Safe Speed Limits

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Pedestrian impact

Graphic demonstration of how head injuries occur in pedestrians impacts at high speed

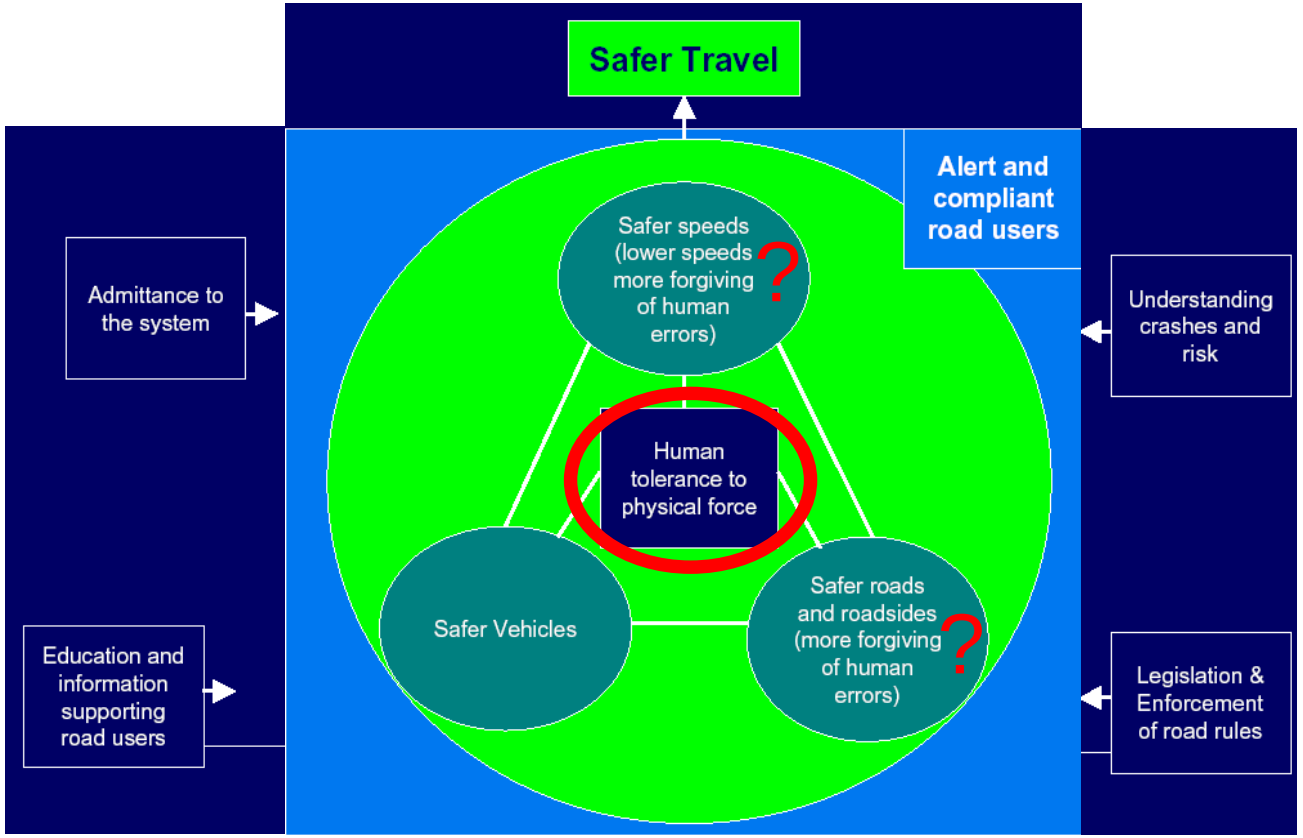
*Old TAC advertisement encouraging drivers to slow down from **70 km/h to 60 km/h** in urban streets – before we had 50 km/h maximum limit in built up urban environments & **before Safe System Approach** introduced in 2004.*

Safe System principles

- Important to recognise humans make errors
- Assess consequences of those errors
- Propose countermeasures: roads more forgiving of errors
- Countermeasures reduces crash severity to survivable limits and/or eliminate or compensates for the human error
- shift responsibility from emphasis on road users being responsible for behaviour on the road to a greater responsibility for road system designers and managers to build safe guards into the system to prevent injury-causing crashes
- No more trading off lives for benefit of mobility and cost efficiency – more humanistic ethical approach

Safe System principles

Focus on Biomechanics Criterion instead of cost benefit



TOWARDS ZERO
Ambitious Road Safety Targets and the Safe System Approach

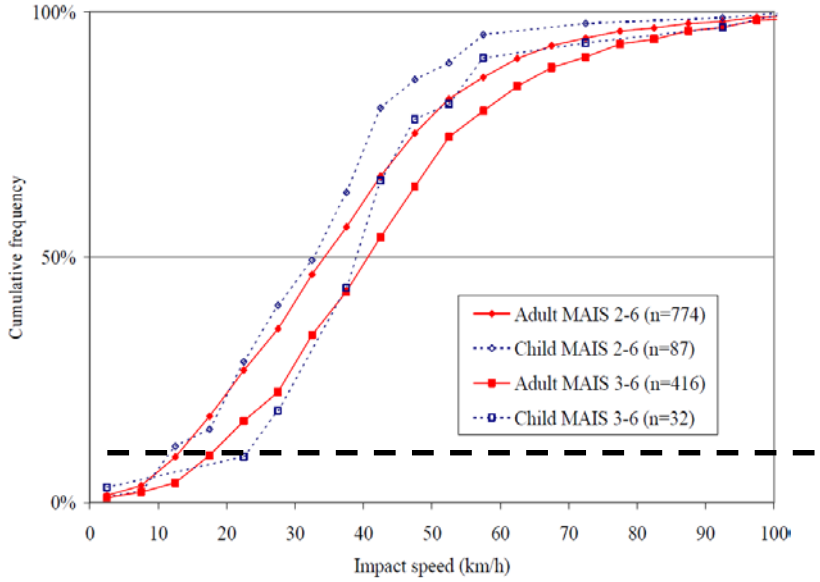
OECD & International Transport Forum

International Working Group Members (25 countries) chaired by Eric Howard –ex head of road safety at VicRoads

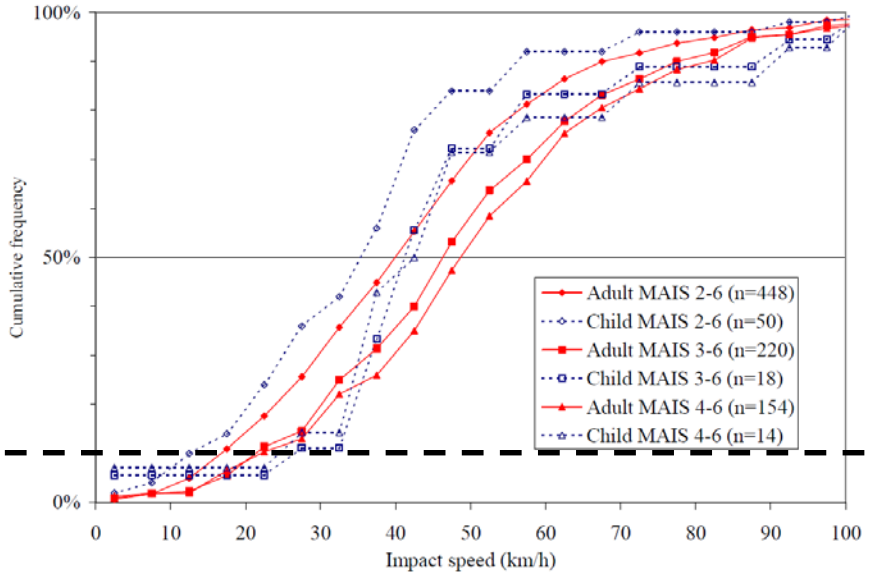
Howard, E., Implementing a "Safe System" approach to road safety in Victoria, Proc. Road Safety Research, Policing and Education Conference, 2004.

