Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes

Introduction

This issue brief documents estimates of the crash reduction that might be expected if a specific countermeasure or group of countermeasures is implemented with respect to pedestrian crashes. The crash reduction estimates are presented as Crash Modification Factors (CMFs). Some of the crash reduction estimates are also presented in terms of left-turn crashes,certain crash severities, or total crashes.

Traffic engineers and other transportation prefessionals can use the information contained in this issue brief when asking the following types of question: What change in the number of pedestrian crashes (and/or other crash types) can be expected with the implementation of the various countermeasures?

Crash Modification Factors (CMFs)

A CMF is the proportion of crashes that are expected to remain after the countermeasure is implemented. For example, an expected 20 percent reduction in crashes would correspond to a CMF of (1-.20) = 0.80. In some cases, the CMF is negative, i.e. the implementation of a countermeasure is expected to lead to a percentage increase in crashes.

One CMF estimate is provided for each countermeasure. Where multiple CMF estimates were available from the literature, selection criteria were used to choose which CMFs to include in the issue brief:

- First, CMFs from studies that took into account regression to the mean and changes in traffic volume were preferred over studies that did not.
- Second, CMFs from studies that provided additional information about the conditions under which the countermeasures was applied (e.g. road type, area type) were preferred over studies that did not.

Where these criteria could not be met, a CMF may still be provided. In these cases, it is recognized that the estimate of the CMF may not be as reliable, but is the best available at this time. The CMFs in this issue brief may be periodically updated as new information becomes available.

The *Desktop Reference for Countermeasures* includes most of the CMFs included in this issue brief, and adds many other CMFs available in the literature. A few CMFs found in the literature were not included in the Desktop Reference. Those excluded CMFs were condidered to have smaller sample sizes or too large a standard error to be meaningful, or the original research did not provide sufficient detail for the CMF to be useful.

A CMF should be regarded as a generic estimate of the effectiveness of a countermeasure. The estimate is a useful guide, but it remains necessary to apply engineering judgment and to consider site-specific environmental, traffic volume, traffic mix, geometric, and operational conditions which will affect the safety impact of a countermeasure. Actual effectiveness will vary from site to site. The user must ensure that a countermeasure applies to the particular conditions being considered. The reader is also encouraged to obtain and review the original source documents for more detailed information, and to search databases such as the National Transportation Library (ntlsearch.bts.gov) for information that becomes available after the publication of this issue brief.

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Presentation of the Crash Modification Factors

In the tables presented in this issue brief, the crash modification estimates are provided in the following format:

CMF (standard error)^{REF}

The CMF is the value selected from the literature.

The standard error is given where available. The standard error is the standard deviation of the error in the estimate of the CMF. The true value of the CMF is unknown for a given treatment type. The standard error provides a measure of the precision of the estimate of the true value of the CMF. A relatively small standard error indicates that a CMF is relatively precisely known. A relatively large standard error indicates that a CMF is not precisely known.

The REF is the reference number for the source information, as given in the reference list.

As an example, the CMF for the countermeasure to add exclusive pedestrian phasing is:

0.65 (0.16)^{13}

The following points should be noted:

- The CMF of 0.65 means that a (1.0 - .65) = 35% reduction in pedestrian crashes is expected after converting to exclusive pedestrian signal timing.
- The standard error for this CMF is 0.16.
- The reference number is 13 (Chen, et. al.), as listed in the References at the end of this issue brief.

Using the Tables

The CMFs for pedestrian crashes are presented in three tables which summarize the available information. The tables are:

Table 1: Signalization Countermeasures

Table 2: Geometric Countermeasures

Table 3: Signs, Markings, and Operational Countermeasures

The following points should be noted:

- Where available, separate CMFs are provided for different crash severities. The crash severites are: all, fatal/injury, fatal, or injury. The categories depend on the approach taken by the original study. For example, some studies referred to fatal/injury (fatal and injury crashes combined). Some distinguished fatal from injury. “All” is used for CMFs from studies which did not specify the severity, and is also used for CMFs that refer to the total number of crashes, including pedestrians.
- The CMF listed under the pedestrian column refers to the reduction in crashes involving pedestrians crossing the street, unless otherwise specified.
- Blank cells mean that no information is reported in the source document.
- For additional information, please visit the FHWA Office of Safety website (safety.fhwa.dot.gov).

