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Events, Exposure, and Risk Factors

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Lecture Topics

- Describing and quantifying injurious events
- Measuring exposure
- Identifying and quantifying risk factors
- Case study

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Section A

Describing and Counting Events

Maria Segui-Gomez, MD, ScD

What Do We Mean by Events?

- Situations where energy is being released in either greater or smaller amounts than ordinary, in less than an ordinary amount of time, or both
- Circumstances that could lead to personal injuries (regardless of whether they actually occur)
  - For example, car or airplane, crashes, fires, falls

Relevance of Events Data

- Necessary to understand circumstances leading to fatal or non-fatal injuries
  - Helps identify circumstances (or aspects of circumstances) that could be addressed by injury prevention programs

Relevance of Events Data

- Necessary to understand circumstances leading to fatal or non-fatal injuries
  - Key for secondary injury prevention planning
  - There is a lot that can be learned from events that do not lead to injuries despite the fact that they look like other events where injuries occurred

Events

- Used as numerators
  - There were 6,335,000 crashes in the U.S. in 1998
- Used as denominators
  - 0.6% of motor vehicle crashes lead to at least one death (41,471 deaths / 6,335,000 crashes)

Data Sources

Multiple:

- Police reports
  - Car crashes—normally there is a minimum amount of damage required before reporting
  - Home robberies
- Firemen records (e.g., fires)
- Nursing home records (e.g., falls among elderly)

Continued

Data Sources

- Personal surveys (e.g., recreational injuries)
- And all the same sources where the injuries are reported

Data Coding

- Events that lead to injuries
- We have listed the most frequent ones in mortality and morbidity sessions
- For example:
  - International Classification of Diseases (E codes in the 9th version), NOMESCO Classification of External Causes of Injuries, New Zealand, Australian codes, International Classification of External Causes of Injury (ICECI)

Continued

Data Coding

Events

- Other multiple data system-specific codes

Event Data Comparability

Beware of:

- Data source variability
- Case identification variability
  - Normally there is a minimum physical / economic damage used to define the event as reportable but that can vary
- Coding system variability

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Section B

Measuring Exposure

Maria Segui-Gomez, MD, ScD

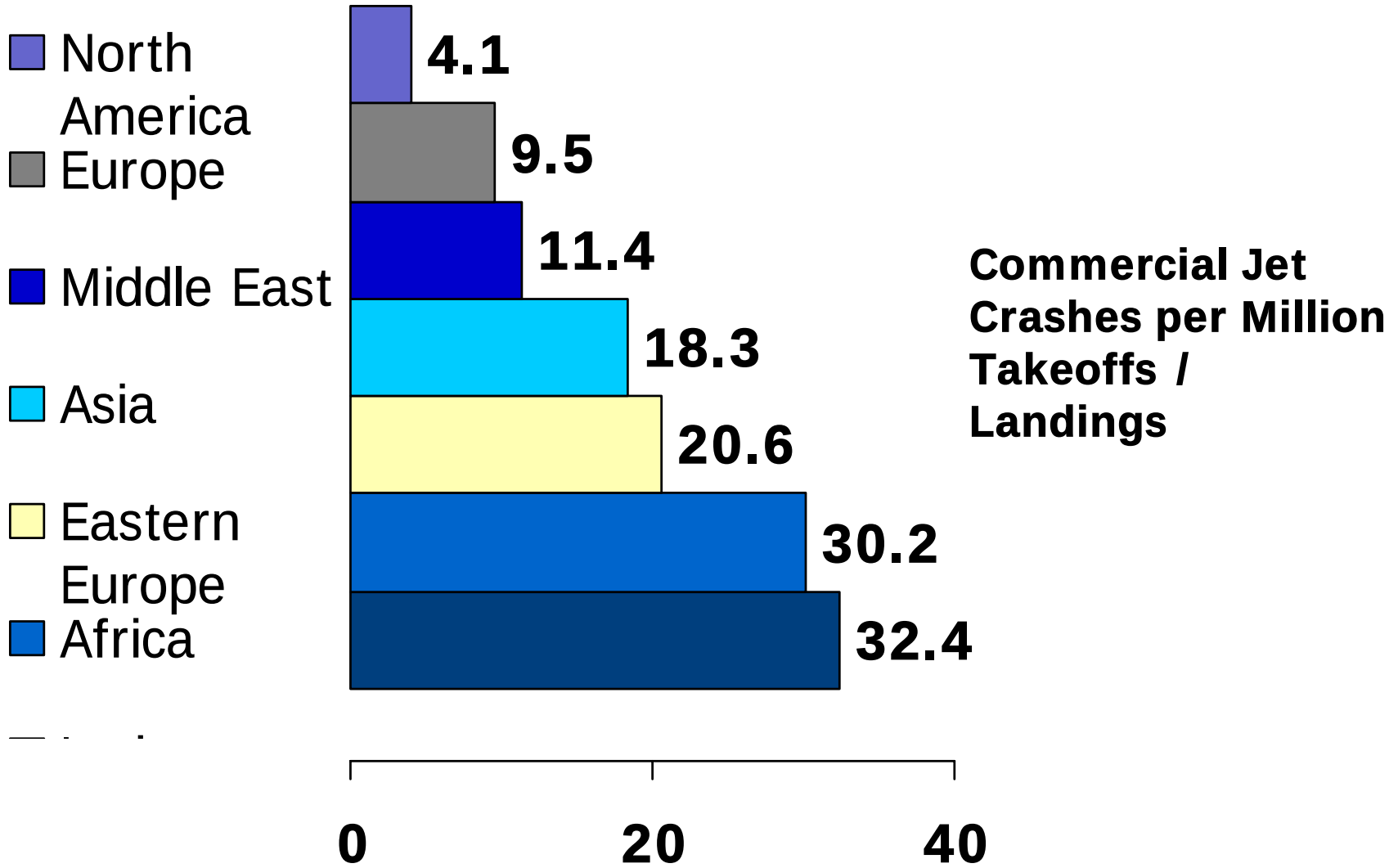
What Do We Mean by Exposure?

- Practically anything we do
- That is, situations where individuals interact with an environment that can eventually generate energy that could lead to an injury
  - For example, population, distance traveled, hours traveled, intersections crossed, takeoffs / landings undergone, hours training soccer, minutes spent using a saw, etc . . .

Relevance of Exposure Data

- Exposure is the denominator
- Needed for risk calculations

An Example



Source: Enders, K., et. al.; Flight Safety Digest*, 1996: 9*

Another (fictional) Example

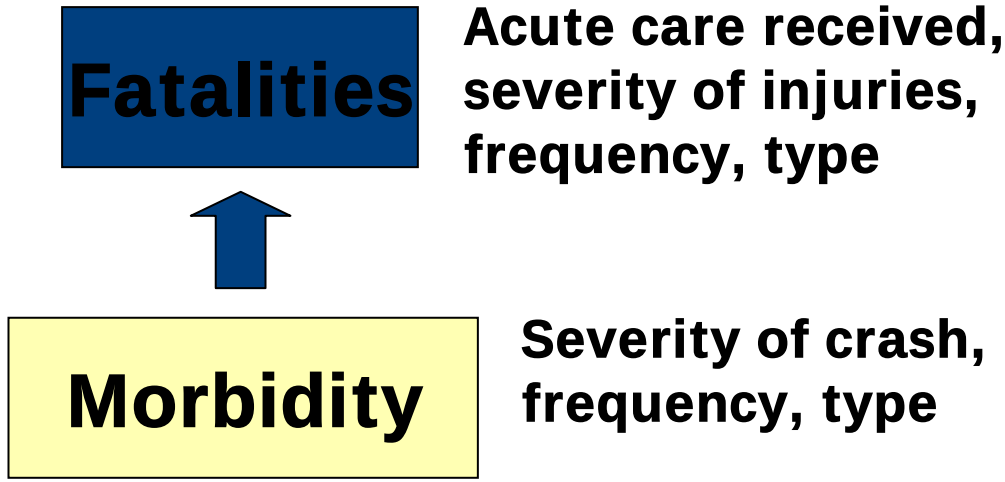
- Country A has fewer child passenger deaths per 100,000 population than country B
- Why?
- Possible explanations: Better child restraint use, fewer parents driving intoxicated, fewer children in cars, etc . . .
- How to look for explanations