Pedestrian Impact Velocity by MAIS

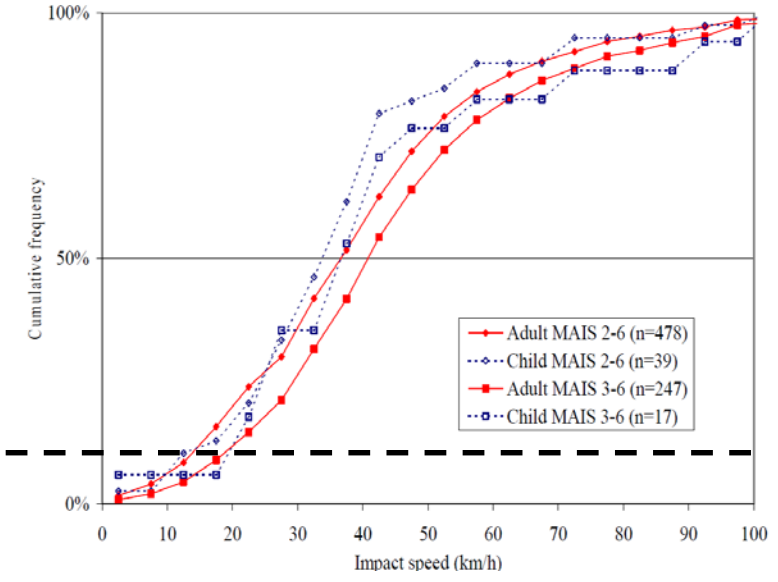
MAIS = Maximum Abbreviated Injury Scale



All body regions



Head Injuries

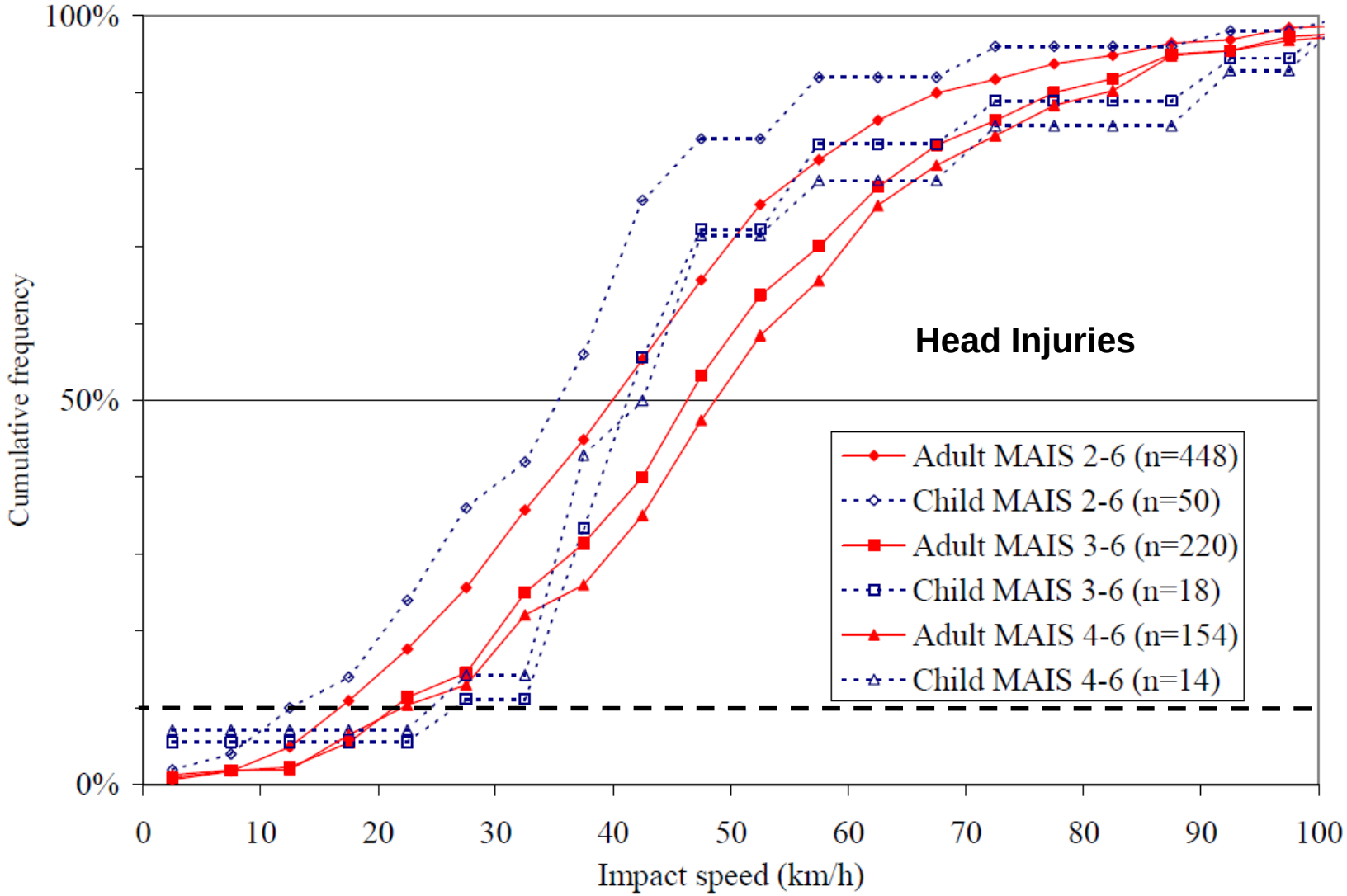


Leg Injuries

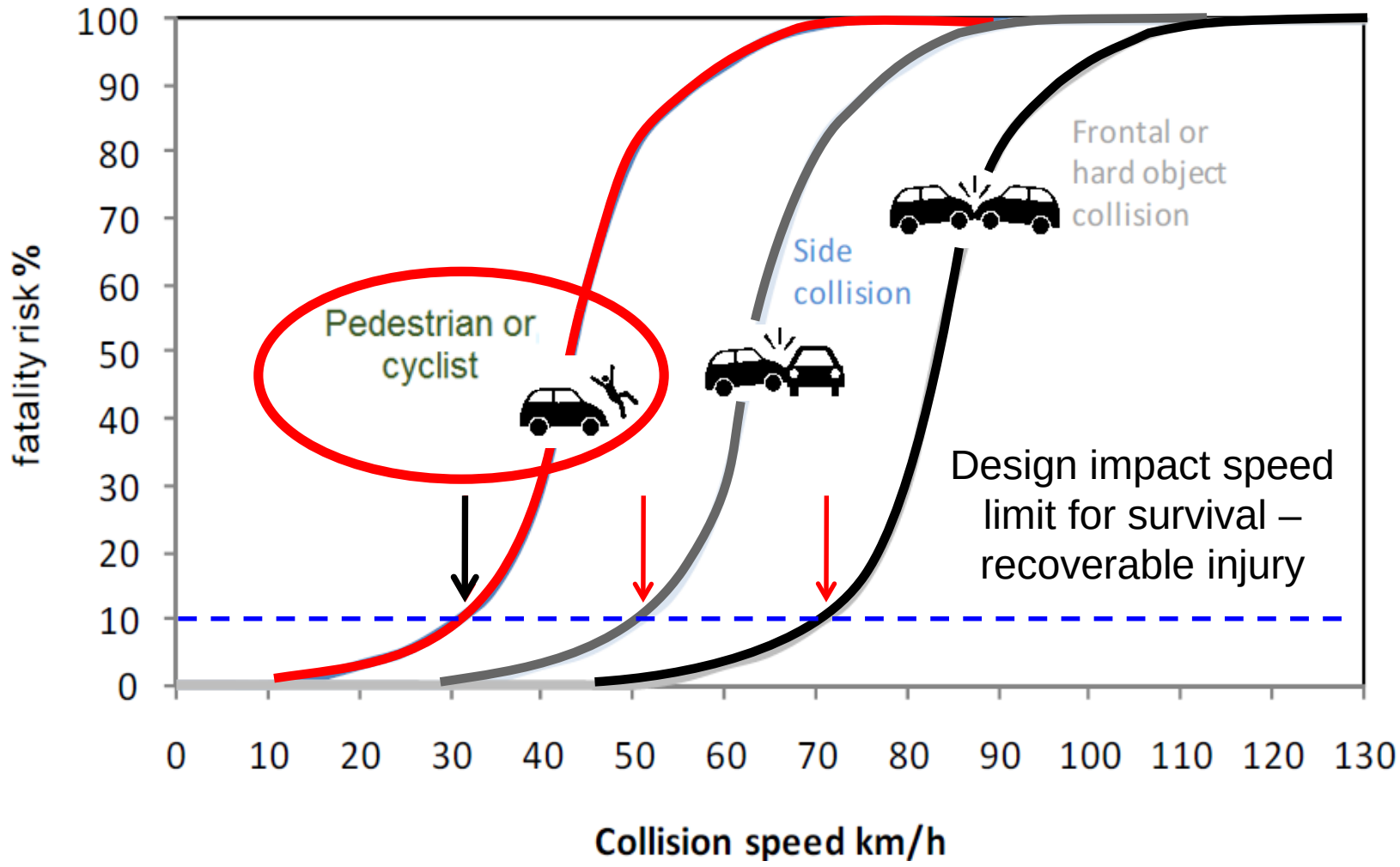
Mizuno, Y. 2005. *Summary of IHRA pedestrian safety WG activities (2005) – proposed test methods to evaluate pedestrian protection afforded by passenger cars, in 19th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 6–9 June 2005, Washington, DC, US, 1–15.*

