CIREN - New Jersey Medical School

The influence of age and gender on the incidence, injury pattern and likelihood of lower extremity fractures sustained by frontal occupants in motor vehicle crashes

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Background

- Projected aging of U.S. population
- Cost of healthcare
  - treatment of primary and secondary disease in the elderly
- Prevention

Objective

- Demonstrate the influence of age and gender on the incidence, injury pattern and likelihood of lower extremity fractures sustained by frontal occupants in motor vehicle crashes.

Methods

- Study population
  - MVC victims admitted to Level I trauma centers
- CIREN inclusion/exclusion criteria
- Data contemporaneously collected
  - Clinical data
    - Physical exam, radiology, laboratory, operative procedures, rehabilitation, post mortem reports
  - Crash reconstruction
    - NASS protocol

Methods

- Data merged from four CIREN centers
- Data was sanitized and streamlined
- Analysis by SAS program
  - Wilcoxon, t-test, paired t-test, Fisher's Exact, odds ratio

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Frontal Crash vs. Lateral Crash

Patient Dynamics	Frontal	Lateral
N	322	113
Avg Age	41.1	36.2
ISS	21.5	27.9
GCS	12.8	11.4
Survival %	0.78	0.78
LOS	14.8	15.8
ICU Days	5.8	6.8
Height (cm)	169.3	168.3
Weight (kg)	78.3	74.8
Crash Dynamics		
Delta V1 (kph) ***	46.9	36.9
Mass V1 avg.	1350.8	1269.9
Mass V2 avg.	1506.1	1616.4

Wilcoxon (ISS&GCS), Fisher's Exact (survival), t-test (LOS, ICU days, HT, WT, Delta V1)
p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