Countries A vs. B

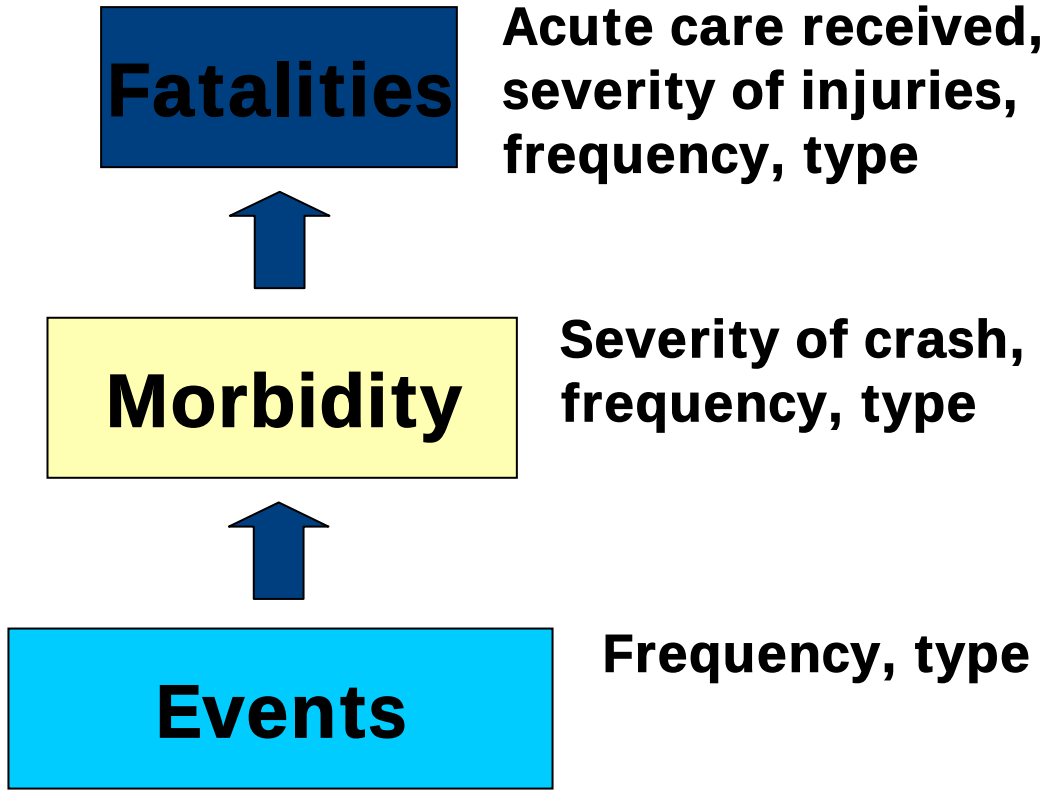
Fatalities

Acute care received, severity of injuries, frequency, type

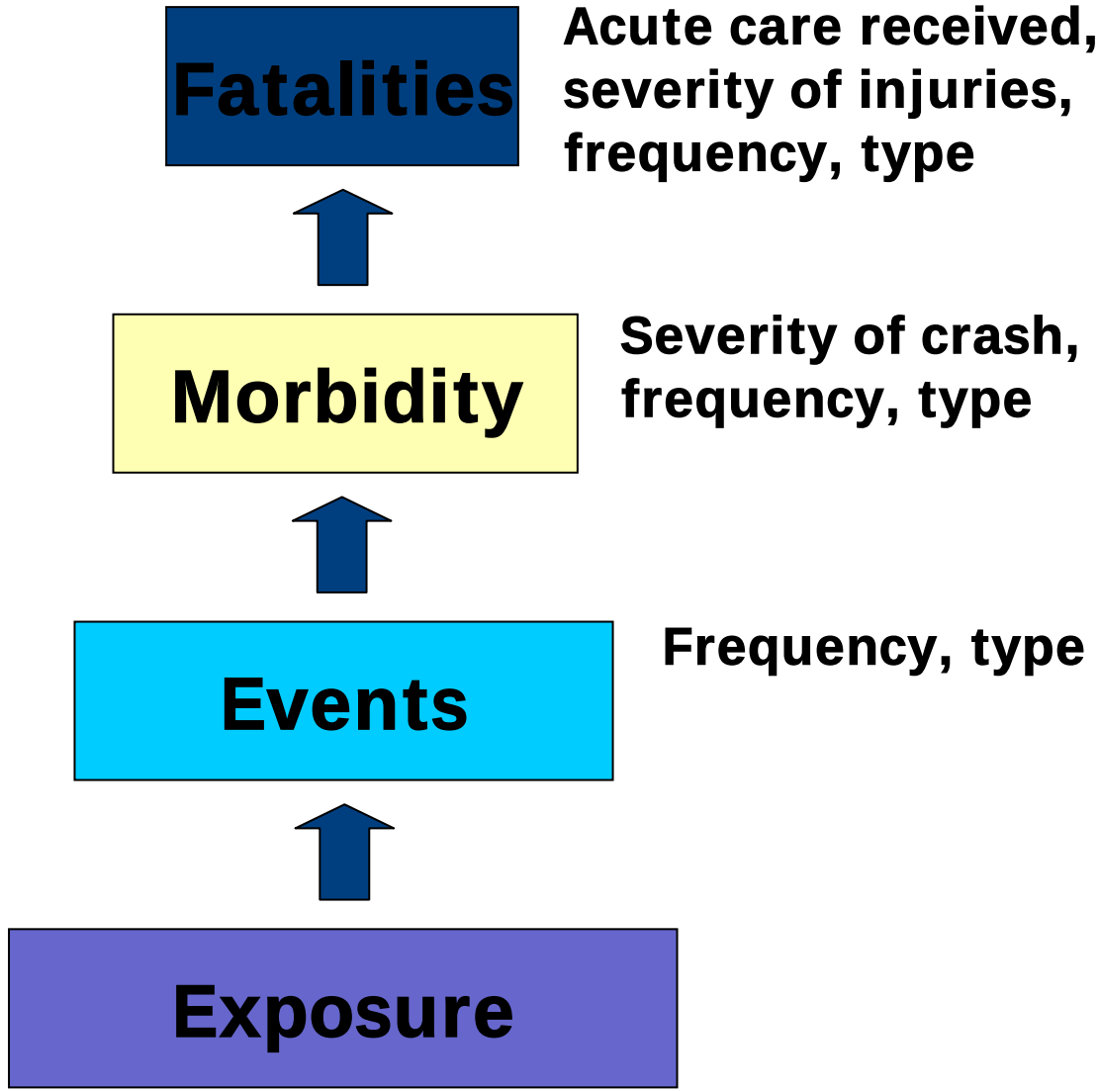
Countries A vs. B



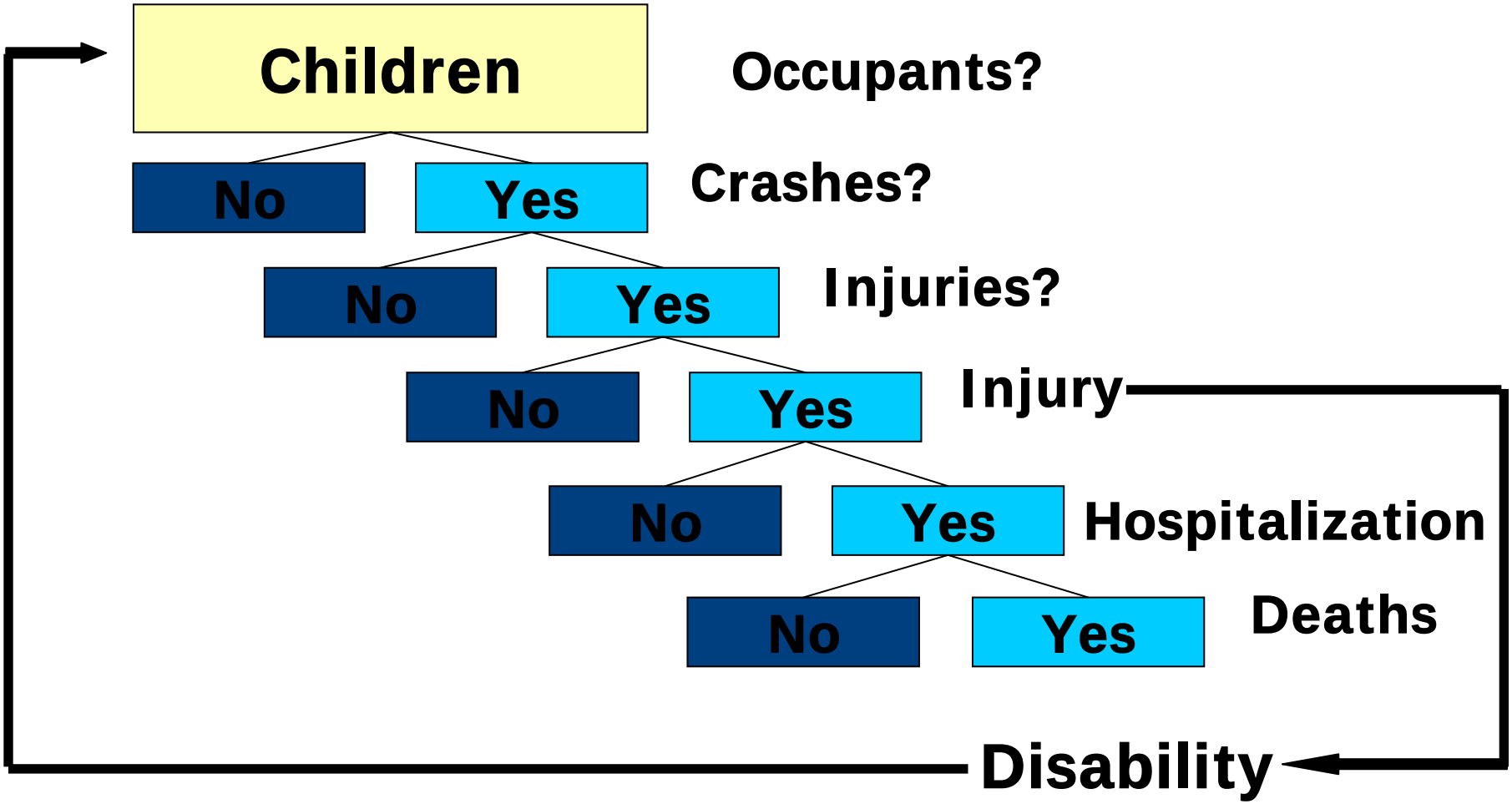
Countries A vs. B



Countries A vs. B



How Does It All Come Together? An Example



Data Sources

- When population: Census
- For all other exposure units: Multiple data sources, specific to injury problem and location
- In general:
  - Personal surveys
  - Observational studies
  - Estimates from goods bought (and average usage)

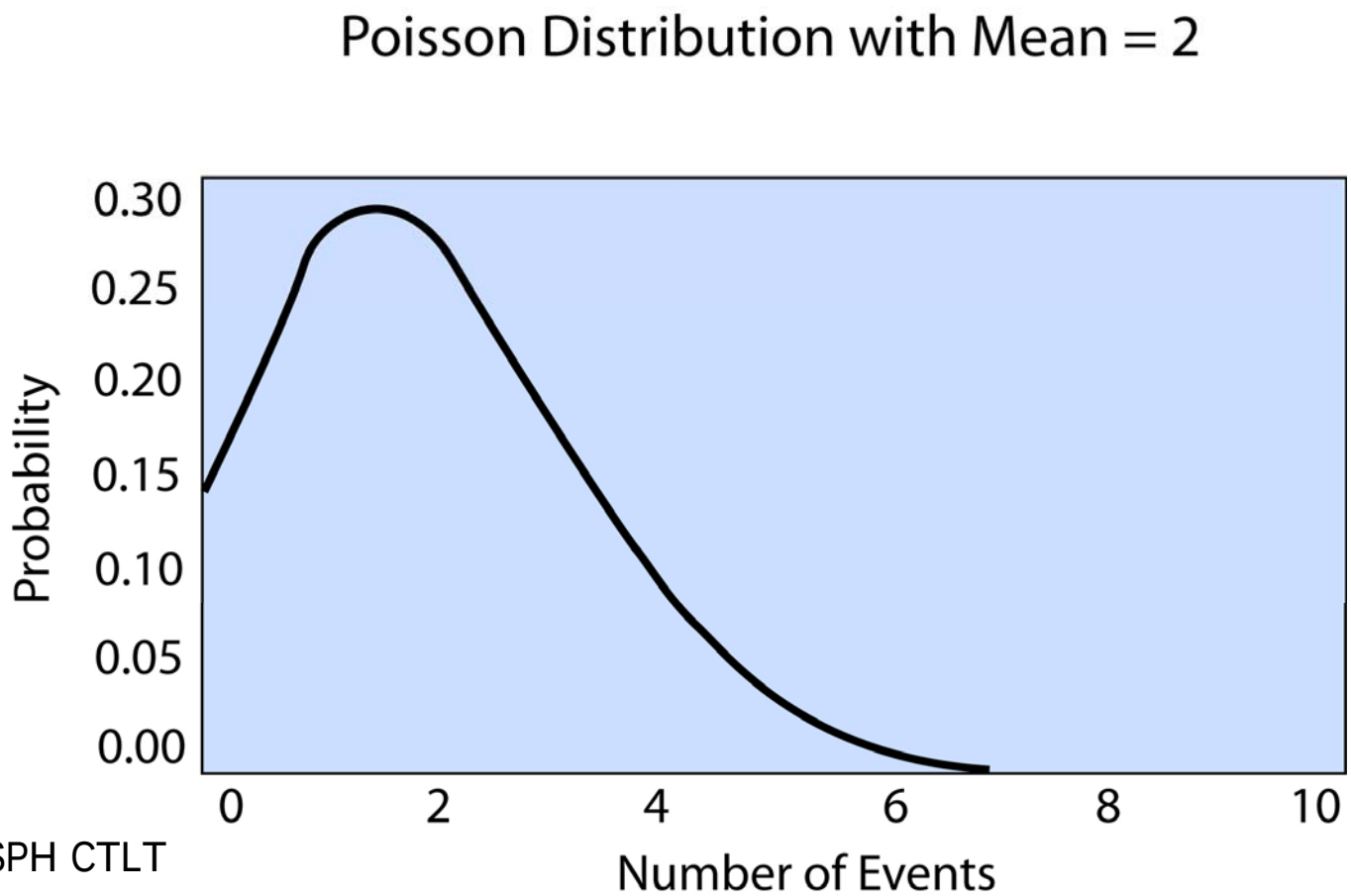
Data Coding

- Fragmented
- Among the most commonly used are vehicle miles (kilometers) traveled, derived from either:
  - Personal diaries / surveys
  - National estimates of fuel used and average fuel consumption per mile