Pedestrian Impact Velocity by MAIS

MAIS = Maximum Abbreviated Injury Scale

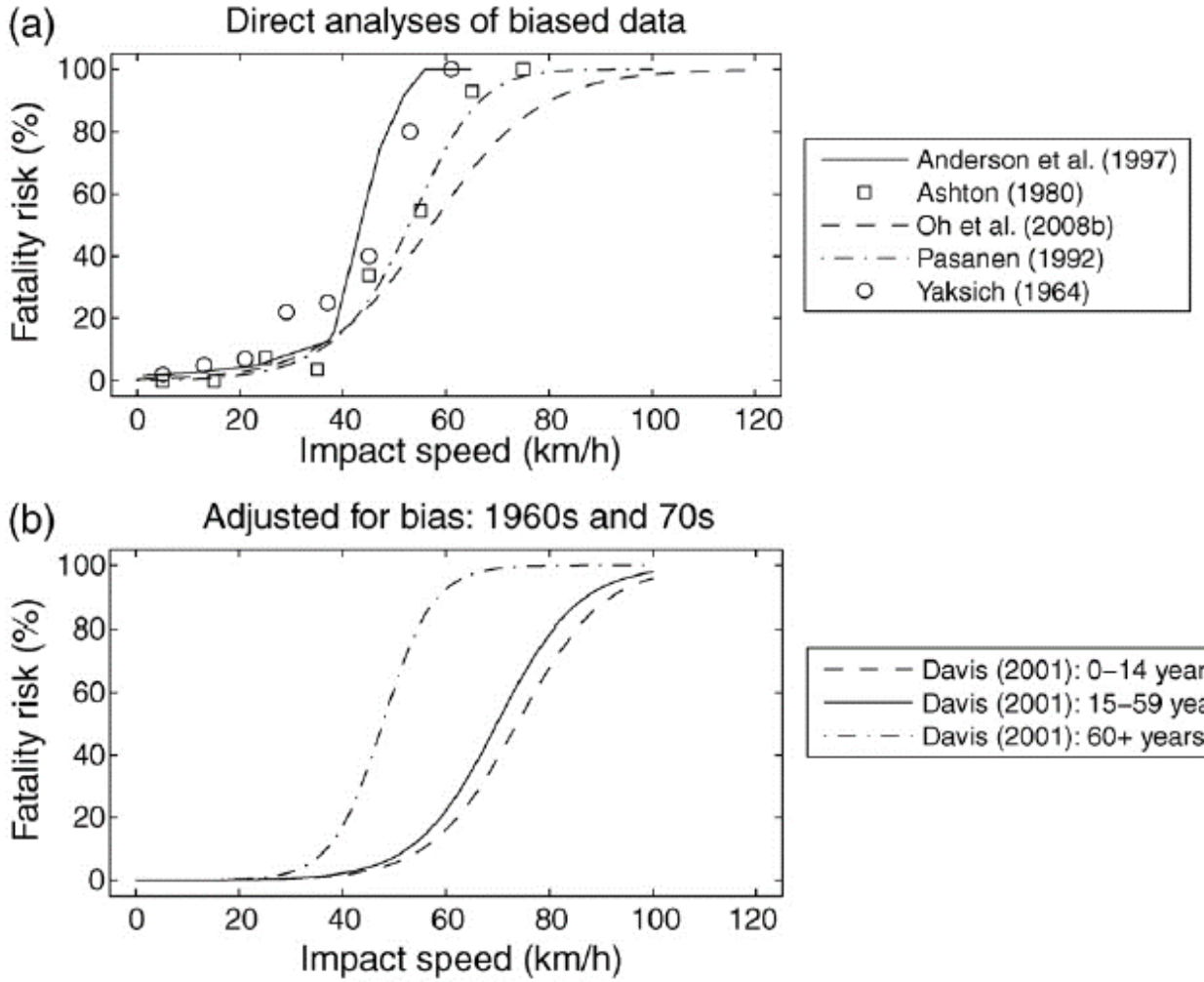


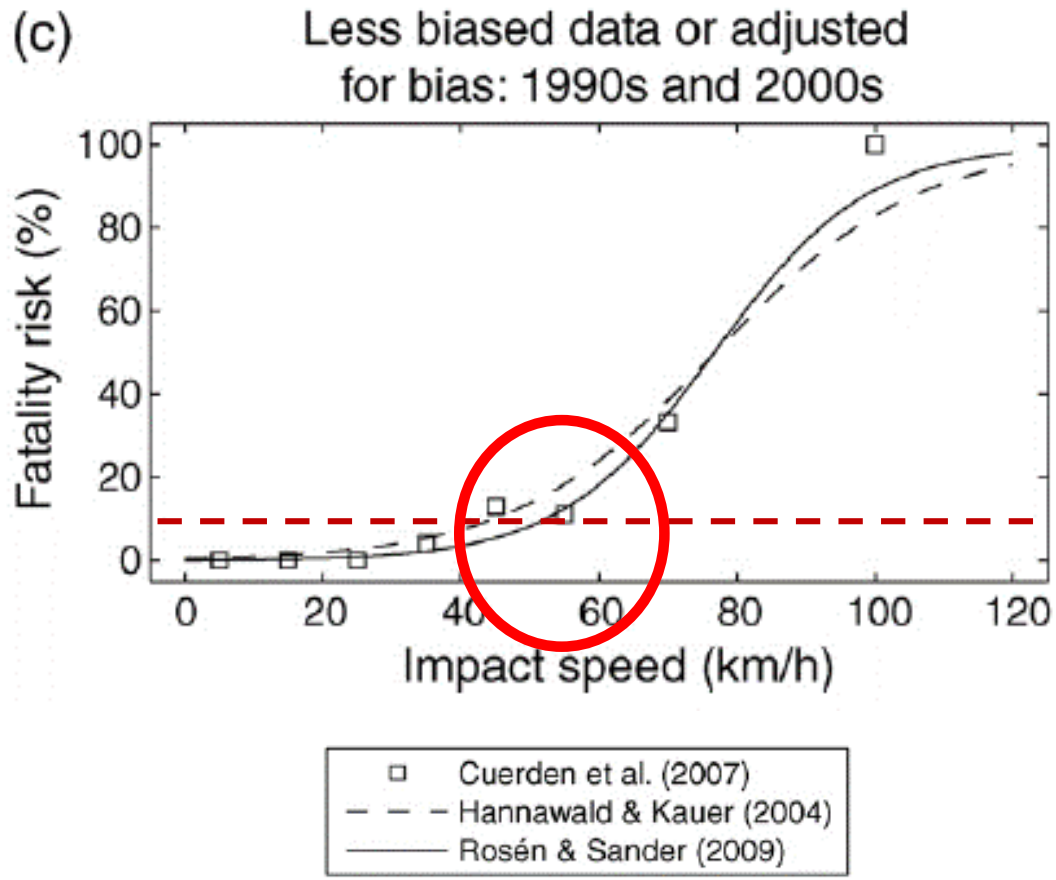
Making crashes survivable – Safe System Approach



Source: Wramborg, P. (2005). A New Approach to a Safe and Sustainable Road Structure and