

Data on equitable occupant protection

Previous presented study at GRSP 2019 updated with data from studies until 2021

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Purpose of this study?

AIM

- Gather and present studies with data on equitable occupant protection
- Update the previous study about male and female occupant protection

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BACKGROUND

Are we different?

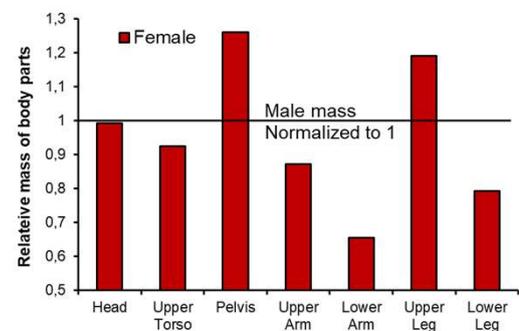
- Size
- Mass distributions
- Age dependence
- Hormones
- Pregnancy
- Anatomy
- Osteoporosis

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BACKGROUND

Are we different?

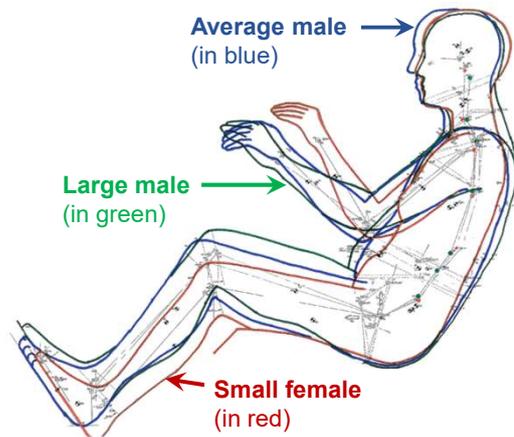
- Size:
Average female: 162 cm / 62 kg
Average male: 175 cm / 77 kg
(Schneider et al. 1983)
- Mass distribution
(Young et al. 1983; McConville et al. 1980)



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Different size

- Different seated posture
- Females tend to have:
 - Different arm position
 - Shorter head restraint distance
 - Shorter distance to steering wheel
 - Different leg position
 - More upright seated posture
 - Shorter distance to floor pan



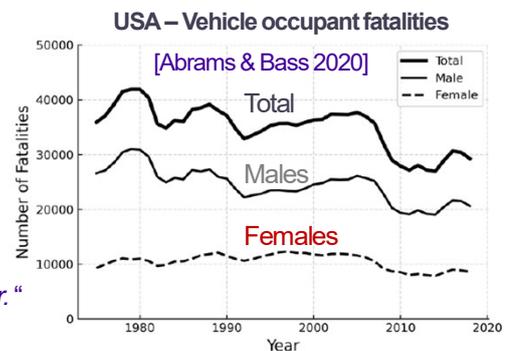
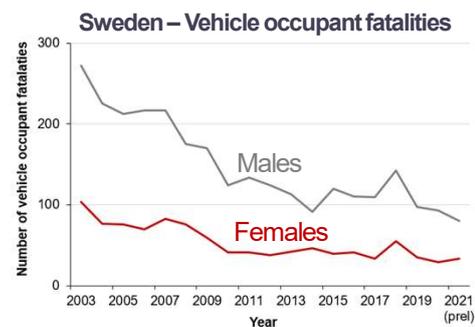
Picture based on UMTRI data

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General statistics

- Females are underrepresented in fatal or serious injury resulting from motor vehicle crashes [Bose et al. 2011]

“Annual vehicle occupant fatalities have decreased overall since 1975, yet fatalities among females have remained largely the same year-to-year.”



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General statistics

- Injury risks are higher for females than males, when controlling for factors such as crash severity, restraint usage and blood alcohol content, ...