Continued

Data Coding

- Units tend to be big since injuries follow a Poisson distribution (that is, their frequency is rare)



Graph by JHSPH CTLT

Exposure Data Comparability

- Beware of:
  - Data source variability
  - Case inclusion criteria
  - Coding system variability

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Section C

Identifying and Quantifying Risk Factors

Adnan Hyder, MD, PhD

Risk Factors for Injuries

Not Modifiable:

- Gender
- Age
- Time

Modifiable:

- Site
- Behavior
- Environment
- Equipment

Population Based Cohort Study of Injuries: Gender Differences

Madras City

- Incidence
- Overall: 127 / 1000 persons
- Males: 137 / 1000 persons
- Females: 118 / 1000 persons

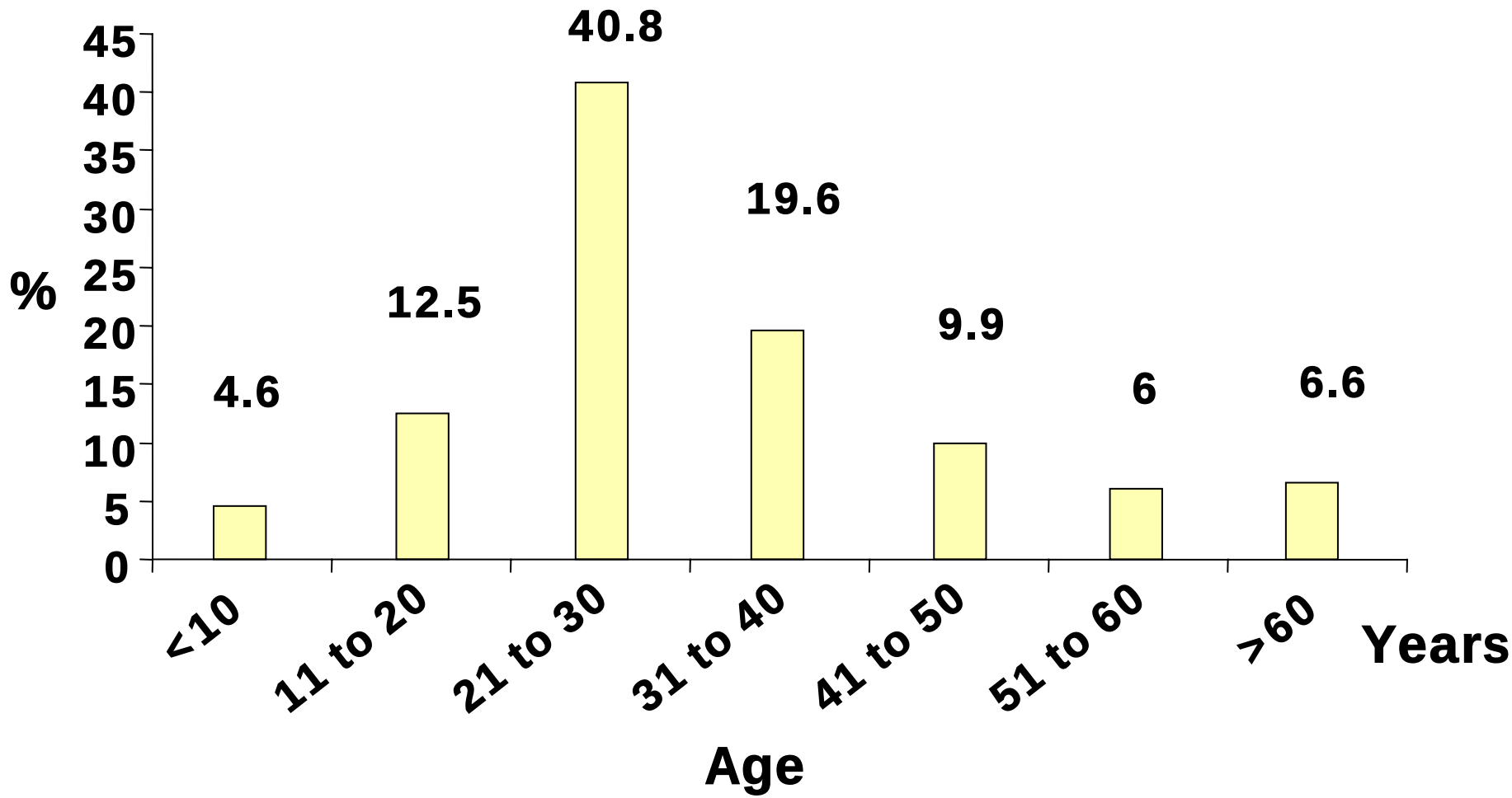
Source: Sathiyasekaran, B.W.C.; Injury *1997; 27: 695–698*