Street Design for Urban Areas. Paper presented at Road Safety on Four Continents Conference, Warsaw Poland.
http://www.internationaltransportforum.org/jtrc/safety/targets/08TargetsSummary.pdf

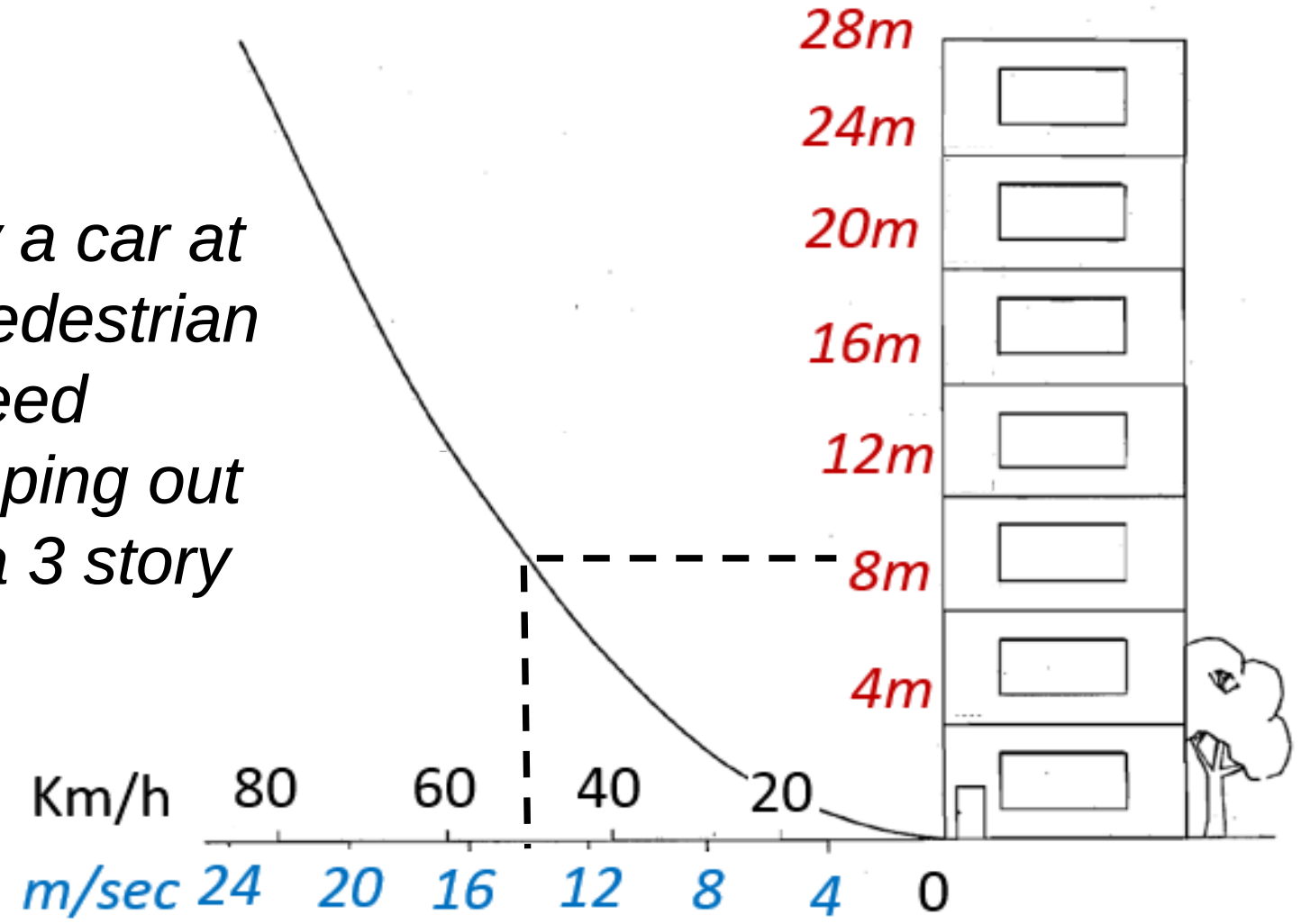
European Citizen´s Initiative "30kmh – making streets liveable!"


