the findings should be interpreted accordingly

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Descriptive Statistics

- Number of obese claims and number of tying non-obese neighbors at 12, 36, and 60-month maturities

Injury Year	Obese	Non-Obese	Obese	Non-Obese	Obese	Non-Obese
	Maturity					
	12 months		36 months		60 months	
1998	250	537	266	518	271	529
1999	282	565	313	573	304	545
2000	343	802	365	831	364	831
2001	417	1,058	430	1,018	413	953
2002	467	1,108	481	1,106	459	1,049
2003	553	1,290	517	1,157	—	—
2004	630	1,464	656	1,414	—	—
2005	722	1,514	—	—	—	—
2006	836	1,744	—	—	—	—

- In any given injury year, the number of obese claims may vary with maturity as (1) non-obese claims may turn obese and (2) obese claims may record lump sum payments
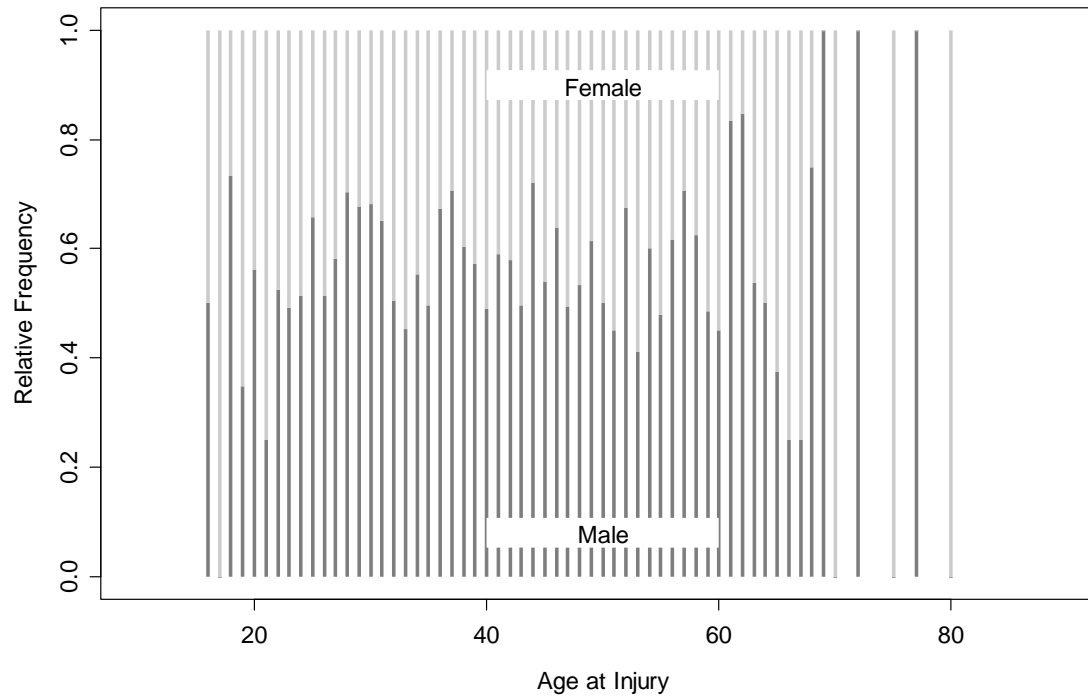
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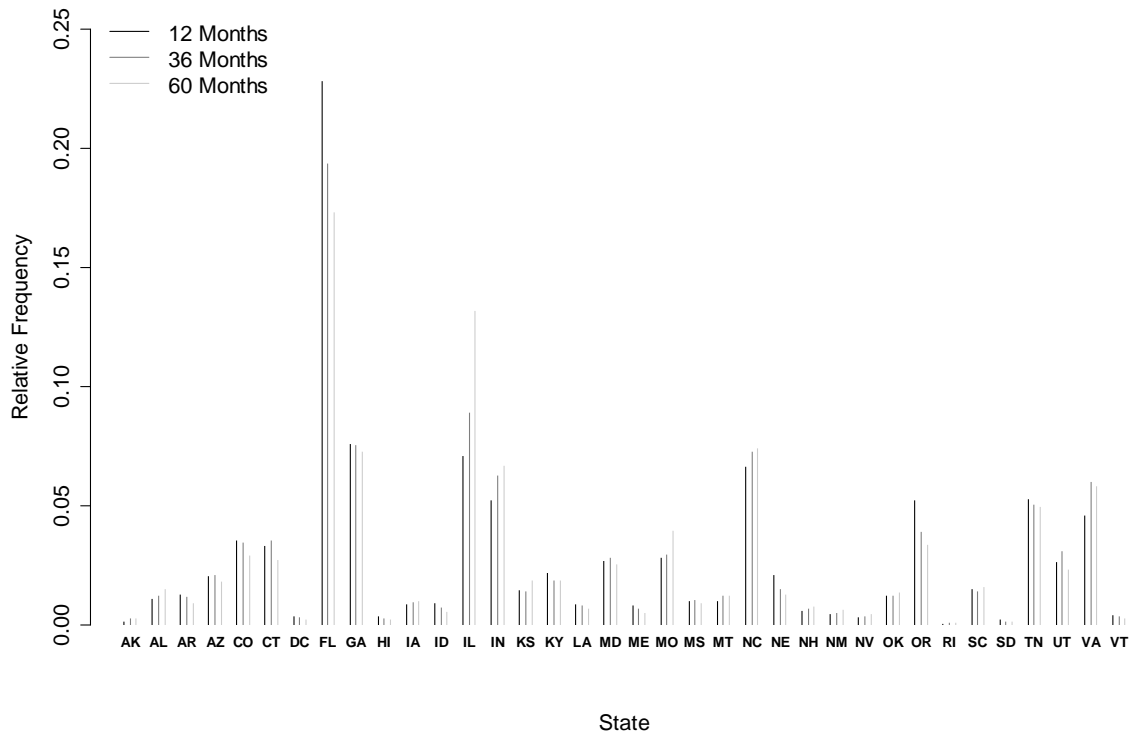# Descriptive Statistics