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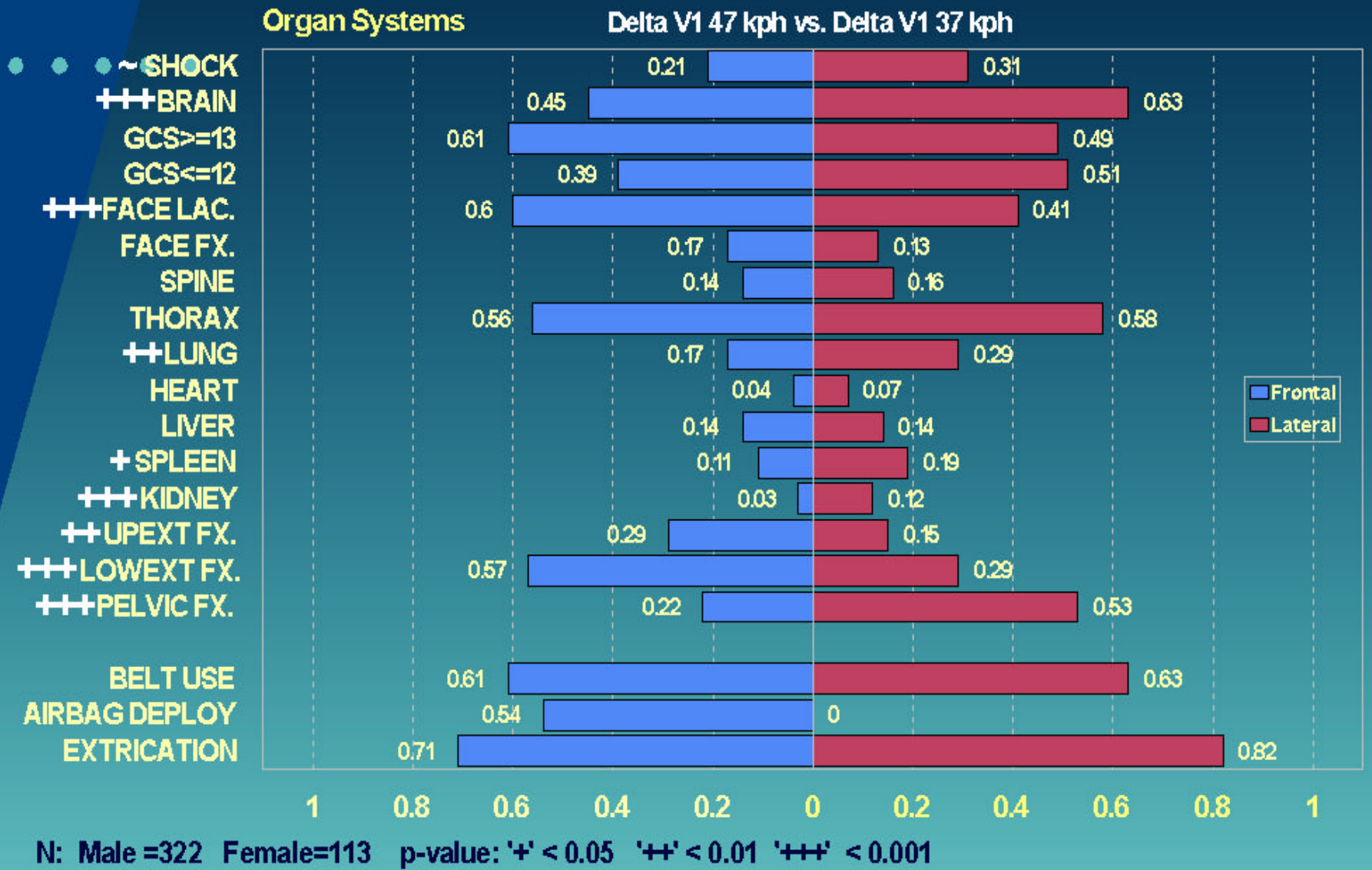
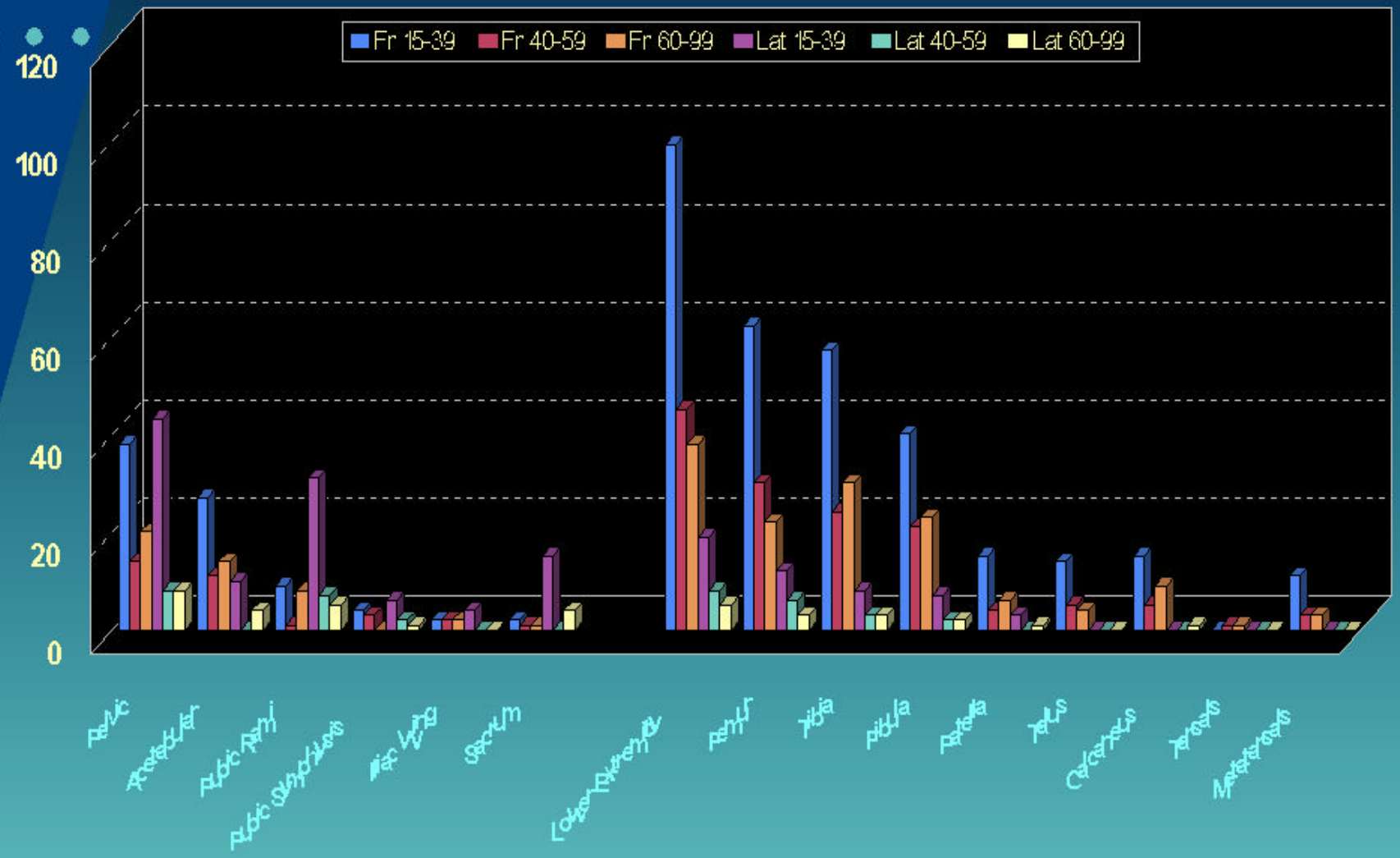
Associated Injuries: Frontal vs. Lateral