(a)
Direct analyses of biased data
Fatality risk (%)
Impact speed (km/h)
Anderson et al. (1997)
Ashton (1980)
Oh et al. (2008b)
Pasanen (1992)
Yaksich (1964)
(b)
Adjusted for bias: 1960s and 70s
Fatality risk (%)
Impact speed (km/h)
Davis (2001): 0–14 years
Davis (2001): 15–59 years
Davis (2001): 60+ years


(c)
Less biased data or adjusted for bias: 1990s and 2000s
Fatality risk (%)
Impact speed (km/h)
Cuerden et al. (2007)
Hannawald & Kauer (2004)
Rosén & Sander (2009)

What is a survivable impact?

Being struck by a car at 50 km/h as a pedestrian is the same speed reached by jumping out the window of a 3 story window



Murray N.W., When it Comes to the Crunch, The mechanics of Car Collisions, World Scientific, Singapore, 1994

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journal homepage: www.elsevier.com/locate/aap

The relationship between impact speed and the probability of pedestrian fatality during a vehicle-pedestrian crash: A systematic review and meta-analysis

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[b] Uhasselt, Transportation Research Institute (IMOB), Agoralaan, 3590, Diepenbeek, Belgium
[c] School of Mathematics and Statistics, UNSW, Sydney, NSW, 2052, Australia
[d] Transport and Road Safety (TARS) Research Centre, UNSW, 1st Floor West Wing, Old Main Building (K15), Sydney, NSW, 2052, Australia

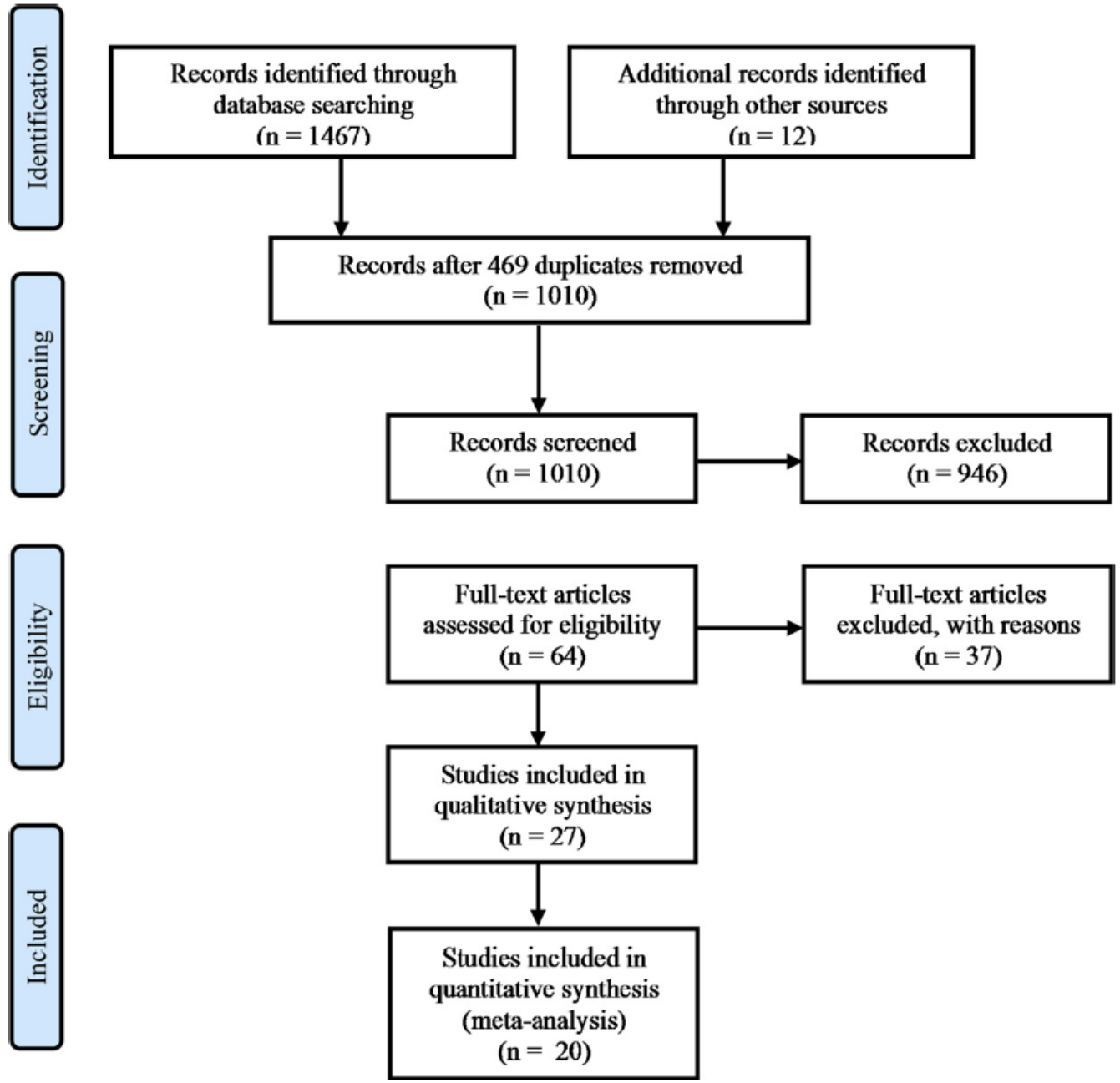
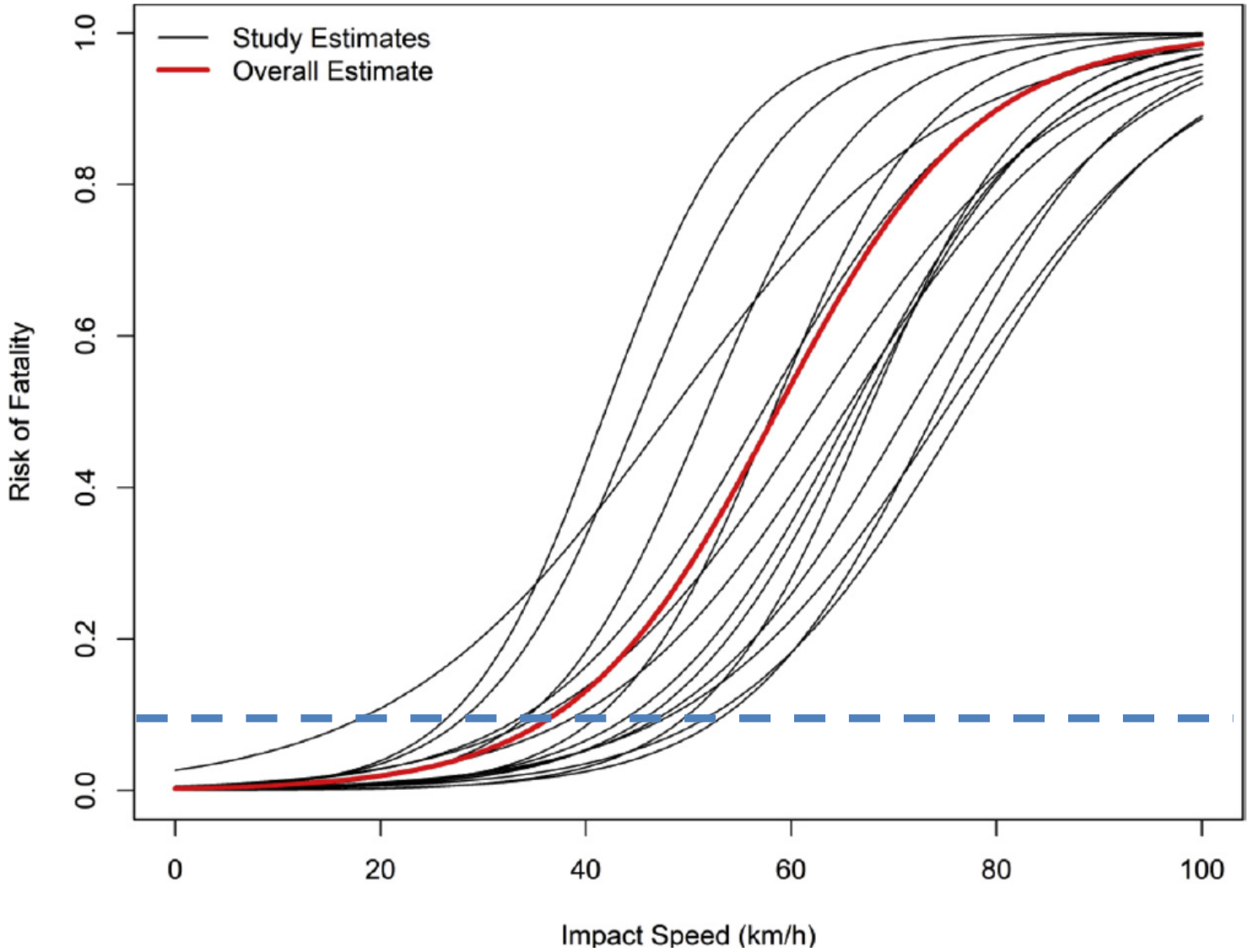