[Narragon 1965; Foret-Bruno 1990; Evans 2000; Evans & Gerrish 2001; Bédard et al. 2002; Digges & Dalmotas 2007; Bose et al. 2011; Parenteau et al. 2013; Forman et al. 2019; Abrams & Bass 2020; Kullgren et al. 2020; Brumbelow & Jermakian 2021]

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General statistics

Females:

- Sustain injuries at lower velocity changes (Δv)
[Mackay & Hassan 2000; Welsh & Lenard 2001]
- Relatively less are uninjured
[Welsh & Lenard 2001; Obeng 2011]
- Higher risk of crash related injury requiring hospitalization
[Cullen et al. 2021]

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BACKGROUND

Shift: Fatality => Injury & disability

- The burden of road traffic injuries has shifted from
 - fatality / premature death
 to
 - injury (AIS 3+ / AIS 2+)
 - disability with long-term consequences (AIS 1; PMI 1%+, 10%+)
 - quality of life

[Hasselberg et al. 2018]

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RESULTS

Females / males fatal (-2020)

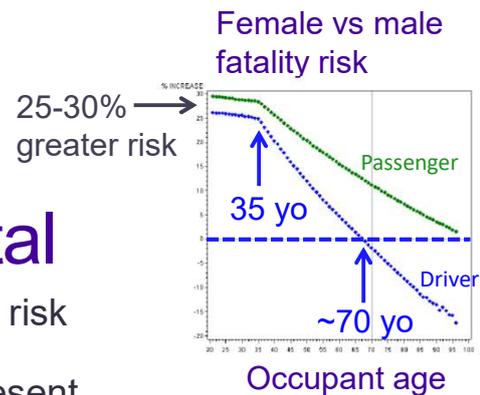
- Foret-Bruno (1990) **20%** higher fatal injury risk
- Evans (2000) **35%** higher fatal injury risk (25 yo)
- Bédard et al. (2002) **54%** higher fatal injury risk
- Kahane (2013) **25-30%** higher fatal injury risk (-30 yo)
- Abrams & Bass (2020) **20-25%** higher fatal injury risk (20-30 yo)

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Females / males fatal

- The substantial increase in fatality risk for young adult females relative to males the same age is already present by age 18.
- After ~35 years of age, females' added risk sharply diminishes.
- After ~70 years of age, female drivers are at lower risk than male drivers.

[Kahane 2013]



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Females / males AIS 3+ (-2021)

- Digges & Dalmotas (2007) **63%** higher MAIS3+ injury risk (50–97 yo)
187% higher MAIS3+ injury risk (15–49 yo)
- Bose et al. (2011) **47%** higher MAIS 3+ injury risk
- Forman et al. (2019) **73%** higher AIS 3+ injury risk
- Brumbelow & Jermakian (2021) **45%** higher AIS 3+ injury risk
No significant differences found (OR 1.45; CI: 0.81–2.56)

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RESULTS

Females / males AIS 2+ (-2021)

- Bose et al. (2011) **71%** higher MAIS 2+ injury risk
- Forman et al. (2019) **142%** higher AIS 2+ injury risk
- Brumbelow & Jermakian (2021) **123%** higher MAIS 2+ injury risk