N: Male =322 Female=113 p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

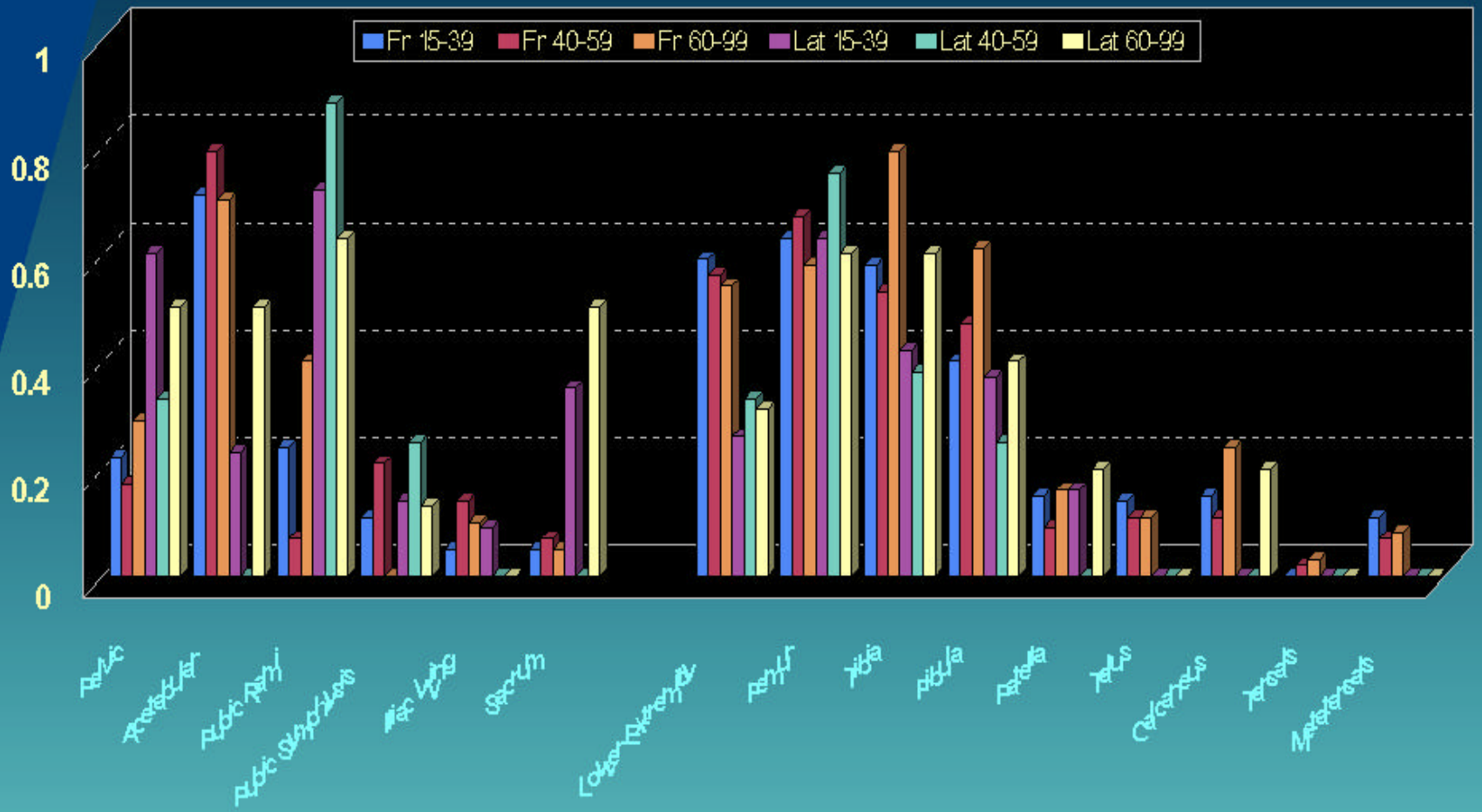
Anatomical Location by Impact Direction

Pelvic and Lower Extremity Fractures



Anatomical Location by Impact Direction

Pelvic and Lower Extremity Fractures %



Anatomical location of fractures

- There appeared to be no strong anatomical differences when stratified by age and gender. Impact direction was a more critical indicator in the anatomical fracture pattern.
- In frontal crashes, lower extremity fractures were more incidental, while in lateral crashes pelvic fractures were more noticeable.
- Pelvic fractures that occurred in frontal impacts seem to be heavily concentrated on the acetabulum, while in lateral crashes they seem to favor the pubic rami area.
- Finally, in frontal crashes there was a noticeable incidence of fractures to bones of the foot, whereas they were negligible in lateral crashes.