- Age distribution, by maturity
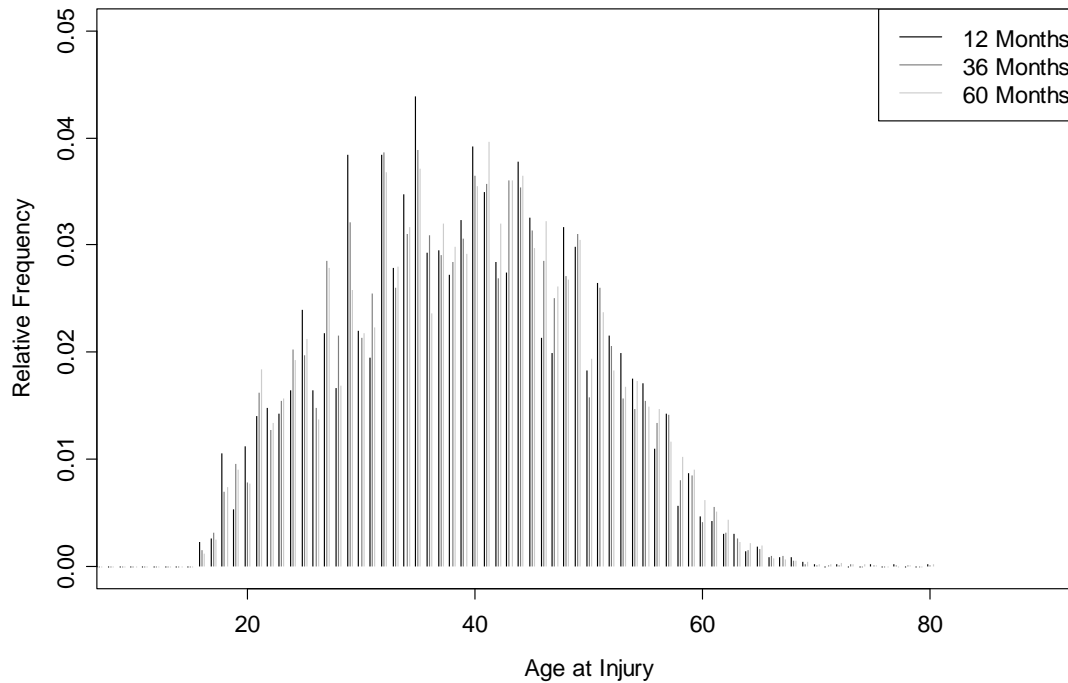
Descriptive Statistics

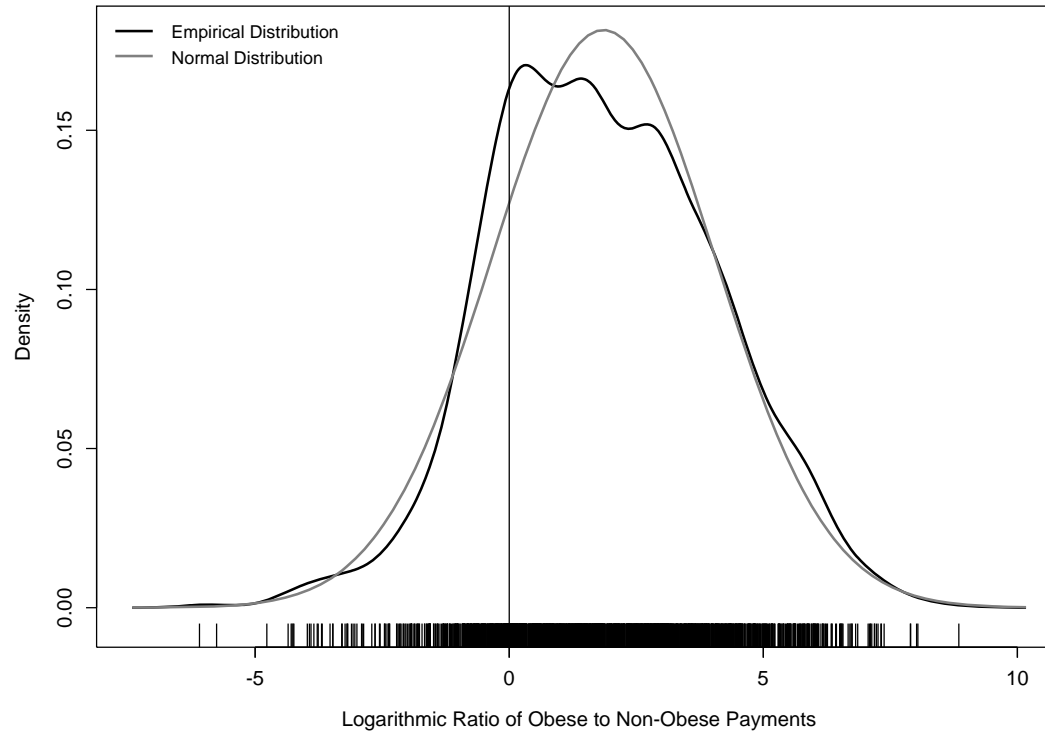- Age distribution by gender, 60-month maturity