Relative Risk of Injuries Occurring to Males Compared to Females

By Place of Occurrence

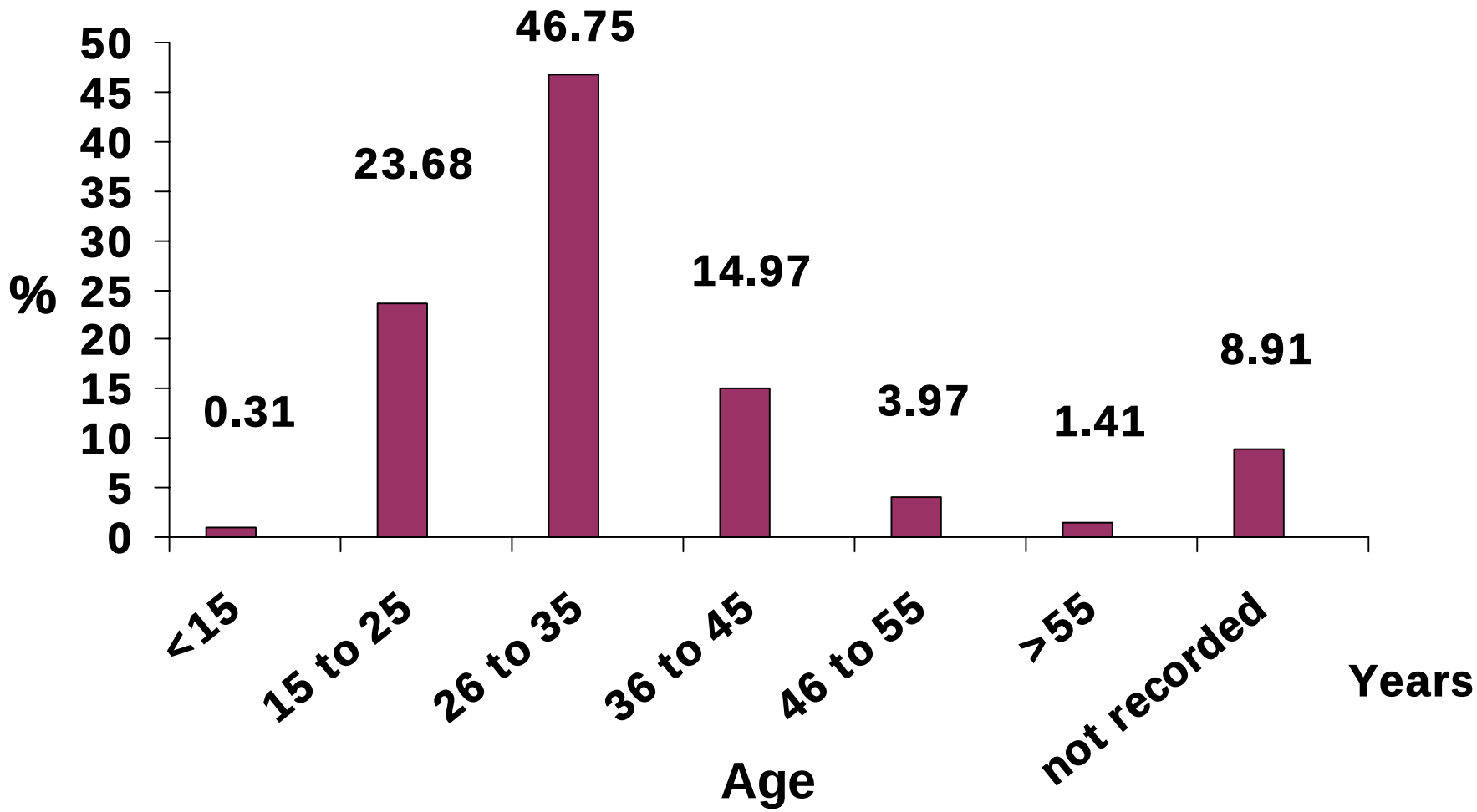
Source: Sathiyasekaran, B.W.C.; Injury *1997; 27: 695–698*

Sao Paulo Brazil—*Age* of Traffic Accident Victims 1995



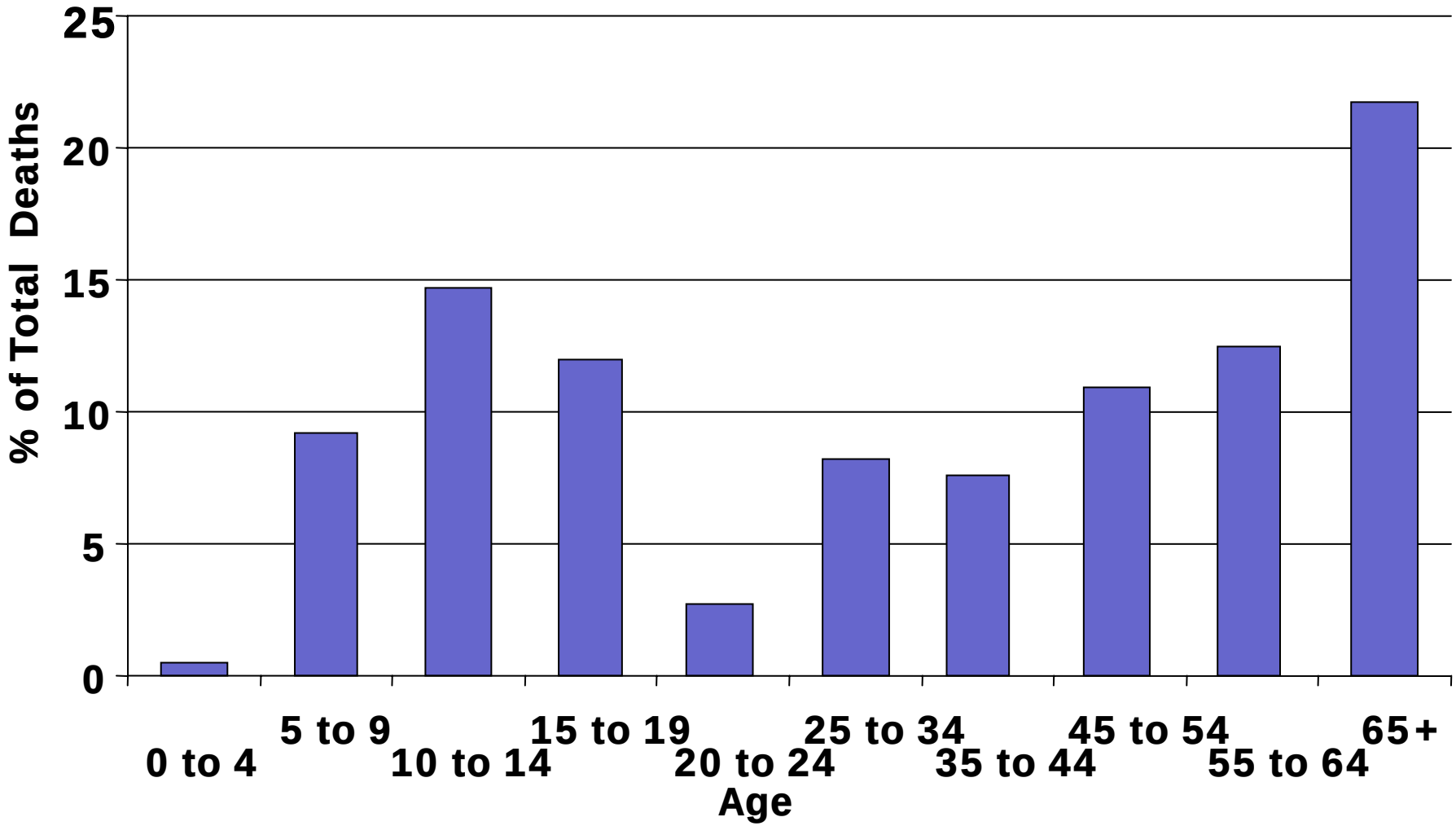
Source: Vasaconocellos, E.A., et al.; Accid Anal Prev *1999; 31: 319–328*