Other Useful Resources

www.cmfclearinghouse.org

www.walkinginfo.org

www.walkinginfo.org/pedsafe/

safety.fhwa.dot.gov/provencountermeasures/

Legend

CMF(standard error)[REF]

CMF is a crash modification factor, which is an estimate of the proportion of crashes expected to result after implementing a given countermeasure. REF is the reference number for the source information.

Table 1: Signalization Countermeasures

Countermeasure(s)	Crash Severity	All Crashes	Left-Turn Crashes	Pedestrian
Add exclusive pedestrian phasing	All			.65 (.16)[13]
Improve signal timing [to intervals specified by the ITE *Determining Vehicle Change Intervals: A Proposed Recomended Practice (1985)*	Fatal/Injury			.63[8]
Replace existing WALK / DON'T WALK signals with pedestrian countdown signal heads*	All			.75[5]
Modify signal phasing (implement a leading pedestrian interval)	All			.95[4]
Remove unwarranted signals (one-way street)	All			.83[7]
Convert permissive or permissive/protected only left-turn phasing	All		.01[10]	
Convert permissive or permissive/protected left-turn phasing	All	.83 (.07)[13]	.84[10]	.57 (.22)[13]
Pedestrian hybrid beacon	All	.71[12]		.31[12]
Increase pedestrian crossing time	All			.49 (.10)[13]
Add new traffic signals when warranted	All	.75 (.07)[13]		

***Countdown pedestrian signals are now a requirement for all new pedestrian signal installations, according to Part 4 of the 2009 MUTCD.**

Table 2: Geometric Countermeasures

Countermeasure(s)	Crash Severity	All Crashes	Pedestrian
Convert unsignalized intersection to roundabout	Fatal/Injury		.73[2]
Install pedestrian overpass/underpass	Fatal/Injury		.10[3]
	All		.14[3]
Install pedestrian overpass/underpass (unsignalized intersection)	All		.87[4]
Install raised median	All		.75[3]
Install raised median (marked crosswalk) at unsignalized intersection	All		.54[9]
Install raised median (unmarked crosswalk) at unsignalized intersection	All		.61[9]
Install raised pedestrian crossing	All	.70[1]	
	Fatal/Injury	.64[1]	
Install refuge islands	All		.44[4]
Install sidewalk (to avoid walking along roadway)	All		.12[6]*
Provide paved shoulder (of at least 4 feet)	All		.29[3]*
Narrow roadway cross section from four lanes to three lanes (two through lanes with center turn lane)	All	.71[10]	

***This only applies to "walking along the roadway" type crashes**

Table 3: Signs, Markings, and Operational Countermeasures

Countermeasure(s)	Crash Severity	All Crashes	Pedestrian
Add intersection lighting	Injury	.73[10] *	
	All	.79[10] *	
Add segment lighting	Injury	.77[10] *	
	All	.80[10] *	
Improve pavement friction (skid treatment with overlay)	Fatal/Injury		.97[3]
Increase Enforcement**	All		.77[11]
Prohibit right-turn-on-red	All	.97[10]	
Prohibit left-turns	All		.90[3]
Restrict parking near intersections (to off-street)	All		.70[3]
High-visibility crosswalk	All		.52(.17)[13]
High-visibility crosswalk in school zones	All		.63(12)[14]

***This applies to nighttime crashes only**

**** This applies to crash reduction on corridors where sustained enforcement is used related to motorist yielding in marked crosswalk combined with a public education campaign**

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