Descriptive Statistics
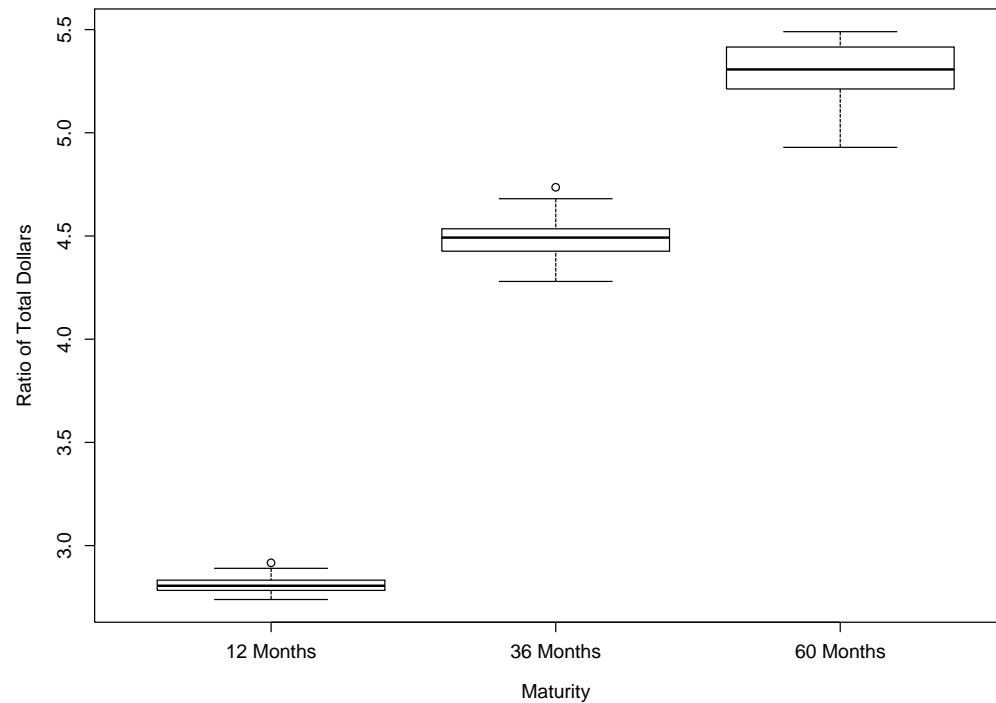
- Distribution of observations by state, by maturity

Descriptive Statistics

- Kernel density estimate of log ratio of claim costs, 60-month maturity

Descriptive Statistics

- Ratio of sum of "obese dollars" to sum of "non-obese dollars," by maturity

The Multilevel Model

- The outcome (left-hand side) variable is the log ratio, by claim, of the obese to the non-obese claim costs

  - The regression equation includes every obese claim and, for every obese claim, one nearest neighbor

  - Because there are potentially several nearest neighbors ("tying neighbors"), the matching neighbor is drawn randomly

    - To control for this randomness in the matching process, we compile 50 data sets

    - We analyze each of these 50 data sets and then aggregate the results

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The Multilevel Model

- The predictors (right-hand side variables) explain the percentage cost difference between obese and non-obese claims recorded by the outcome variable

  - We allow for "random effects" by injury year, state, gender, industry group, and injury group

    - Note that in the statistical analysis, we use the aggregated injury groups (instead of the ICD9 codes)

  - We control for the effect of age (which may entirely or in part reflect the effect of matching toward the center)

  - We break out the effect of two legislative stipulations

    - Mandatory Utilization Review
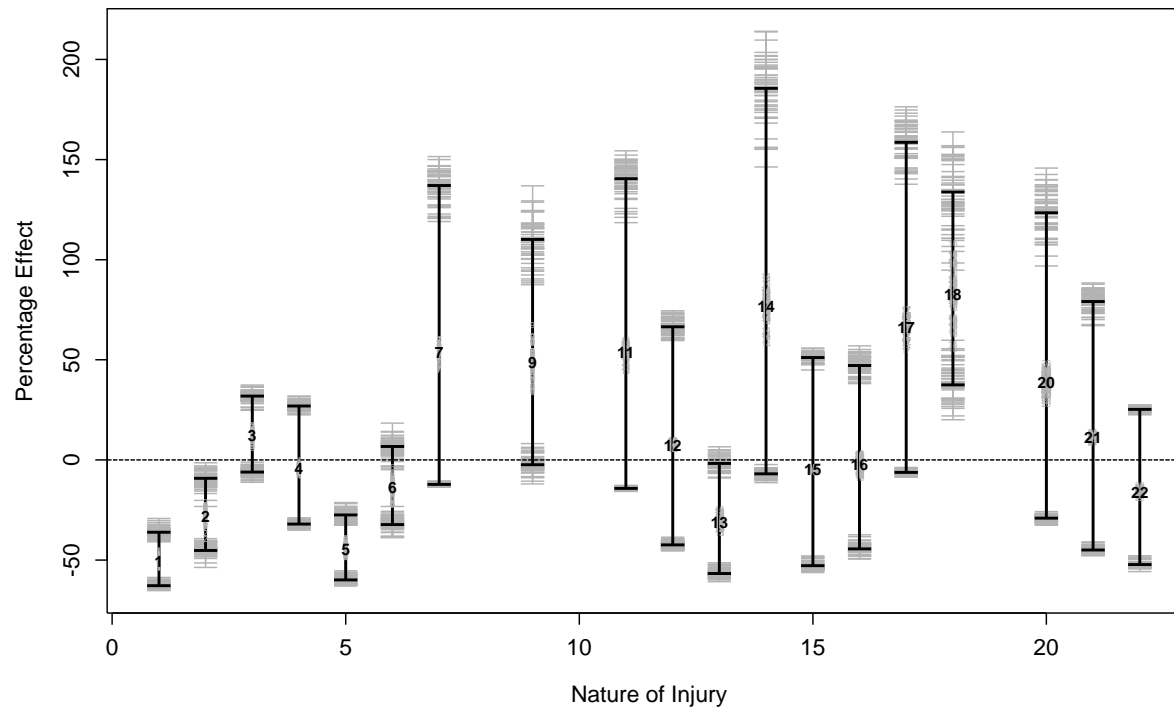   - Mandatory Bill Review

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Effect of Injury Year (60 Months)