Saudi Arabia—*Age* of Traffic Accident Victims 1993



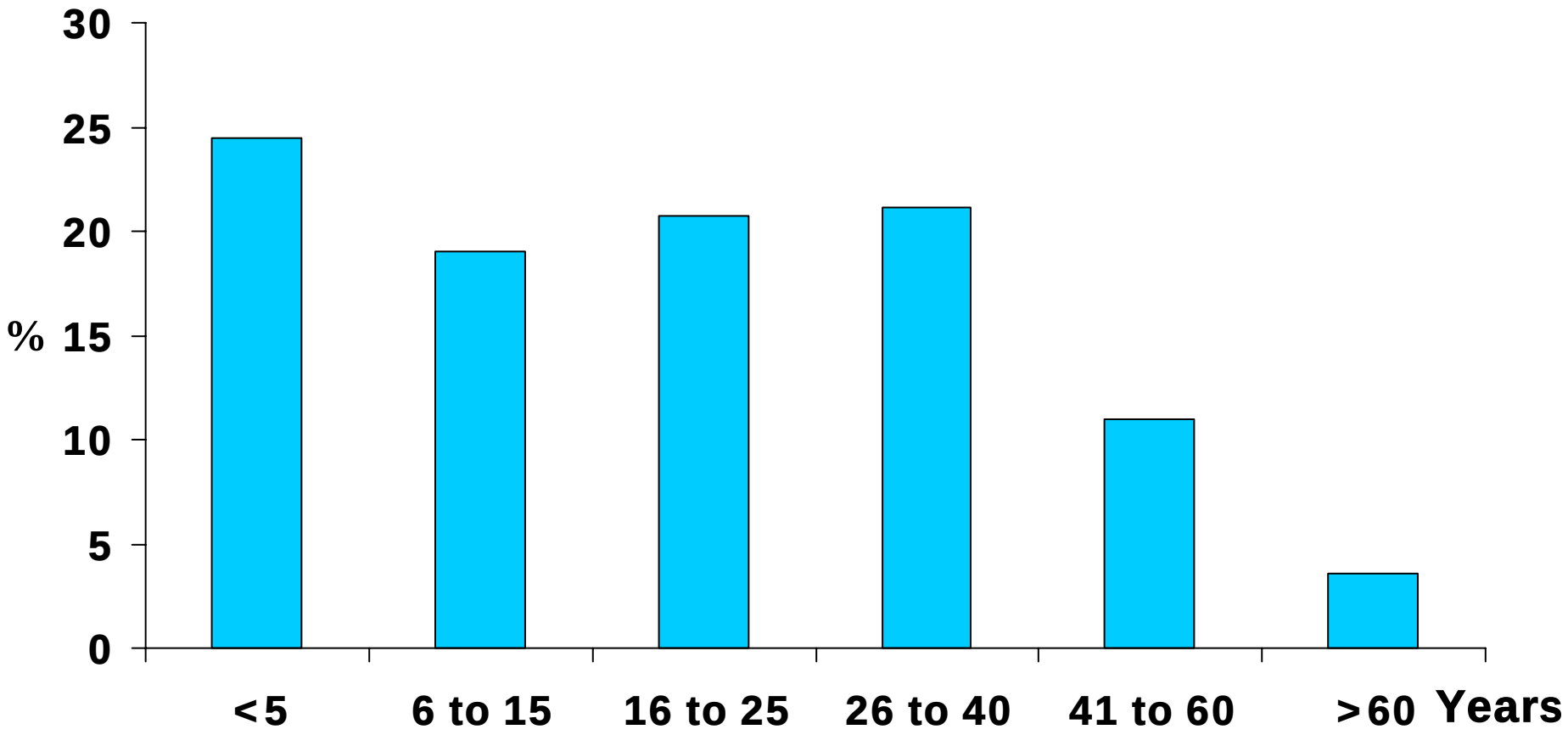
Source: Vasaconocellos, E.A., et al.; Accid Anal Prev *1999; 31: 319–328*

Deaths from Bicycle Injuries by Age: 1979-1990, Israel



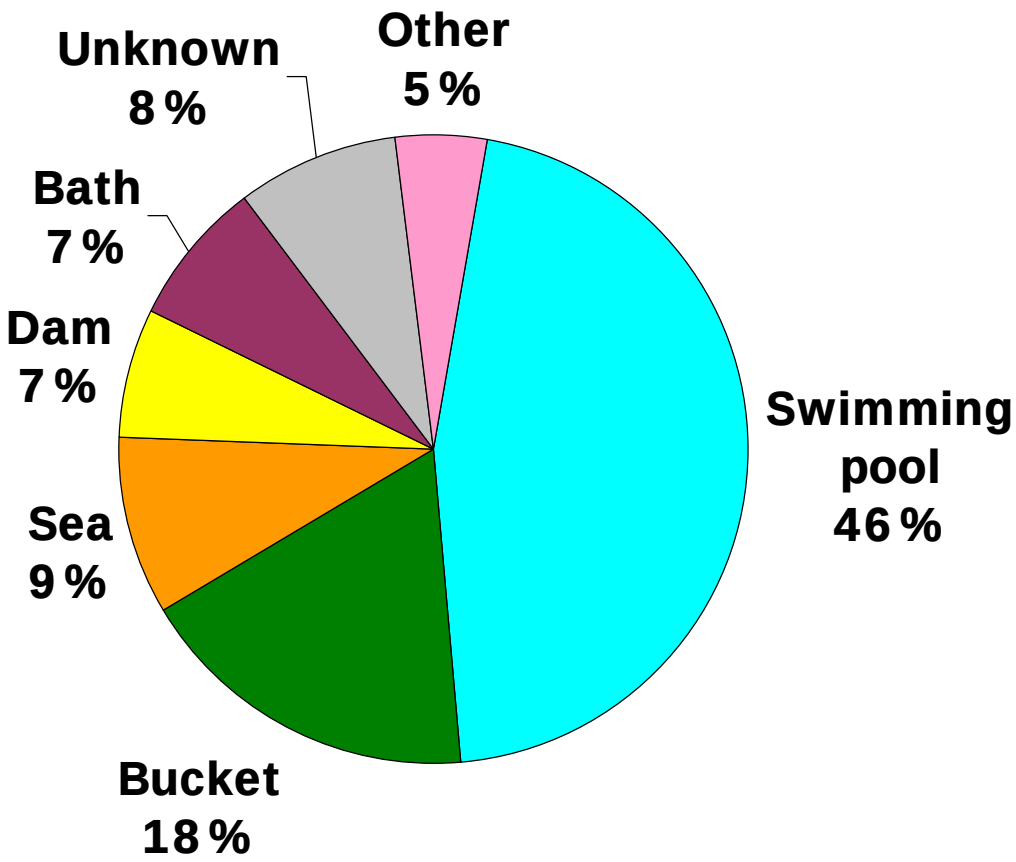
Source: Ginsberg, G.M., et al.; A J Public Health *1994; 84: 653–656*

% Distribution According to *Age* of Patient Admitted in Burn Care Center in Teheran



Source: Lari, A.R., et. al; Burns *2000; 26: 49–53*

Sites of 107 Near Drownings,
1976–1987, South Africa



Source: Kibel, S.M., et al.; A Afr Med J *1990; 78: 418–421*

Risky Behavior of Bus *Commuters* in Karachi, Pakistan

Disembarking Passengers

- 33% did not wait for bus to stop
- 54% stepped off into the center of the road
- 84% did not look out for traffic

