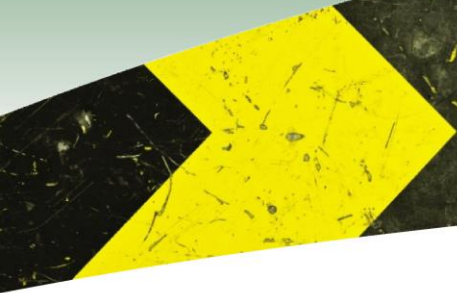


# iRAP Road Attribute Risk Factors

## Operating and Mean Speeds



This factsheet describes the road attribute risk factors used in the iRAP methodology for Operating Speed and Mean Speed. Operating Speed is used in the calculation of Star Ratings and is the greater of the posted (or official) speed limit or 85<sup>th</sup> percentile speed. Casualty estimations and economic analyses (in the Safer Roads Investment Plans) are based on mean speeds.

### About road attribute risk factors

Road attribute risk factors, sometimes called crash modification factors (CMF), are used in the iRAP Star Rating methodology to relate road attributes and crash rates. Risk factors (or CMF) are described by the Crash Modification Factor Clearing House as follows:

*A crash modification factor (CMF) is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site.*

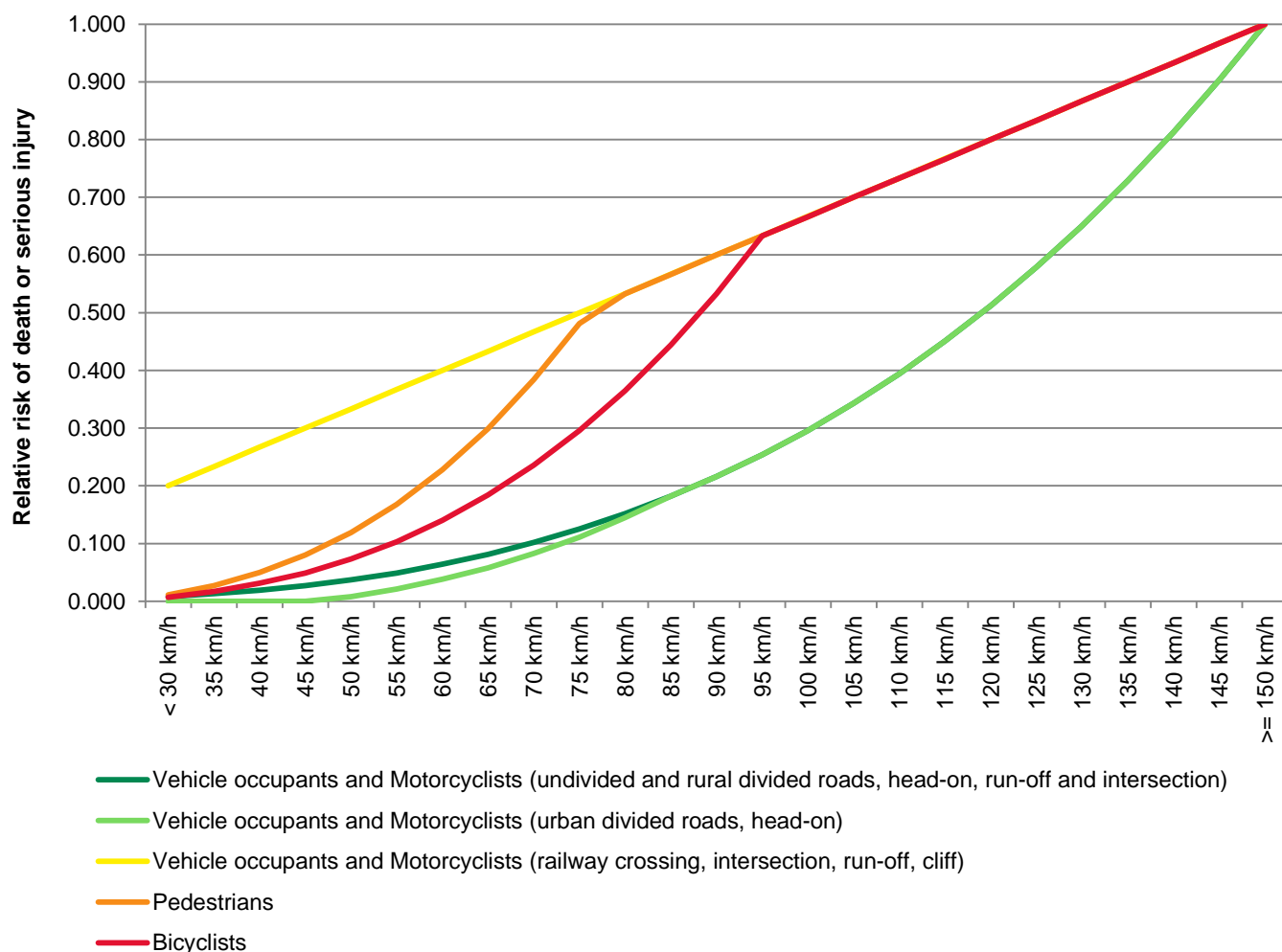
*For example, an intersection is experiencing 100 angle crashes and 500 rear-end crashes per year. If you apply a countermeasure that has a CMF of 0.80 for angle crashes, then you can expect to see 80 angle crashes per year following the implementation of the countermeasure ( $100 \times 0.80 = 80$ ). If the same countermeasure also has a CMF of 1.10 for rear-end crashes, then you would also expect to also see 550 rear-end crashes per year following the countermeasure ( $500 \times 1.10 = 550$ ).*