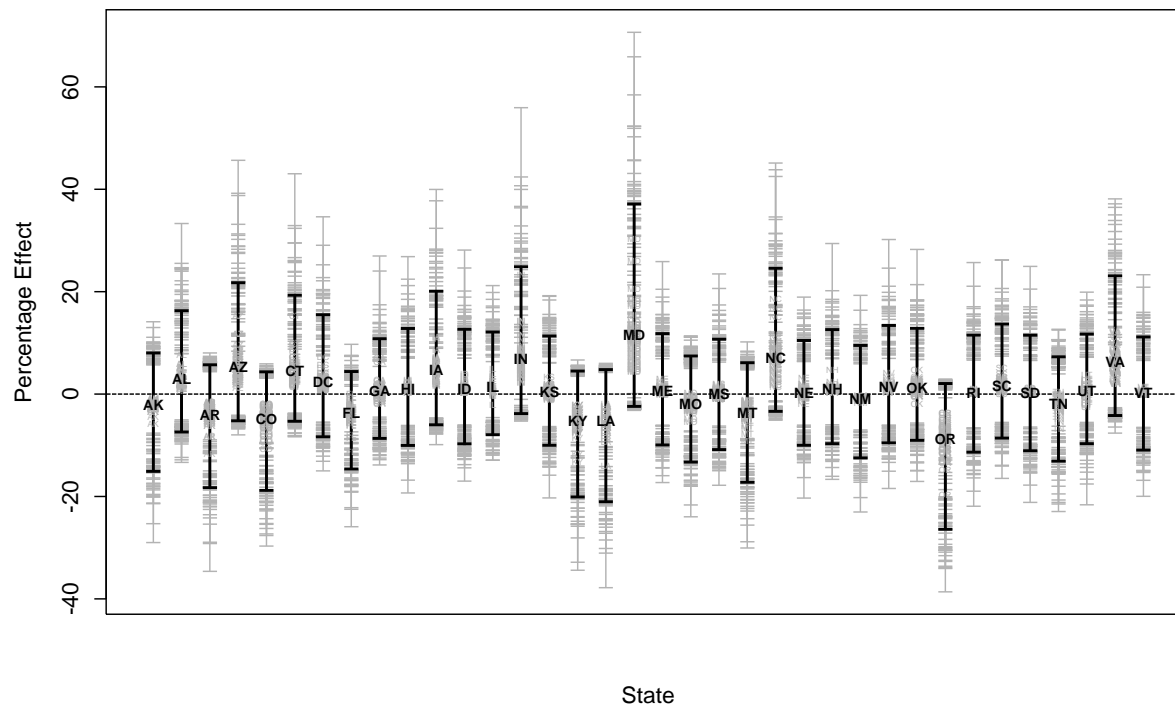- Injury year, random effect, percentage impact
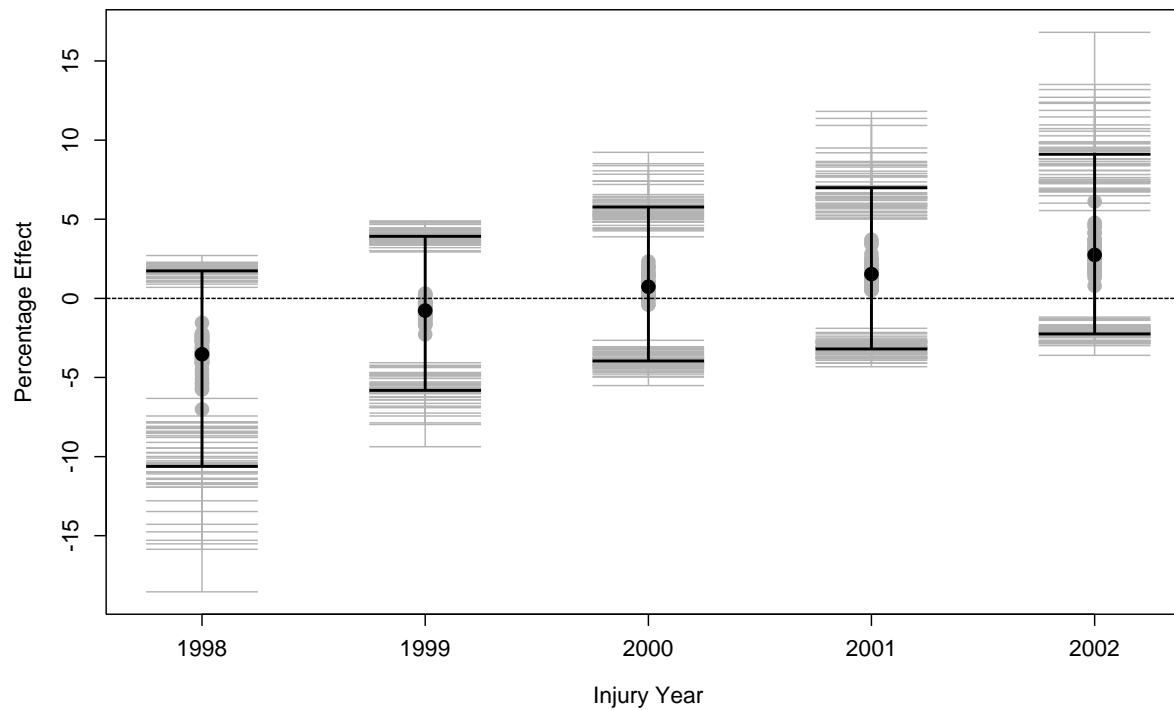
Effect of Injury Groups (60 Months)