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Frontal Crash Age Group Male 60-99 vs. Female 60-99

Patient Dynamics	Fr M60-99	Fr F60-99
N	33	37
Avg Age	70.6	69.5
ISS	23.7	23.9
GCS	12.3	13
Survival %	0.61	0.68
LOS	23.2	20.8
ICU Days	12.1	7.3
Height (cm) ***	177.8	161.3
Weight (kg) **	82.4	72.3
Crash Dynamics		
Delta V1 (kph)	41.3	37.5
Mass V1 avg.	1406.9	1364.1
Mass V2 avg.	1476	1394.2

Wilcoxon (ISS&GCS), Fisher's Exact (survival), t-test (LOS, ICU days, HT, WT, Delta V1)
p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

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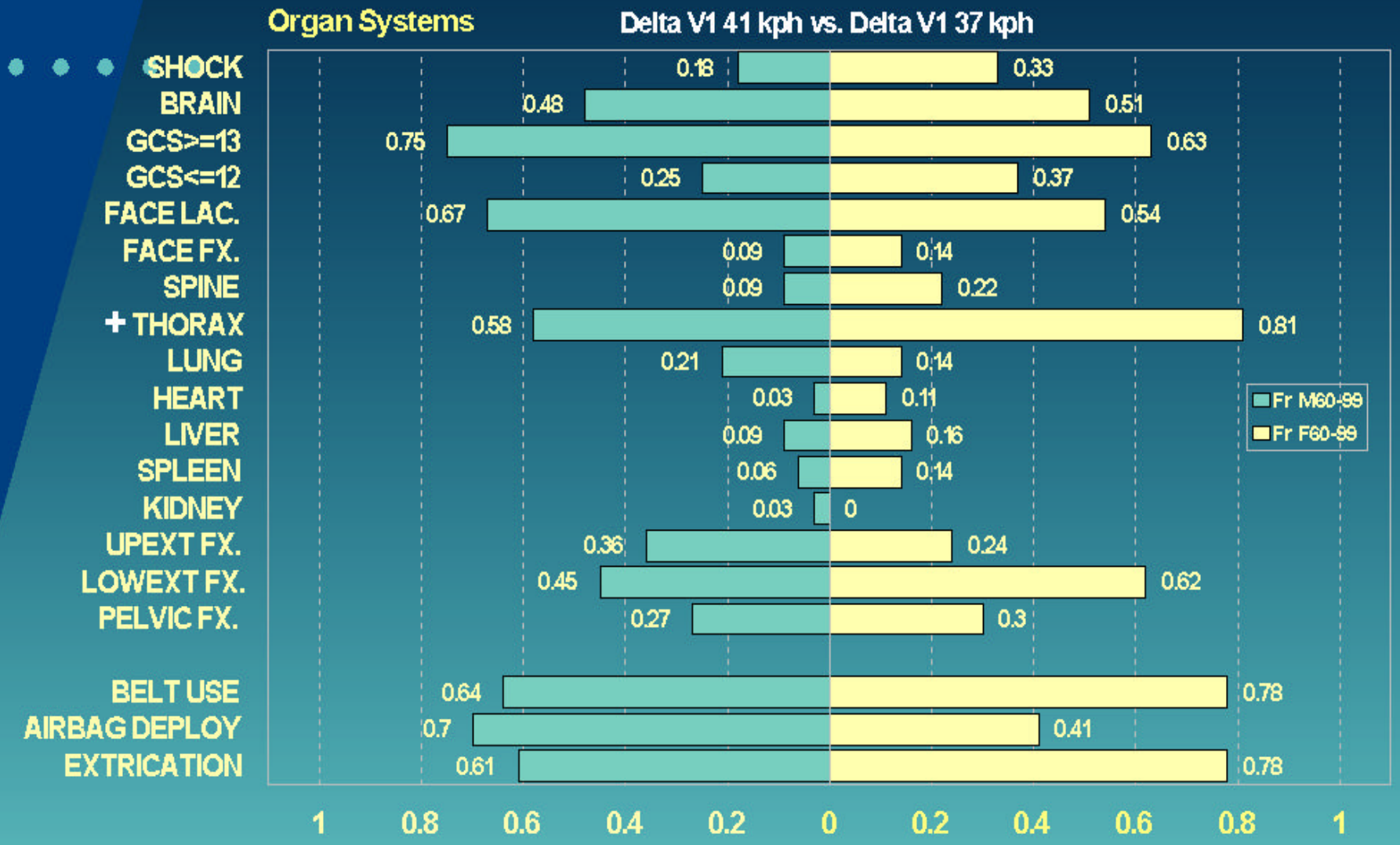
Frontal Crash Age Group Male 60-99 vs. Female 60-99