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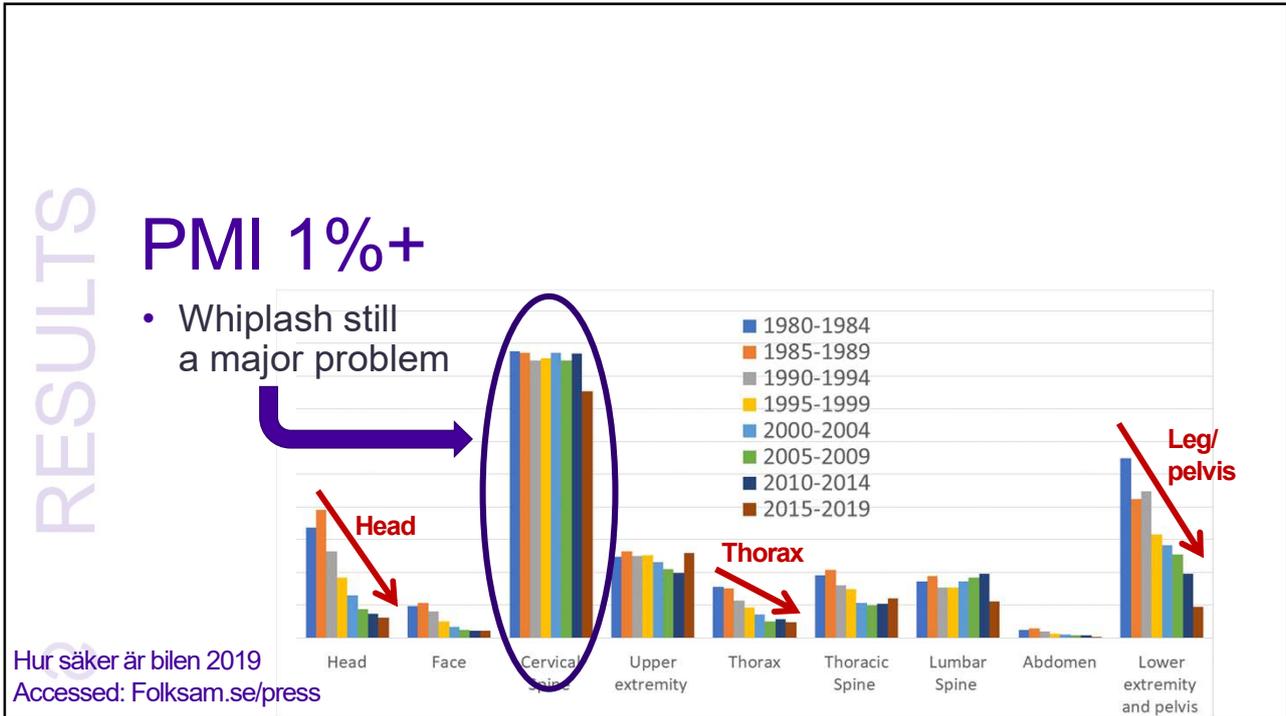
RESULTS

Females / males PMI (-2020)

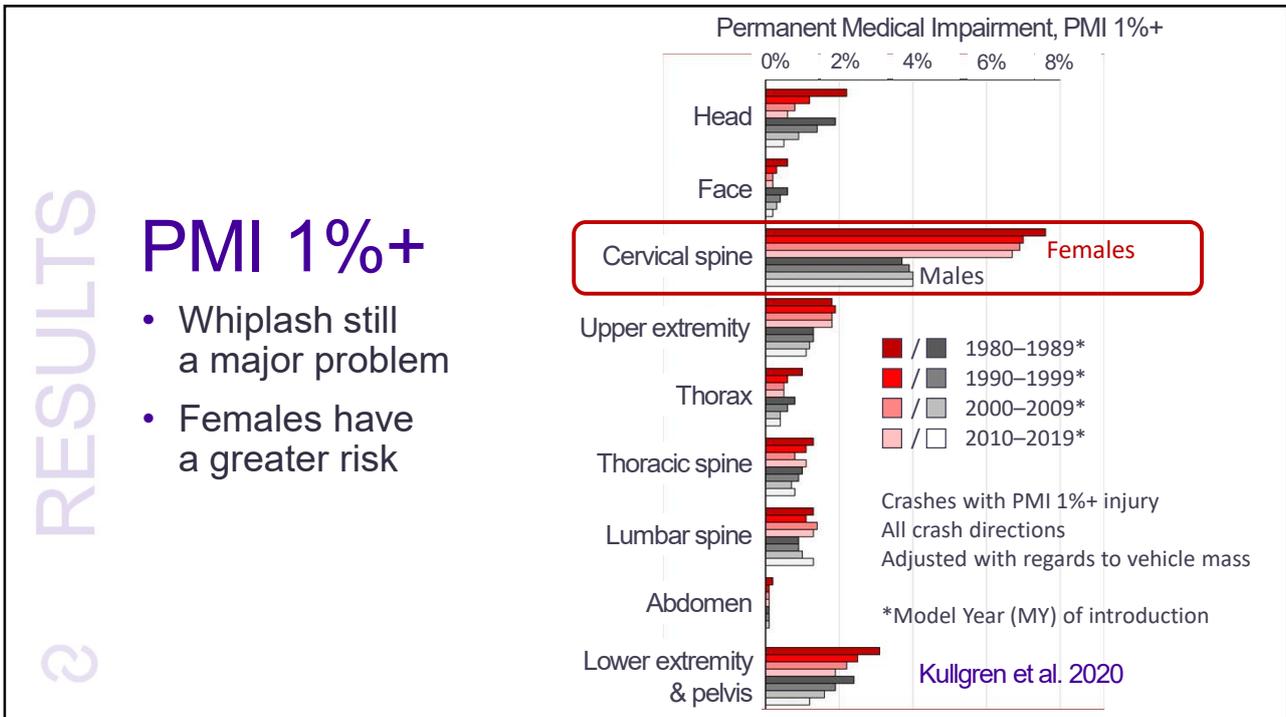
- Kullgren et al. (2020) **43%** higher PMI 1%+ risk
28% higher PMI 10%+ risk