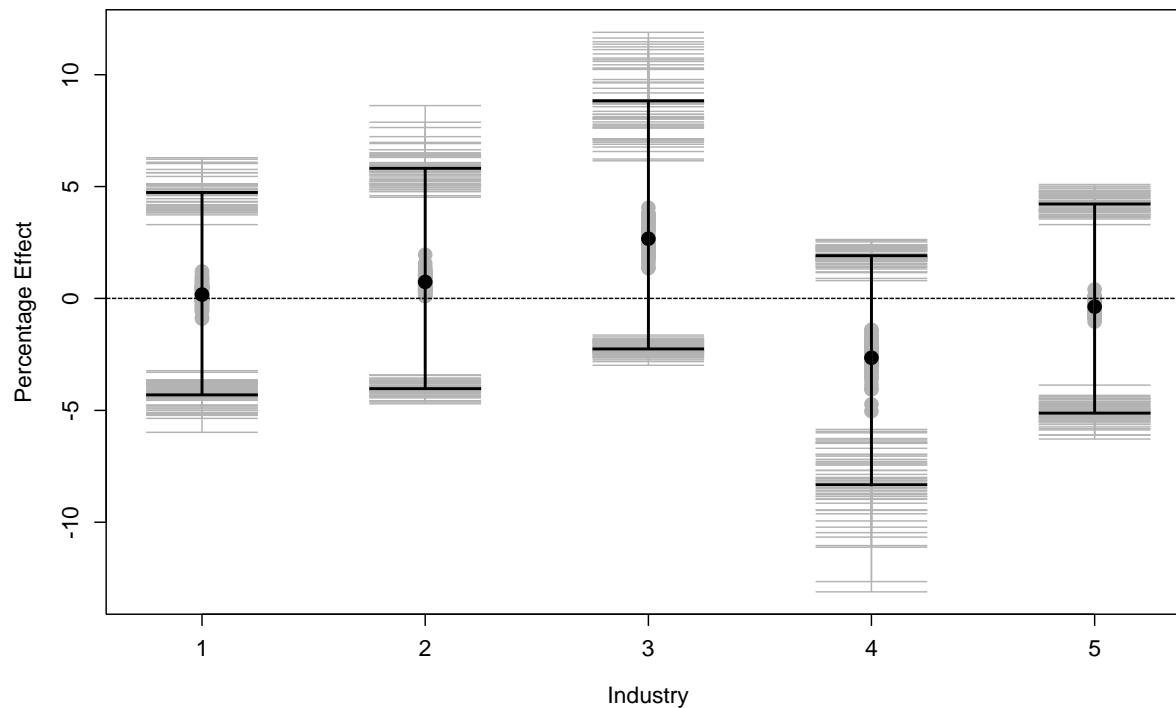- Injury group (see appendix), random effect, percentage impact

Effect of States (60 Months)
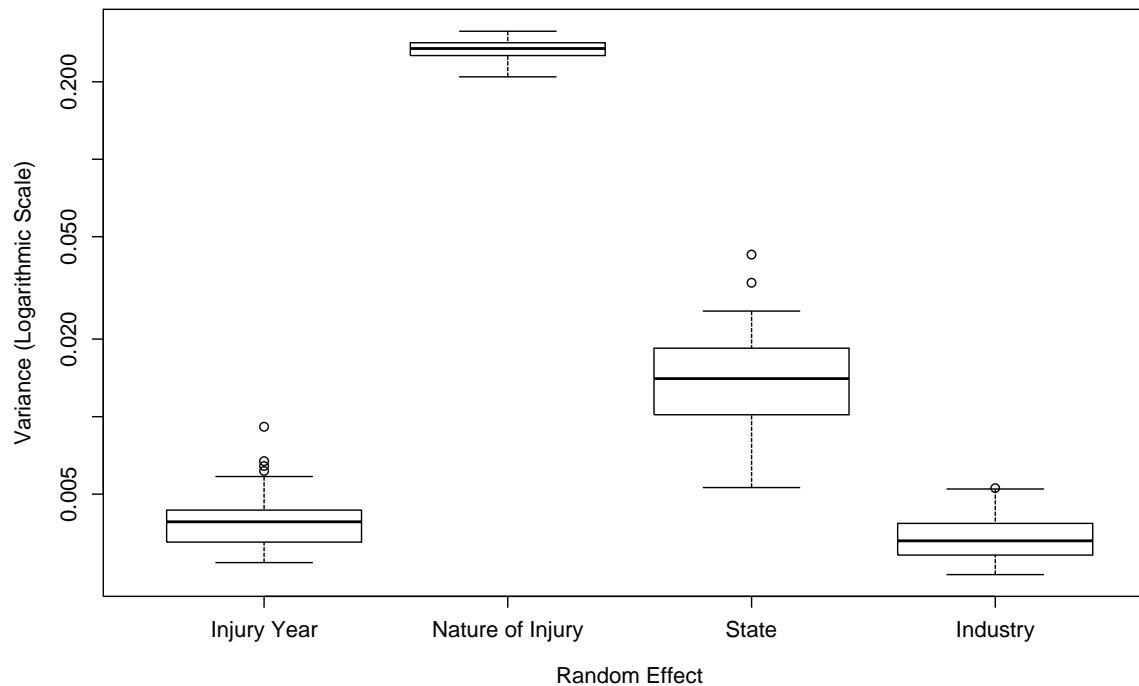
- State, random effect, percentage impact

Effect of Industry Groups (60 Months)