N: Male =33 Female=37 p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

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Frontal Crash Age Group Male 15-39 vs. Female 60-99

Patient Dynamics	Fr M15-39	Fr F60-99
N	95	37
Avg Age	26.2	69.5
ISS	21	23.9
GCS	12.3	13
Survival % *	0.84	0.68
LOS ~	14.1	20.8
ICU Days	5.7	7.3
Height (cm) ***	177.1	161.3
Weight (kg) **	84.9	72.3
Crash Dynamics		
Delta V1 (kph) ***	52.1	37.5
Mass V1 avg.	1317.2	1364.1
Mass V2 avg.	1618.8	1394.2

Wilcoxon (ISS&GCS), Fisher's Exact (survival), t-test (LOS, ICU days, HT, WT, Delta V1)
p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

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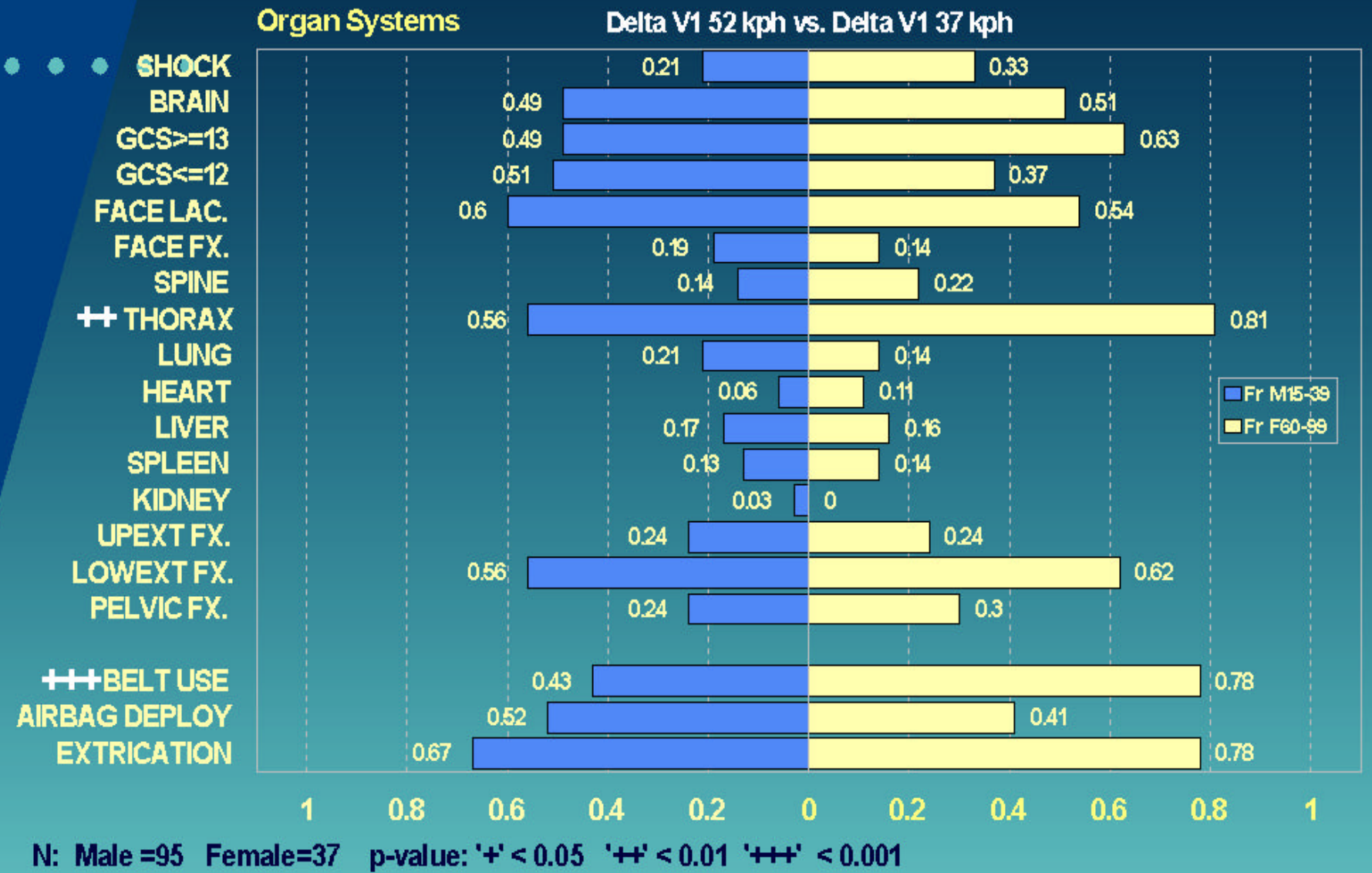
Frontal Crash Age Group Male 15-39 vs. Female 60-99