Embarking passengers

- 38% got on moving bus
- 83% waited for buses on the street

Source: Mirza, S., et al.; Accid Anal Prev *1999; 31: 329–333*

Risky Behavior of *Bus Drivers* in Karachi, Pakistan

- At the bus stop, 30% of the bus drivers did not stop completely
- 46% stopped away from the stop
- 79% stopped in the center of the road

Source: Mirza, S., et al.; Accid Anal Prev *1999; 31: 329–333*

Young Drivers *Life Style* and Road Traffic Accident Risk in Athens

- Logistic regression analysis showed:
  - Young drivers whose dominant life style trait is alcohol consumption or driving without destination have a *higher risk* of road traffic accident

Source: Chliaoutakis, J.E., et al.; Accid Anal Prev *1999; 31: 771–780* *Continued*

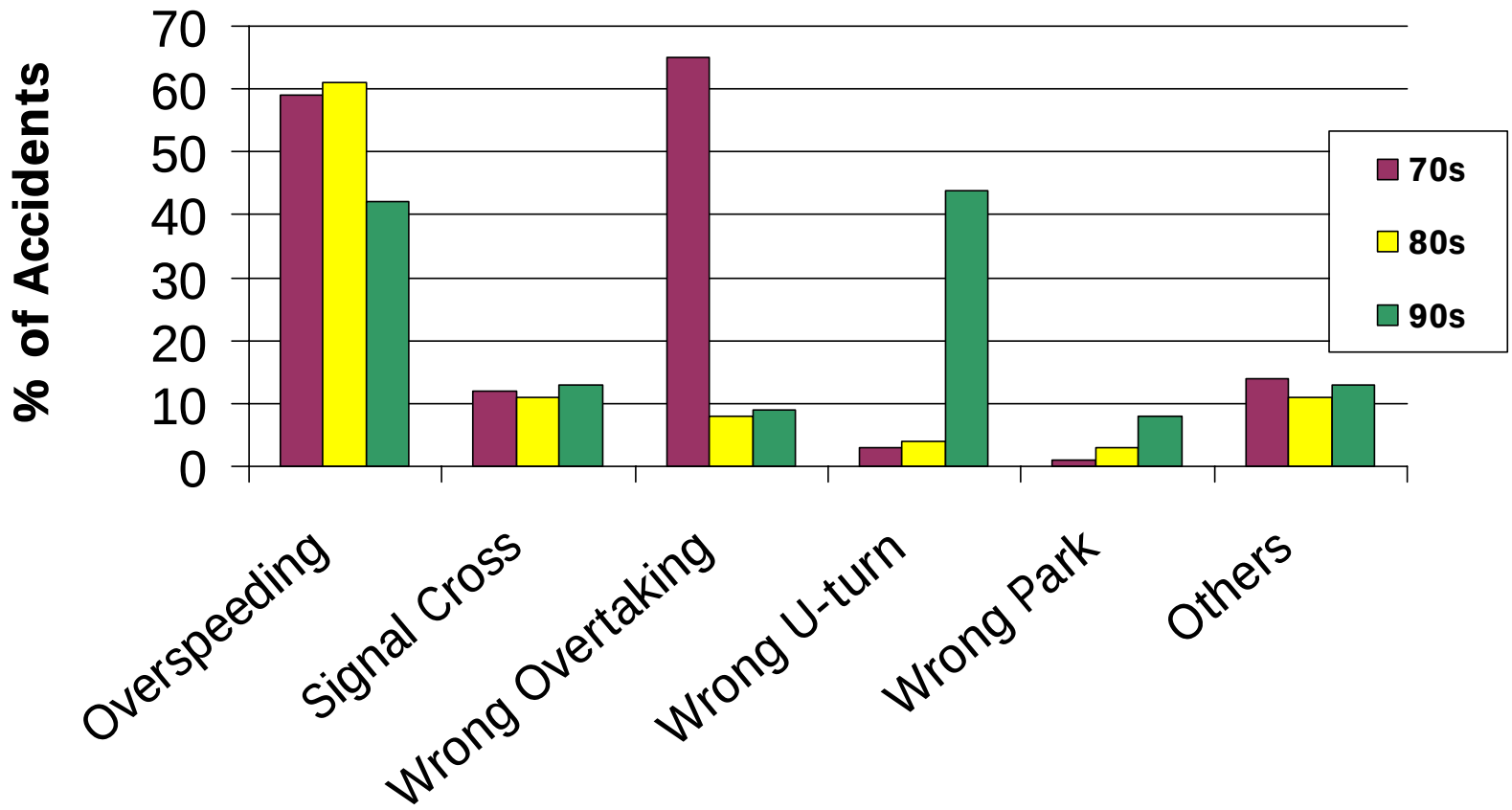
Young Drivers *Life Style* and Road Traffic Accident Risk in Athens

- Logistic regression analysis showed:
  - Those whose dominant lifestyle is “culture” face low risk of RTA
  - Young drivers who were “religious” also seem to have low accident risk

Source: Chliaoutakis, J.E., et al.; Accid Anal Prev *1999; 31: 771–780*

Causes of Road Accidents in Saudi Arabia

For the Decades 1970s, 1980s, 1990s



Source: Ansari, A., et .al.; Public Health *2000; 114: 37–39*

Risky Behavior and Injuries

Drowning

- Study in Barbados found that 37% of visitors who were victims of a near drowning experience had evidence of alcohol intoxication

Source: Corbin, et al.; West Ind J Med *1981; 30: 29–30*

Continued

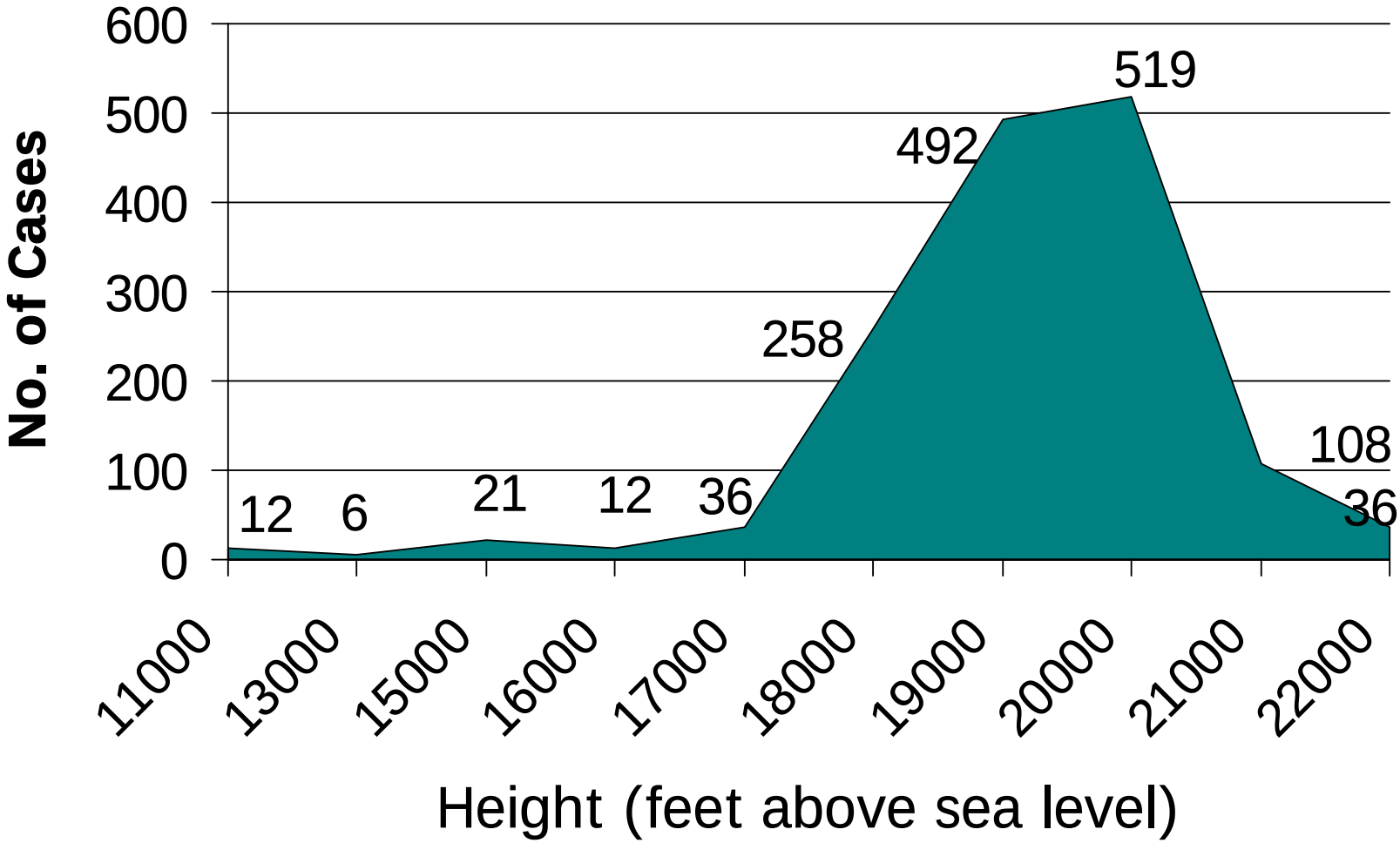
Risky Behavior and Injuries

Poisoning

- In India, more than 200 people died in New Delhi after drinking alcohol mixed with methanol during the Hindu festival of Deepawali

Source: Lingman, 1992.