- Industry group, random effect, percentage impact
  1: Manufacturing; 2: Contracting; 3: Office and Clerical; 4: Goods and Services; 5: Miscellaneous
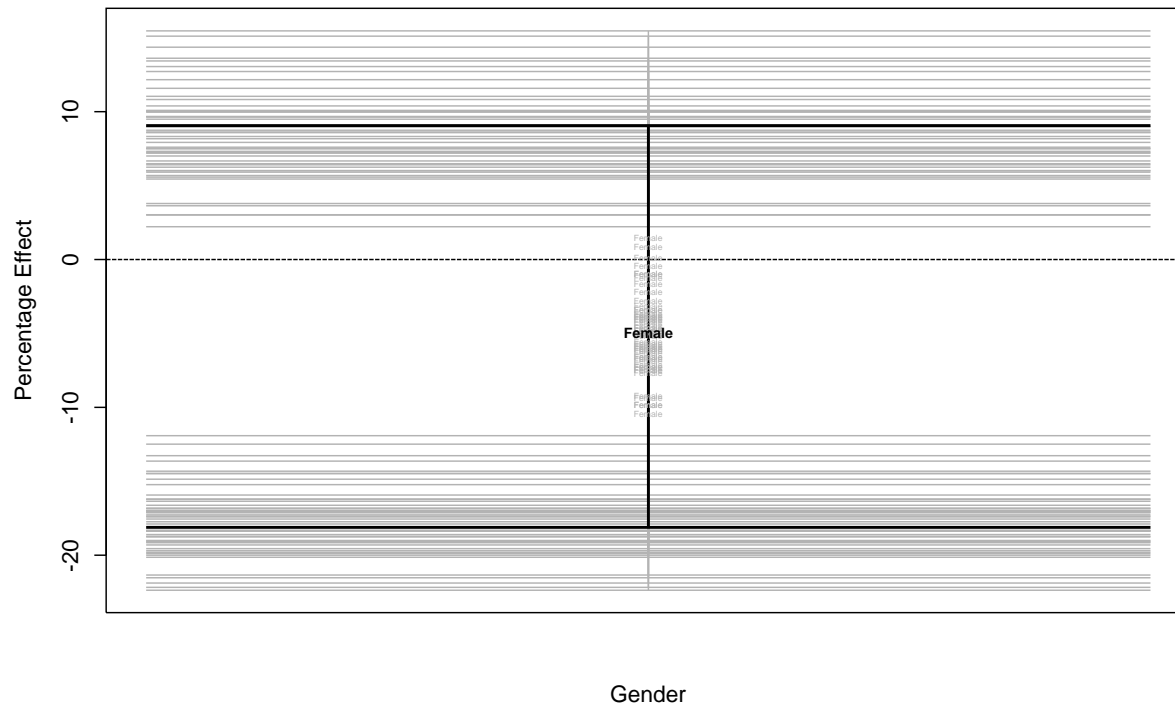
Variances of Random Effects (60 Months)

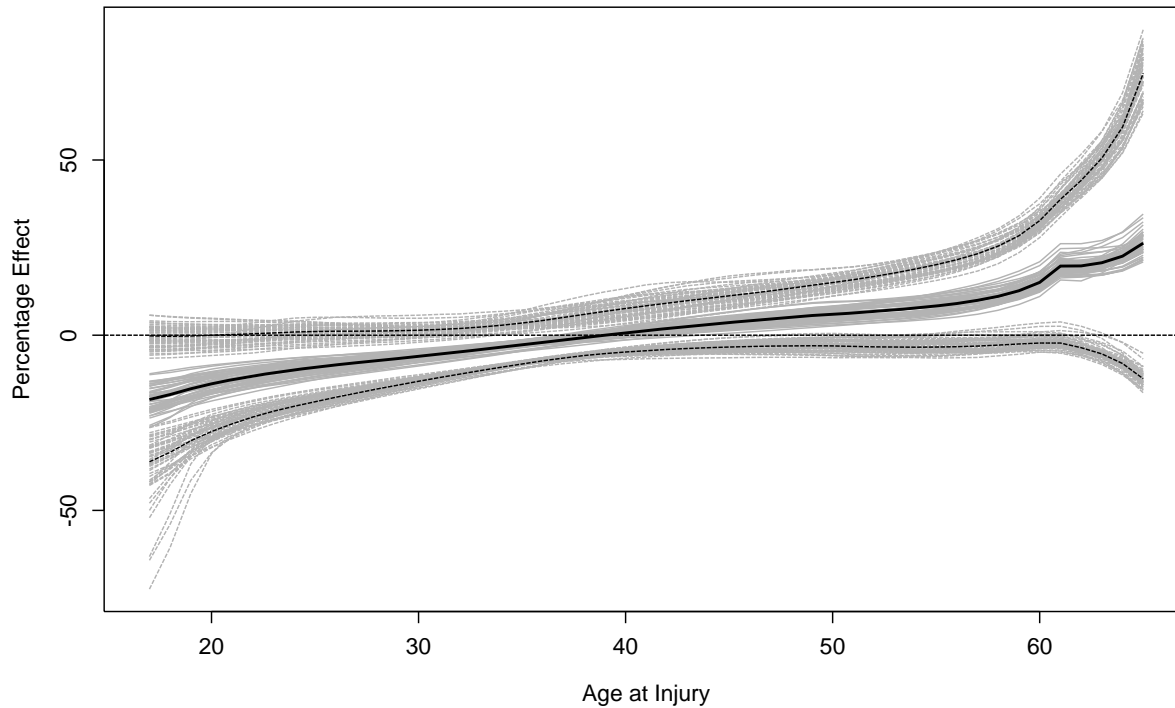- Variances of the Random Effects in Comparison

Effect of Gender (60 Months)

- Gender, percentage impact
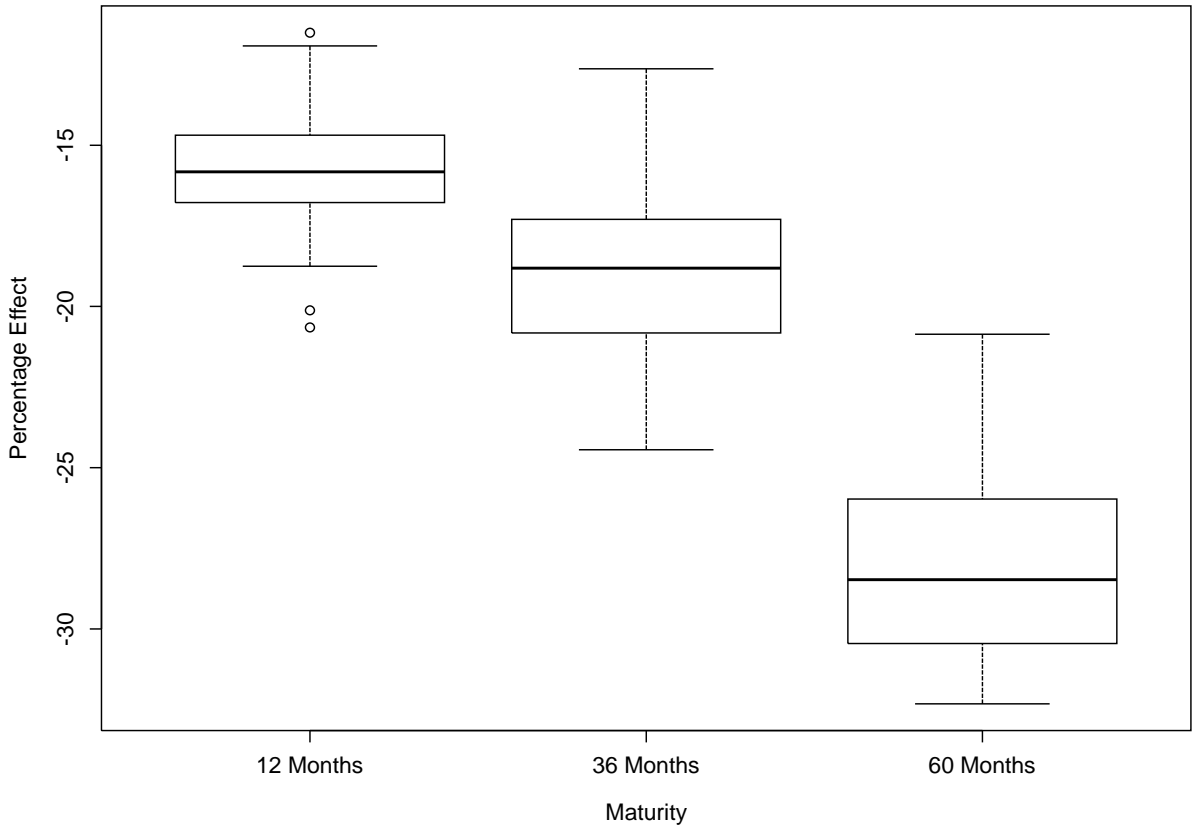
Effect of Age (60 Months)