N: Male =95 Female=37 p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

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Frontal Crash Age Group Female 15-39 vs. 60-99

Patient Dynamics	Fr F15-39	Fr F60-99
N	74	37
Avg Age	26.6	69.5
ISS	20.5	23.9
GCS	13	13
Survival %	0.82	0.68
LOS **	10.3	20.8
ICU Days *	2.7	7.3
Height (cm)	161.2	161.3
Weight (kg)	68.7	72.3
Crash Dynamics		
Delta V1 (kph) **	47.8	37.5
Mass V1 avg.	1269.3	1364.1
Mass V2 avg.	1437.4	1394.2

Wilcoxon (ISS&GCS), Fisher's Exact (survival), t-test (LOS, ICU days, HT, WT, Delta V1)
p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

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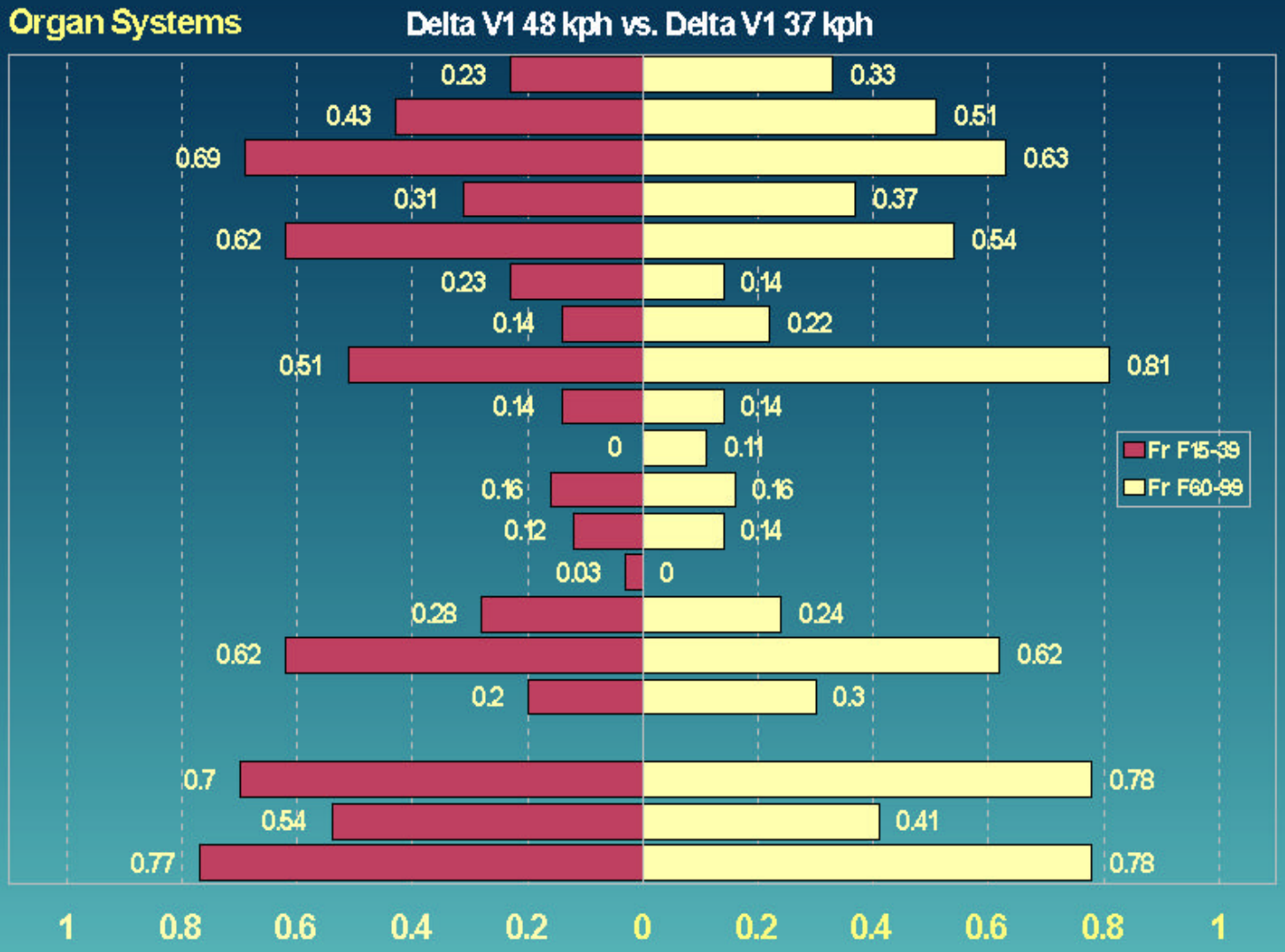
Frontal Crash Age Group Female 15-39 vs. 60-99