Frequency of Frostbites According to Height (Environment) in the Karakoram Mountains, Pakistan



Source: Hashmi, M.A.; Ann R Coll Surg Engl *1998 Mar; 80(2): 91–5*

Rural and Urban *Environment*

China

- Rates of suicide and drowning are much higher in rural areas
- Death rates for the elderly (from falls) are much higher in urban areas

Source: WHO, 1998

Continued

Rural and Urban *Environment*

Papua New Guinea

- Rates of suicide among women and of drowning among men are significantly higher in remote rural villages than in periurban villages

Source: Barrs, 1991

Equipment Factors

Burns

- From May 1995 to December 1996, 40% of patients admitted to the burn unit of Ain Shams University (Cairo, Egypt), sustained injuries from kerosene stoves

Source: Mabrouk, A.; Burns *26 (2000) 474–477*

Continued

Equipment Factors

Burns

- In developing countries, hot tap water is a main cause of severe burns in children
- 63% of all burn cases among children aged less than 15 years in Casablanca, Morocco were scalds from water

Source: Bukind, E.H.; et al.; Burns *1995; 21: 349–351*

Continued

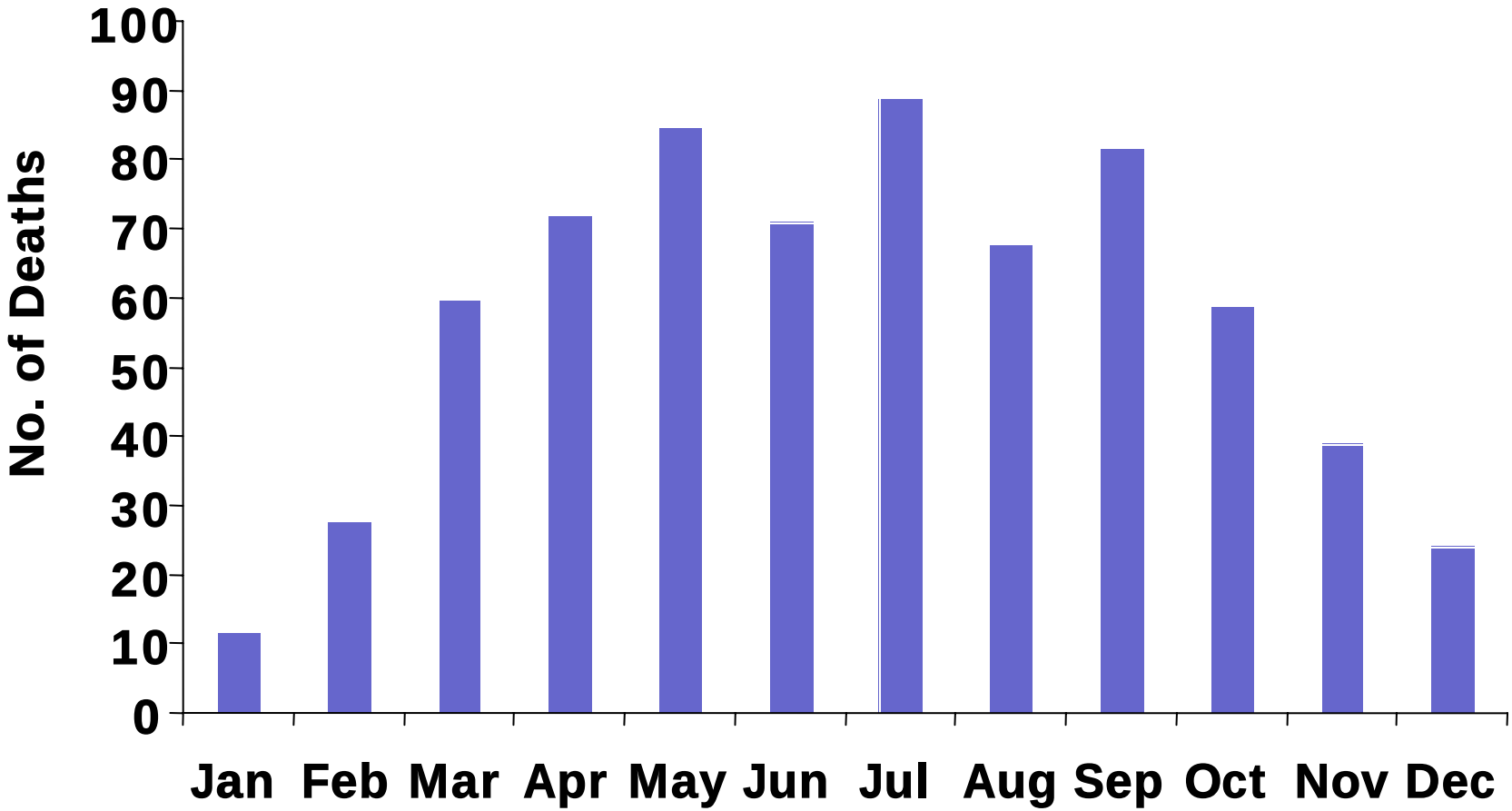
Equipment Factors

MVA

- On the main highway, between Delhi and Bombay, India, it was found that 25% of all fast moving vehicles did not have a proper brake system

Source: Desai, et al.; J Traffic Med *1990; 18: 307*

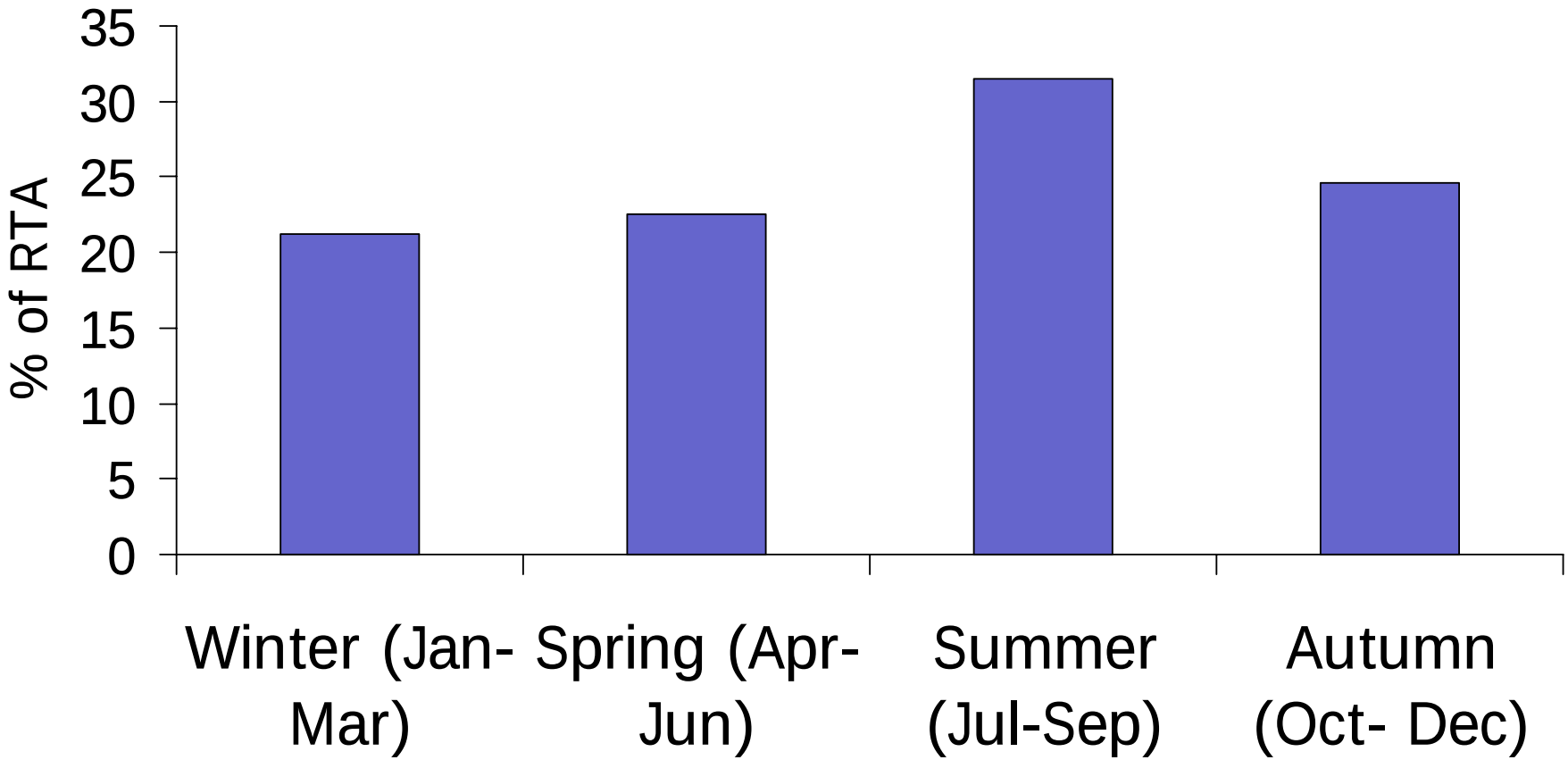
Seasonality of Drowning Deaths of Children Aged 1–4 in Matlab, 1983–95