### Related documents

This factsheet should be read in conjunction with:

- *iRAP Methodology Fact Sheets* (<http://irap.org/about-irap-3/methodology>).
- *Star Rating and Investment Plan Coding Manual* (<http://irap.org/about-irap-3/specifications>).
- *Road Safety Toolkit* (<http://toolkit.irap.org>).
- *Risk factors*

## Risk factors by road attribute category, road user type and crash type



## Selection of risk factors

There is considerable evidence on the relationship between speed and the likelihood and severity of a crash (see for example, Wrangborg, 2005). The effect of traffic speed is especially pronounced for pedestrians, 90% of whom will be killed on impact from a vehicle travelling at 80km/h and above. In essence, the safety of a road cannot be understood without knowledge of traffic speeds, and as such, speed is a critical part of the iRAP methodology. This topic is discussed further in *Vehicle Speeds and the iRAP Protocols*, available at [www.irap.org](http://www.irap.org).

The risk factors used in the iRAP methodology are based on a power model (see for example, Elvik et al, 2004). Five sets of curves are used in the methodology, each of which is reproduced in the chart above. Generally, these curves were developed by multiplying together a likelihood factor (whereby the relationship between speed and the likelihood of a crash is linear) and a severity factor (whereby the relationship between speed and the severity of a crash is generally square). The exceptions to this are:

- for bicyclists, the severity factor equals one at speeds of 95km/h and greater (reflecting the assumption that death or serious injury is certain in a crash at this speed)
- for pedestrians, the severity factor equals one at speeds of 75km/h and greater (reflecting the assumption that death or serious injury is certain in a crash at this speed)
- for vehicle occupants and motorcyclists at railway crossings (intersection crashes) and where there is a cliff (run-off road crashes) the severity factor is set to one for all speeds (reflecting the assumption that death or serious injury is certain in these situations)
- for vehicle occupants and motorcyclists on urban divided roads (head-on crashes) risk factors are set to zero for speeds of less than 50km/h, assuming that a vehicle or motorcycle cannot cross the median at that speed.

## Risk factors in earlier versions of the iRAP model

Speed	Vehicle occupants, motorcyclists, bicyclists and pedestrians
<= 40 km/h	0.33
50 km/h	0.42
60 km/h	0.50
70 km/h	0.58
80 km/h	0.67
90 km/h	0.75
100 km/h	0.83
110 km/h	0.92
120 km/h	1.00

## Primary references

The following publications are the primary references used in the selection of the iRAP road attribute risk factors. A complete list of citations is available in: *iRAP Road Attribute Risk Factors: Full Reference List*.

Elvik, R, Høy, A, Vaa, T, and Sørensen, M. (2009). *The Handbook of Road Safety Measures*, Second Edition (2009) Emerald Group Publishing Limited. ISBN 978-1-84855-250-0.

Lynam, D (2012). *Development of Risk Models for the Road Assessment Programme*. RAP504.12 and TRL Report CPR1293, Published by iRAP and TRL and available at: <http://www.trl.co.uk> and at <http://www.irap.org>.

Mak, K. and Sicking, D. (2003). *Roadside Safety Analysis Program – Engineer’s Manual*. Transportation Research Board (TRB) National Cooperative Highway Research Program (NCHRP) Report 492. ISBN 0-309-06812-6.

Turner, B. Steinmetz, L., Lim, A. and Walsh, K. (2012). *Effectiveness of Road Safety Engineering Treatments*. AP-R422-12. Austroads Project No: ST1571.

Turner, B., Affum, J., Tziotis, M. and Jurewicz, C. (2009). *Review of iRAP Risk Parameters*. ARRB Group Contract Report for iRAP.

Turner, B., Imberger, K., Roper, P., Pyta, V. and McLean, J. (2010). *Road Safety Engineering Risk Assessment Part 6: Crash Reduction Factors*. Austroads AP-T151/10. ISBN 978-1-921709-11-1.

University of North Carolina Highway Safety Research Center and U.S. Department of Transportation Federal Highway Administration (2013). *Crash Modification Factors Clearing House*: <http://www.cmfclearinghouse.org/>.