- Age, centered percentage impact

Impact of Utilization and Bill Reviews

- Mandatory Utilization Review (MUR) and Mandatory Bill Review (MBR)

    - We have information on MUR and MBR (provided by WCRI) at two points in time: 1997 and 2001

        - We use the 1997 information for injury years 2000 and earlier

        - See appendix for details

    - The estimates for the effects of MUR and MBR on the cost difference between obese and non-obese claims are derived under the assumption that the coding of claims as obese is independent of these two legal stipulations being in place

        - If the presence of MUR or MBR increases the propensity of a claimant being coded as obese, then the influence of these two legal stipulations on the cost difference is underestimated (due to a simultaneity bias)

Impact of Mandatory Utilization Review

Impact of Mandatory Bill Review
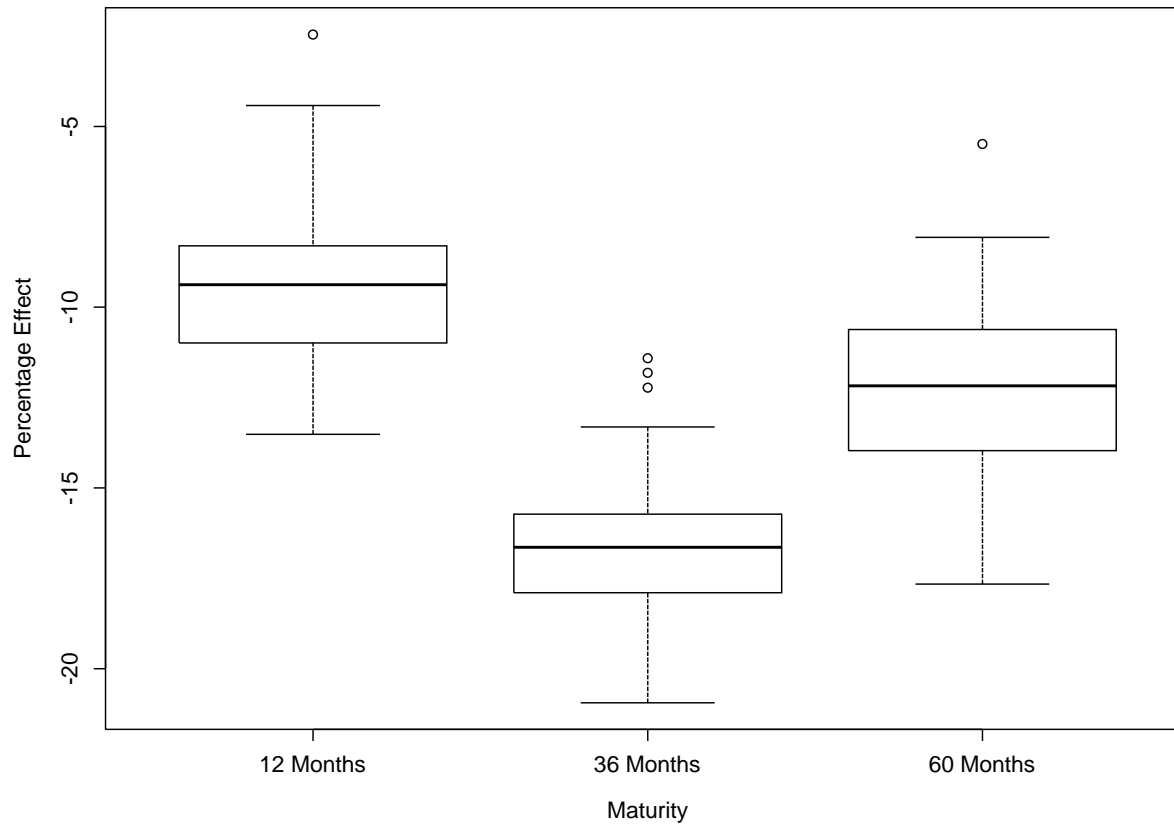
Impact of States (60 Months)