Fig. 1. PRISMA flow diagram of included studies.



Results suggest an impact speed of **30 km/h** has on average a **risk of a fatality** of **around 5%**. The risk increases to **13% for an impact speed of 40 km/h** and **29% at 50 km/h**.

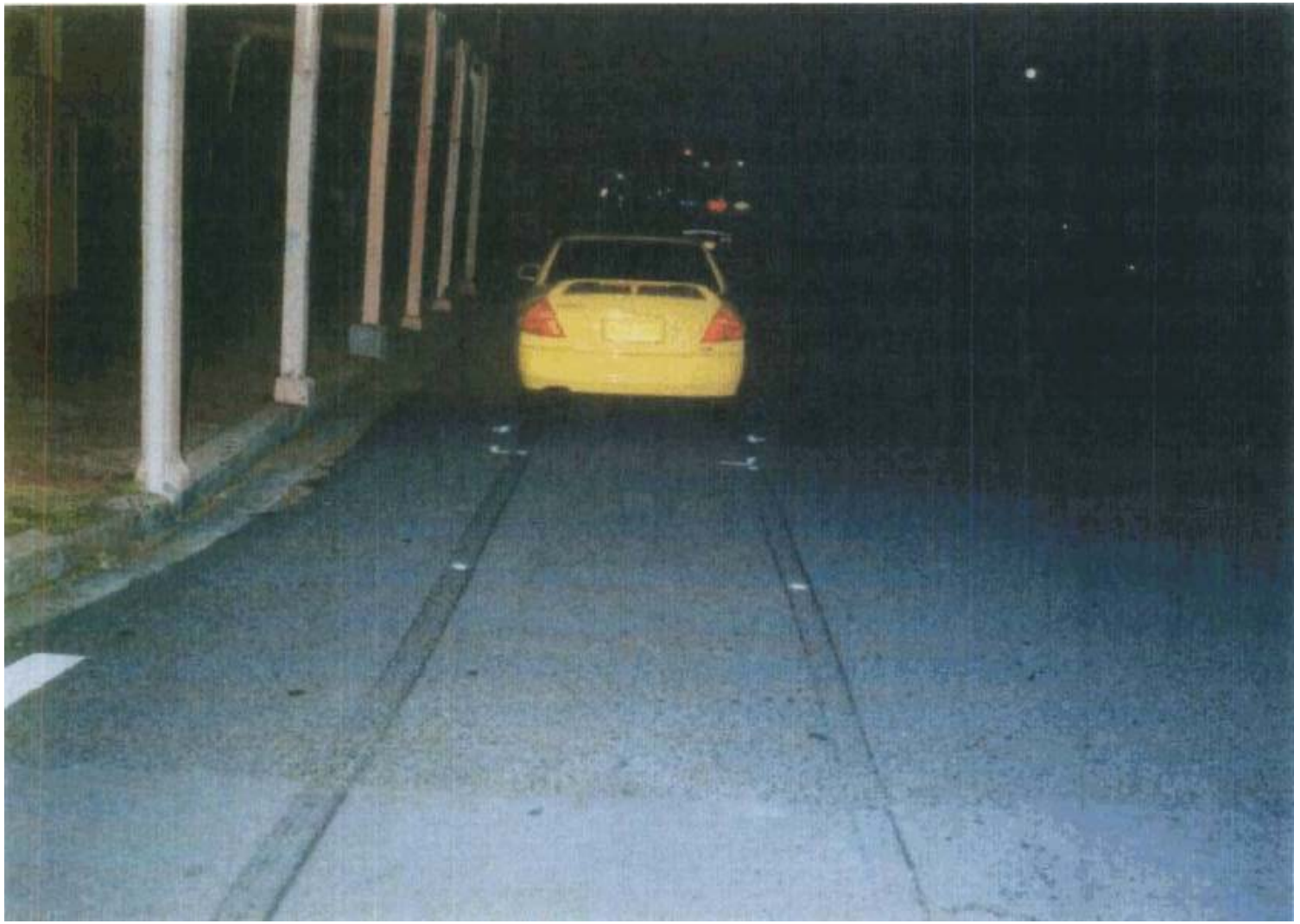
SAFE SYSTEM APPROACH - human factors

Pedestrian impact at night

Glancing blow – head strike where glass star pattern observed & mirror is broken

SAFE SYSTEM APPROACH - human factors

Pedestrian impact at night

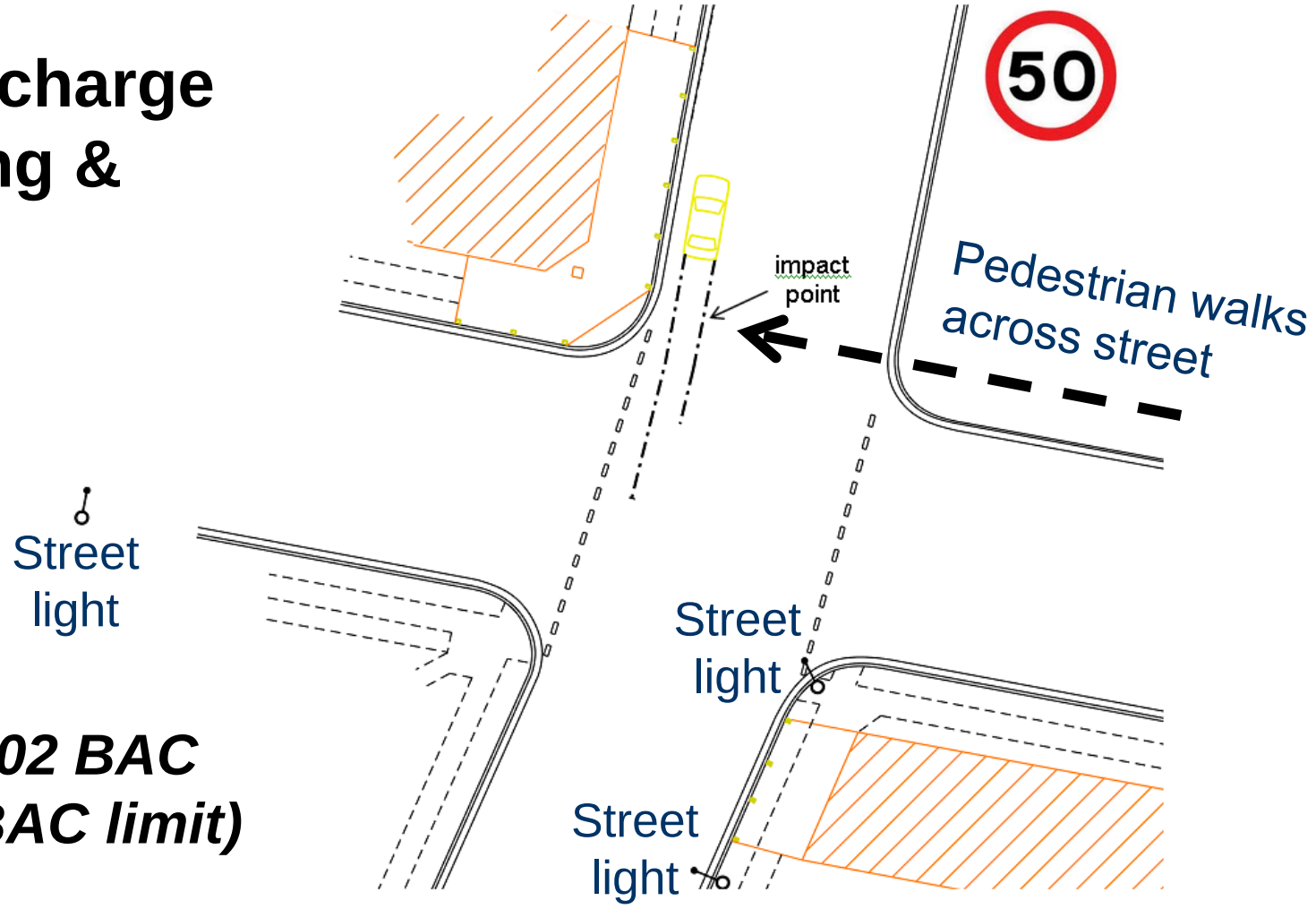


Skid marks left.

Possible to determine impact speed using ‘Speed from Skid’ equation and adopting commonly accepted perception reaction time of driver

Pedestrian impact at night

Police wanted to charge driver for speeding & reckless driving



Driver was 0.02 BAC (below 0.05 BAC limit)

Was it the driver's fault?