Source: Ahmed, M.K., et al.; Int J Epid *2000; 28: 306–311*

Annual *Seasonal* Average % of Road Traffic Accidents

For Period 1989-1993 in Saudi Arabia



Source: Nohal, et al.; Public Health *1997; 111: 51–55*

Injuries and Socioeconomic Development

- Injuries used to be commonly viewed as the “disease of development”
- Kopits E and Copper M (2003) showed a sharp increase in fatalities per head of population with increasing GDP per capita up to a peak of $6100- $8600, after which the fatalities began to decline

Source: World Report on Road Traffic Injury Prevention 2004

Continued

Injuries and Socioeconomic Development

- Their study also showed that fatalities per vehicle decline sharply with income per capita in excess of $1180
- Overall, the results displays how economic development relates to increased motorization and increased exposure to risk.

Source: World Report on Road Traffic Injury Prevention 2004

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Section D

Case Study on Exposure, Events, and Risk Factors

Adnan Hyder, MD, PhD

Occupational Injuries

- Account for nearly one-fifth of the total global burden of injuries
- Estimates of the burden of occupational injury are often imprecise because of under reporting and classification problems

Occupational Injuries in Brazil

- The cohort was comprised of 21,752 male workers at a steel plant in Minas Gerais, Brazil who were employed between 1 January 1977 and 31 August 1990

Continued

Occupational Injuries in Brazil

- The study monitored injuries to these workers in two categories
- Workplace injuries that occurred inside the plant during the work shift (see risk factors in tables I to III)
- Injuries that occurred during travel to and from work (see risk factors in tables IV-VI)

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Tables I–III

Risk Factors for Injuries in the Workplace

Table I—Age Group

	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
<20	891	7084	**12.6**	1.00
20–24	3240	35003	**9.3**	0.76 (0.70–0.83)
25–29	2799	44958	**6.2**	0.61 (0.56–0.66)
30–34	1780	42197	**4.2**	0.51 (0.46–0.55)
35–39	1043	30358	**3.4**	0.42 (0.38–0.47)
40–44	628	18438	**3.4**	0.40 (0.36–0.45)
≥45	510	16183	**3.2**	0.35 (0.3–0.40)

Table II—Duration of Employment (DOE)

DOE (y)	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
<1	1547	11281	**13.7**	1.00
1–1.9	1400	11947	**11.7**	0.89 (0.82–0.95)
2–4.9	3278	37394	**8.8**	0.72 (0.67–0.76)
5–9.9	2346	52528	**4.5**	0.47 (0.44–0.51)
10–14.9	1293	42853	**3.0**	0.39 (0.36–0.42)
≥15	1027	38218	**2.7**	0.30 (0.27–0.33)

Table III—Calendar Year

Years	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
1977Ğ80	5636	49174	**11.5**	1.00
1981Ğ84	2538	51965	**4.9**	0.53 (0.50Ğ0.56)
1985Ğ88	1671	50526	**3.3**	0.40 (0.38Ğ0.43)
1989Ğ92	1046	42557	**2.5**	0.33 (0.30Ğ0.35)

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Table IV–VI

Risk Factors for Injuries During Travel to and from Work

Table IV—Age Group

	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
<20	305	7084	**4.3**	1.00
20Š24	1206	35003	**3.5**	0.84 (0.74Š0.95)
25Š29	1046	44958	**2.3**	0.65 (0.57Š0.74)
30Š34	686	42197	**1.6**	0.53 (0.46Š0.62)
35Š39	395	30358	**1.3**	0.44 (0.38Š0.52)
40Š44	223	18438	**1.2**	0.40 (0.33Š0.48)
45	220	16183	**1.4**	0.43 (0.35Š0.51)

Table V—Duration of Employment

DOE (y)	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
<1	463	11281	**4.1**	1.00
1Š1.9	474	11947	**4.0**	1.00 (0.88Š1.14)
2Š4.9	1203	37394	**3.2**	0.89 (0.80Š0.99)
5Š9.9	964	52528	**1.8**	0.62 (0.55Š0.70)
10Š14.9	522	42853	**1.2**	0.48 (0.42Š0.56)
15	455	38218	**1.2**	0.43 (0.38Š0.50)

Table VI—Calendar Period

Calendar Period	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
1977-80	1948	49174	**4.0**	1.00
1981-84	947	51965	**1.8**	0.54 (0.49-0.59)
1985-88	775	50526	**1.5**	0.51 (0.46-0.56)
1989-92	411	42557	**1.0**	0.35 (0.31-0.39)

Rate of Injury

- Rate of injury relative to the number of previous injuries experienced for workers recruited January 1, 1977 or later (n=10,963)

Table VII—Injury in the Workplace

n	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
0	3074	57406	**5.4**	1.00
1	1168	16431	**7.1**	1.89 (1.76Ğ2.03)
2	443	5617	**7.9**	2.63 (2.36Ğ2.93)
3	191	1764	**10.8**	4.03 (3.44Ğ4.72)
4	82	761	**10.8**	4.13 (3.27Ğ5.22)
5	35	330	**10.6**	4.27 (3.09Ğ5.89)
6	39	212	**18.4**	8.13 (5.92Ğ11.19)

Table VIII—Injury During Travel to Work

n	Injuries (n)	Person Years	Rate / 100 Person Years	Adjusted Rate Ratio (95% CI)
0	1457	71567	**2.0**	1.00
1	274	9127	**3.0**	2.15 (1.81Ğ2.56)
2	40	1543	**2.6**	2.37 (1.58Ğ3.56)
>3	11	285	**3.9**	3.24 (1.59Ğ6.59)

Table IX—Job Category

	Workplace	Workplace	Travel to work	Travel to work
	Rate / 100 Person Years	Adjusted Rate Ratio	Rate / 100 Person Years	Adjusted Rate Ratio
Professionals	1.0	**1.00**	0.7	**1.00**
Technicians	2.3	**2.34**	1.5	**1.26**
Support Workers	2.9	**2.70**	2.8	**3.86**
Group Leaders	4.2	**3.99**	1.6	**2.14**
Laborers	7.5	**7.35**	2.2	**3.13**

Table X—Place of Work

	Workplace	Workplace	Travel to Work	Travel to Work
	Rate / 100 Person Years	Adjusted Rate Ratio	Rate / 100 Person Years	Adjusted Rate Ratio
General Support Services	2.7	**1.00**	2.2	**1.00**
Research & Production	4.5	**1.67**	2.5	**1.15**
Energy Supply	4.4	**1.63**	2.0	**0.91**
Maintenance	6.5	**2.41**	1.9	**0.88**

Continued

Table X—Place of Work

	Workplace	Workplace	Travel to Work	Travel to Work
	Rate / 100 Person Years	Adjusted Rate Ratio	Rate / 100 Person Years	Adjusted Rate Ratio
Cranes / Rail & Trucks	5.9	**2.36**	1.7	**0.83**
Steel Mill & Foundry	11.2	**4.07**	2.4	**1.05**
Plate Mill	5.9	**2.25**	2.2	**1.05**
Coke Oven & Blast Furnace	6.5	**2.49**	1.8	**0.85**

Main Results

- Injury rates are highest for workers less than 20 years of age and the rates progressively decline with increasing age
- Recently employed workers met with more injuries than those who had been employed for longer periods

Continued

Main Results

- Decreasing trend in injury rate with calendar year
- Significant increase in both workplace and travel injuries was found to be related to the number of injuries of that type previously experienced (table VII and VIII)
- Laborers and group leaders were at highest risk for workplace injuries (table IX)

Main Results

- Highest rate of injury was among those working in foundry
- The smallest number of injuries among those in general support services (table X)