PMI = Permanent Medical Impairment

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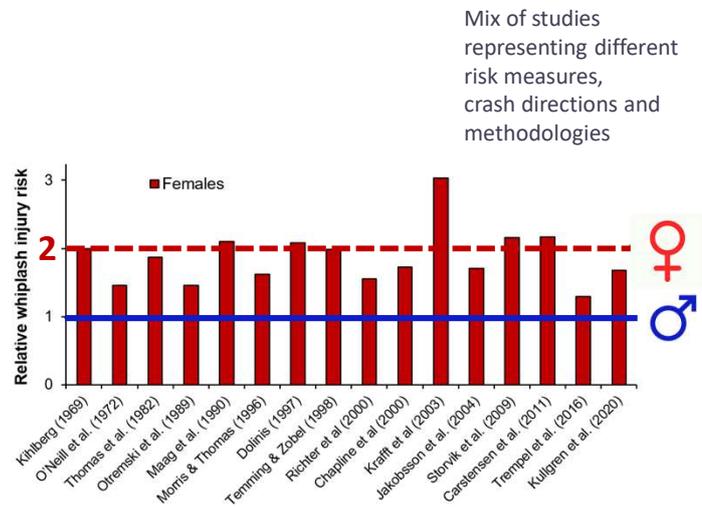


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RESULTS

Whiplash

- Females have generally a higher risk of whiplash injury



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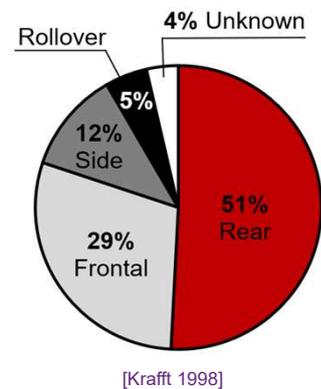
RESULTS

Whiplash

Whiplash most common in

- Rear impacts
- Low velocity changes (<25 km/h)

[Eichberger et al. 1996; Kullgren et al. 2003]

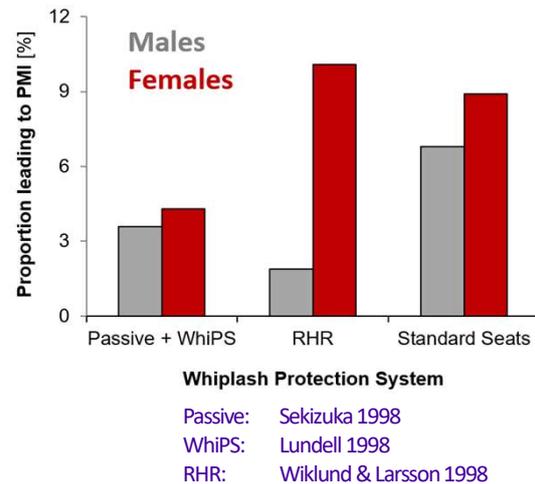


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Whiplash

- Different effectiveness in protecting females with different types of whiplash protection systems (rear impacts)

[Kullgren et al. 2013]



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To conclude

- Continuous improvements in vehicle safety with regards to long term consequences
- Whiplash injury is a major problem for both females and males, but especially females
- Crash related injury risks are generally higher in females

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Thank you for your attention!