Visibility and lighting

Car headlights on low beam

Speed from skid equation

$$V^2 = 2ad$$

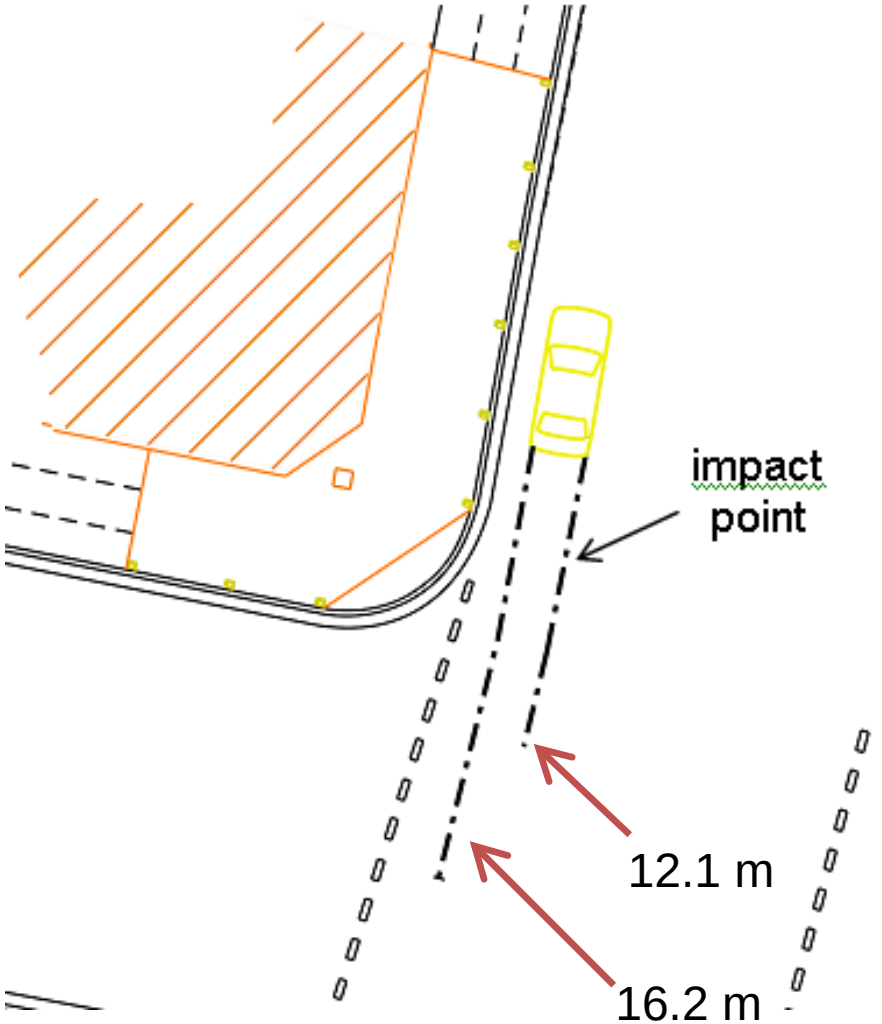
V = vehicle velocity

a = *deceleration*

d = *length of skid*

Crash reconstruction

Speed from skid



assumed $\mu = 0.6$

$$V^2 = 2ad$$

$$V = \sqrt{2\mu g \times 16.2}$$

$$= \sqrt{2 \times 0.6 \times 9.81 \times 16.2}$$

$$= \sqrt{190.7}$$

$$= 13.8 \text{ m/sec}^2$$

$$= 50\ km/h$$

Crash reconstruction

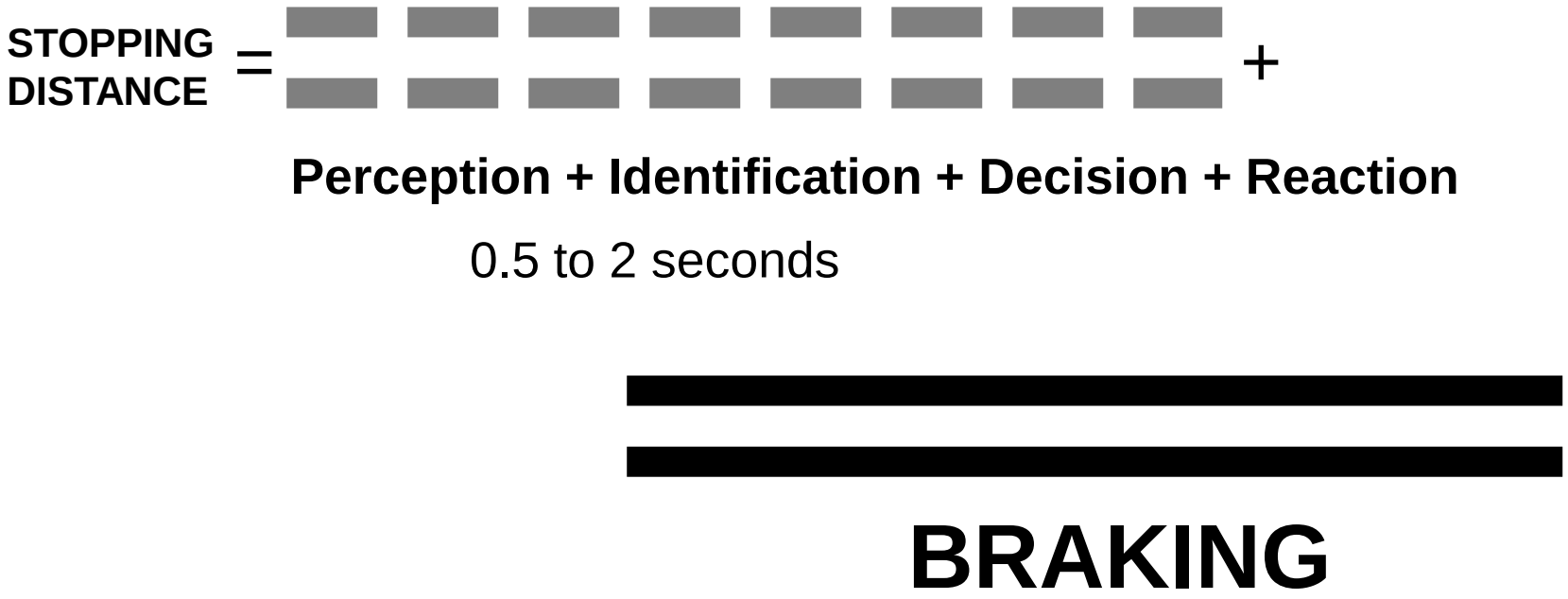
Perception reaction time

From around 1.0 second to up to 2.5 seconds depending on the experience and alertness of the driver but commonly adopt 1.5 seconds

- detect the presence of the pedestrian
- identify that the pedestrian represents a hazard
- decide action to be taken
- react or respond by taking action (e.g. apply brakes)

Crash reconstruction

Perception + Reaction + Braking



Visibility and lighting

At **36 meters** away from crossing pedestrian using **low beam lights**

Visibility and lighting

At **36 meters** away from crossing pedestrian using **high beam lights**

Visibility and lighting

At **20 meters** away from crossing pedestrian using **low beam lights**

Visibility and lighting

At **14 meters** away from crossing pedestrian using **low beam lights**

Crash reconstruction

Is it possible to brake in time?

Assuming 1.5 seconds PRT and speed of 50 km/h

Car traveling at around 14 m/sec
In 1.5 seconds travels around 21 metres
Not possible to perceive and react in time!

IMPACT AT 50 km/h = Jumping out top window of 3 story building

(Assuming 1 second P-R - impact speed is around 40 km/h)
Jumping out top floor window of 2 story house

Crash reconstruction

Is it possible to brake in time?

Assuming 1.5 seconds P-R and speed of **40 km/h**

Car traveling at around 11 m/sec

In 1.5 seconds travels around 17 metres (at 20 m visible)

Car will brake for 3 metres (needs around 10 metres to stop)
and will strike pedestrian at around 33 km/h

IMPACT AT 33 km/h = Jumping off a house roof

(Assuming 1 second P-R - impact speed is 17 km/h)

Crash reconstruction

Is it possible to brake in time?

Assuming 1.5 seconds P-R and speed of **30 km/h**

Car traveling at around 8.3 m/sec

In 1.5 seconds travels around 12.5 metres (at 20 m visible)

Car needs around 6 metres to stop

NO IMPACT!

Conclusions

Do we blame the driver?

The driver was likely travelling at the speed limit.

The driver did exceptionally well perceiving and reacting to the pedestrian within 1 second despite being 0.02 BAC.

Do we blame the pedestrian?

Not really as the pedestrian was mentally handicapped.

INFRASTRUCTURE - POOR LIGHTING

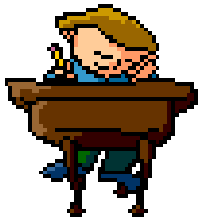
SPEED LIMIT IS TOO HIGH FOR ROAD CONDITIONS

SAFE SYSTEM APPROACH = 30 km/h (40 km/h maybe acceptable)

Safe System thinking essential to reduce trauma

Pedestrians must be visible at night if you want to maintain 50 km/h speed limit
Otherwise set to 30 km/h (or 40 km/h)

Australia's default speed limit for a Safe System to reduce pedestrian trauma



Questions?

DECADE OF ACTION FOR ROAD SAFETY 2011-2020

Together
we can save lives.