- Random effects, percentage impact (net of MUR and MBR effects)
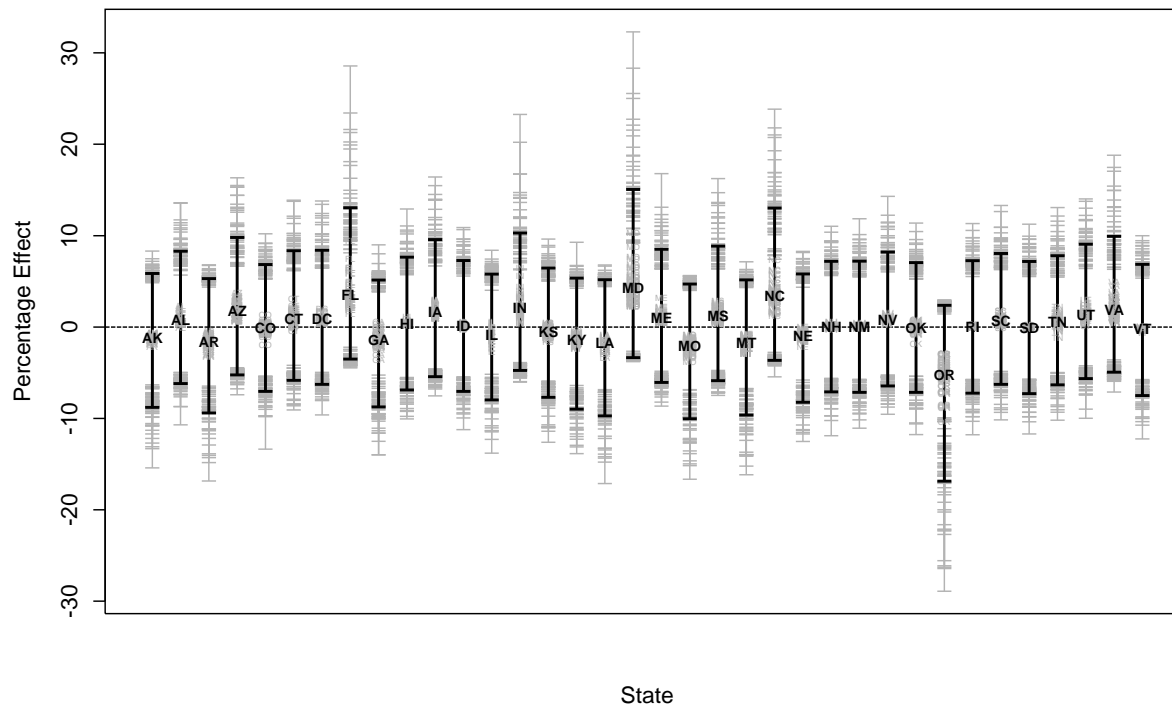
State

Conclusion

- Obesity contributes to the cost of workers compensation claims

    - The percentage effect of obesity varies greatly by injury group, is lower in states where MUR and MBR stipulations are in place, and agrees in magnitude with previous research at Duke University

- The estimated effects may reflect an upper bound for the effect of obesity

    - The proportion of obese claims in the data set is considerably smaller than in the U.S. population, thus suggesting that obese claims represent obesity of the highest category

    - For some claims, the arrival of medical complications may be causal to the claimant being coded as obese—such cases pose a problem of "self-selection"

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Appendix
Injury Groups

Category	ICD-9 Codes	Description
1	001–289.9 and 390–629.9	Diseases other than diseases of the musculoskeletal system and connective tissue and diseases of the nervous system and sense organs
2	320–389.9	Diseases of the nervous system and sense organs
3	710–739.9	Diseases of the musculoskeletal system and connective tissue
4	800–829.1	Fractures
5	830–839.9	Dislocation
6	840–848.9	Sprains and strains of joints and adjacent muscles
7	850–854.1	Intracranial injury, excluding those with skull fracture
8	860–869.1	Internal injury of thorax, abdomen and pelvis
9	870–897.7	Open wounds
10	900–904.9	Injury to blood vessels
11	905–909.9	Late effects of injuries, poisonings, toxic effects, and other external causes
12	910–919.9	Superficial injury
13	920–924.9	Contusion with intact skin surface
14	925–929.9	Crushing injury
15	930–939.9	Effects of foreign body entering through orifice
16	940–949.5	Burns
17	950–957.9	Injury to nerves and spinal cord
18	958–959.9	Certain traumatic complications and unspecified injuries
19	960–979.9	Poisoning by drugs, medicinal, and biological substances
20	980–989.9	Toxic effects of substances chiefly nonmedical as to source
21	990–995.94	Other and unspecified effects of external causes
22	996–999.9	Complications of surgical and medical care, not elsewhere classified

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Appendix
Mandatory Utilization and Bill Reviews (MUR, MBR)

State	Year			
	1997		2001	
	MUR	MBR	MUR	MBR
AL	No	No	No	No
AK	No	No	No	No
AZ	No	No	No	No
AR	Yes	Yes	No	Yes
CO	Yes	Yes	Yes	Yes
CT	No	No	No	No
DC	No	No	No	No
FL	Yes	Yes	Yes	Yes
GA	No	No	No	No
HI	No	No	No	No
ID	No	No	No	No
IL	No	No	No	No
IN	No	No	No	No
IA	No	No	No	No
KS	No	No	No	No
KY	Yes	No	Yes	Yes
LA	Yes	Yes	Yes	Yes
ME	Yes	No	Yes	No
MD	No	No	No	No
MS	Yes	Yes	Yes	Yes
MO	No	No	No	No
MT	Yes	No	No	No
NE	No	No	No	No
NV	Yes	Yes	No	Yes
NH	No	No	No	No
NM	Yes	No	Yes	No
NC	No	No	No	Yes
OK	No	No	No	No
OR	No	Yes	No	Yes
RI	No	No	No	No
SC	No	Yes	No	Yes
SD	No	No	No	No
TN	Yes	No	Yes	No
UT	Yes	No	Yes	No
VT	No	No	No	No
VA	No	No	No	No

Source:

WCRI (2001) *Managed Care and Medical Cost Containment in Workers' Compensation: A National Inventory, 2001-2002*, Cambridge (MA): Worker Compensation Research Institute.

WCRI (1997) *Managed Care and Medical Cost Containment in Workers' Compensation: A National Inventory, 1997-1998*, Cambridge (MA): Worker Compensation Research Institute.

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