N: Female =74 Female=37 p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

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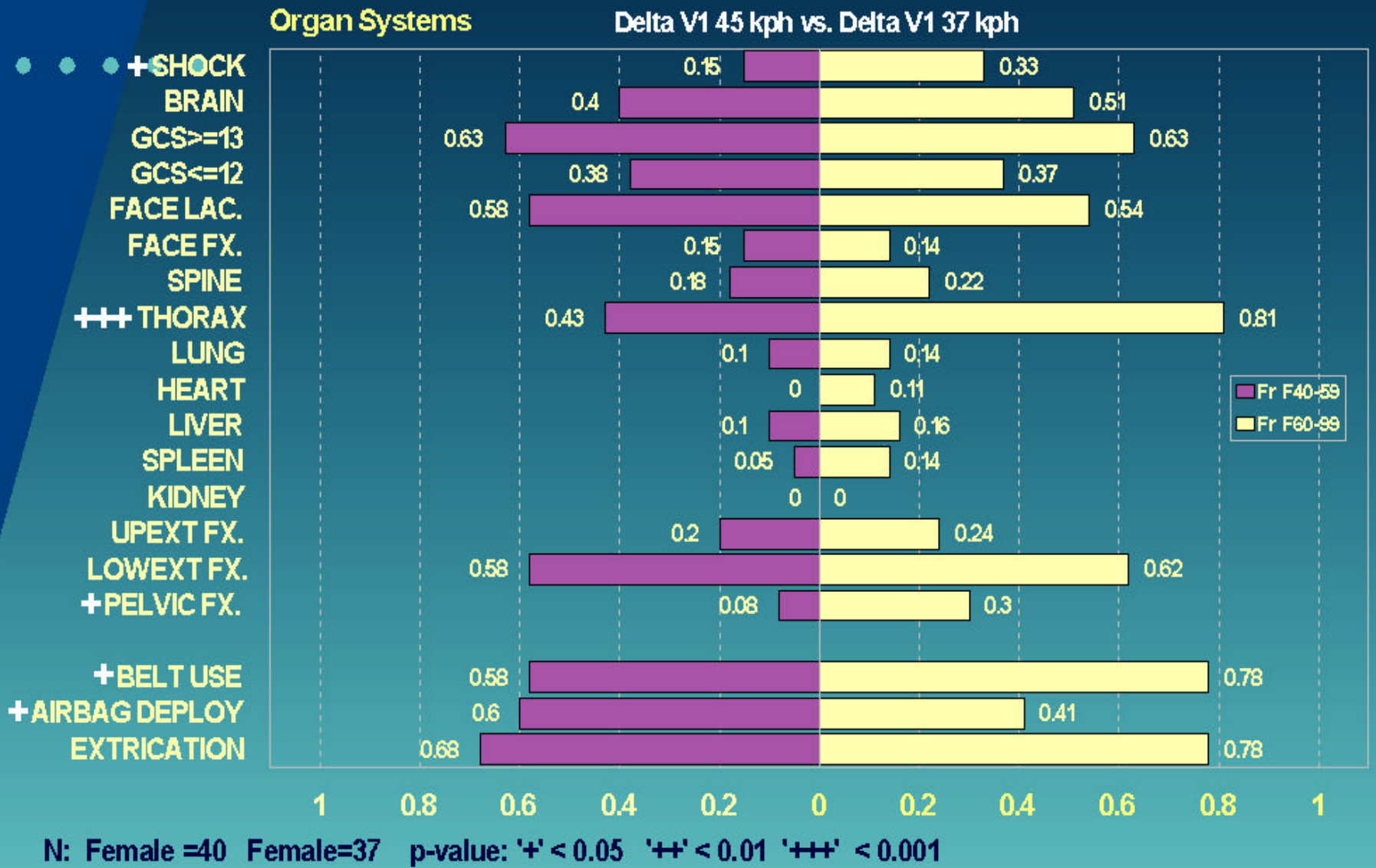
Frontal Crash Age Group Female 40-59 vs. Female 60-99

Patient Dynamics	Fr F40-59	Fr F60-99
N	40	37
Avg Age	47.2	69.5
ISS	20.8	23.9
GCS	13.2	13
Survival %	0.83	0.68
LOS	14.7	20.8
ICU Days	5.6	7.3
Height (cm)	163.1	161.3
Weight (kg)	71.9	72.3
Crash Dynamics		
Delta V1 (kph)	44.9	37.5
Mass V1 avg.	1413.2	1364.1
Mass V2 avg.	1585.3	1394.2

Wilcoxon (ISS&GCS), Fisher's Exact (survival), t-test (LOS, ICU days, HT, WT, Delta V1)
p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

CIREN - Motor Vehicle Crash Study

Frontal Crash Age Group Female 40-59 vs. Female 60-99



N: Female =40 Female=37 p-value: '+' < 0.05 '++' < 0.01 '+++' < 0.001

Likelihood of Pelvic and Lower Extremity Fx.

Lower Extremity Fractures		Age Group					
		15-39		40-59		60-99	
Frontal	Female	Case	Control	Case	Control	Case	Control
Yes	Yes	OR=1.30 CI: 0.67-2.54		OR=1.17 CI: 0.44-3.05		OR=1.97 CI: 0.68-5.74	
Yes	No						
No	Yes	OR=0.70 CI: 0.21-2.21		OR=1.0 CI: 0.13-7.47		OR=4.0 CI: 0.29-71.24	
No	No						

Mantel-Hanzel Odds Ratio = 1.39 CI: 0.87-2.23
Mantel-Hanzel Odds Ratio = 0.98 CI: 0.40-2.42

Pelvic Fractures		Age Group					
		15-39		40-59		60-99	
Lateral	Female	Case	Control	Case	Control	Case	Control
Yes	Yes	OR=0.81 CI: 0.28-2.32		O field		OR=5.00 CI: 0.3-167.96	
Yes	No						
No	Yes	OR=0.80 CI: 0.36-1.76		OR=0.22 CI: 0.04-0.97		OR=1.13 CI: 0.35-3.62	
No	No						

Mantel-Hanzel Odds Ratio = 1.85 CI: 0.84-4.64
Mantel-Hanzel Odds Ratio = 0.69 CI: 0.39-1.21

Likelihood of Pelvic and Lower Extremity Fx.

Lower Extremity Fractures		Age Group					
		15-39		40-59		60-99	
Frontal	Female	Case	Control	Case	Control	Case	Control
Yes	Yes	OR=3.95 CI: 2.07-7.59 p<0.001		OR=2.50 CI:0.88-7.26 ~		OR=2.61 CI: 0.73-9.76 N/S	
Yes	No						
No	Yes						
No	No						

Mantel Hanzel Odds Ratio = 3.31 CI: 2.03-5.46 p<0.001

Pelvic Fractures		Age Group					
		15-39		40-59		60-99	
Lateral	Female	Case	Control	Case	Control	Case	Control
Yes	Yes	OR=5.11 CI: 2.71-9.68 P<0.001		OR=2.39 CI: 0.76-7.48 ~		OR=4.17 CI: 1.18-15.16 P<0.01	
Yes	No						
No	Yes						
No	No						

Mantel Hanzel Odds Ratio = 4.23 CI: 2.58-6.89 p<0.001

Likelihood of Pelvic and Lower Extremity Fx.

Females in Frontal Crashes by Age Group

- Although there were differences in the presence of airbags and safety belt use; given similar delta V's women of the oldest age group in frontal crashes had a significantly higher likelihood of a pelvic fracture than women in the middle age group.

FEMALES	FRACTURE TYPE			
	PELVIC FX.		LOWER EXT. FX.	
	CASE	CONTROL	CASE	CONTROL
OLD 60-99	11	26	23	14
MID 40-59	3	37	23	17
	OR=5.22 CI: 1.17-26.41 p=0.012		OR=1.21 CI: 0.44-3.55 NS	

MH Odds Ratio = 1.99 CI: 0.91-4.48 p=0.08

Findings

- Given similar delta V's with some difference in airbag and seatbelt use rates, a comparison showed that late postmenopausal women had significantly more shock, thoracic injury and pelvic fractures than perimenopausal women.

Findings

- Late postmenopausal women in frontal crashes were consistently observed to have increased thoracic injuries.
- Also in frontal and lateral crashes there was suggestive evidence showing that late postmenopausal women may be more susceptible to lower extremity fractures than men in the same late aged group.

Discussion

- Statistically significant associations were not seen in other comparisons which may be due to confounding effects of:
  - Differing Delta V's
  - Body habitus (height and weight)
  - Physical health (premorbid disease)
  - Study population bias

Conclusion

- Although there was a significant difference in thoracic injury and pelvic fractures seen in late postmenopausal women in frontal crashes, the data suggest that there are other causal factors other than age.
- Osteoporosis which is found in the oldest female population may play a critical role in the different patterns of visceral organ and orthopedic injuries.

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