



UNIVERSITÀ
DEGLI STUDI
FIRENZE

Sistemi per il controllo automatico della velocità.

Valutazione dell'efficacia nella prevenzione degli scontri stradali.

Ing. Simone Piantini, PhD

Senior researcher

Domanda di Ricerca

Qual è l'**efficacia** dei **sistemi automatici** di **controllo** della **velocità** nel
ridurre

Scontri Totali, con **Feriti** e con **Feriti Gravi o Mortali**?



SCONTRI
TOTALI

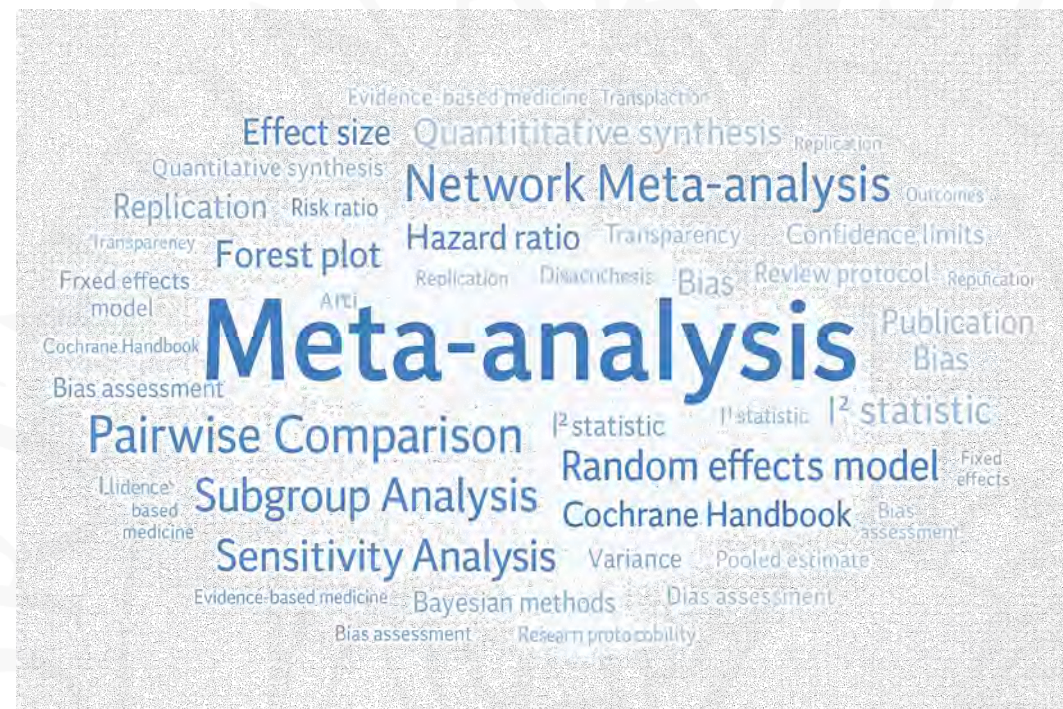


SCONTRI
CON FERITI



SCONTRI CON
FERITI GRAVI
E MORTALI



[illegible]

Revisione Sistemática – definizione



Metodo strutturato e riproducibile per **identificare, valutare e sintetizzare** studi pertinenti.

- Protocollo esplicito
- Criteri di inclusione/esclusione
- Valutazione critica e sintesi dei dati

Revisione Sistemática – percorso



Fasi della Revisione Sistemática

1. Titolo

2. Sommario

3. Introduzione

4. Metodi

5. Risultati

6. Discussione

7. Conclusioni



Speed cameras, section control, and kangaroo jumps—a meta-analysis

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ABSTRACT

A meta-analysis was conducted of the effects of speed cameras and section control (point-to-point speed cameras) on crashes. 63 effect estimates from 15 speed camera studies and five effect estimates from four section control studies were included in the analysis. Speed cameras were found to reduce total crash numbers by about 20%. The effect declines with increasing distance from the camera location. Fatal crashes were found to be reduced by 51%; this result may however be affected by regression to the mean (RTM). Section control was found to have a greater crash reducing effect than speed cameras (−30% for total crash numbers and −56% for KSI crashes). There is no indication that these results (except the one for the effect of speed cameras on fatal crashes) are affected by regression to the mean, publication bias or outlier bias. The results indicate that kangaroo driving (braking and accelerating) occurs, but no adverse effects on speed or crashes were found. Crash migration, i.e., an increase of crash numbers on other roads due to rerouting of traffic, may occur in some cases at speed cameras, but the results do not indicate that such effects are common. Both speed cameras and section control were found to achieve considerable speed reductions and the crash effects that were found in meta-analysis are of a similar size or greater than one might expect based on the effects on speed.

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1. Introduction

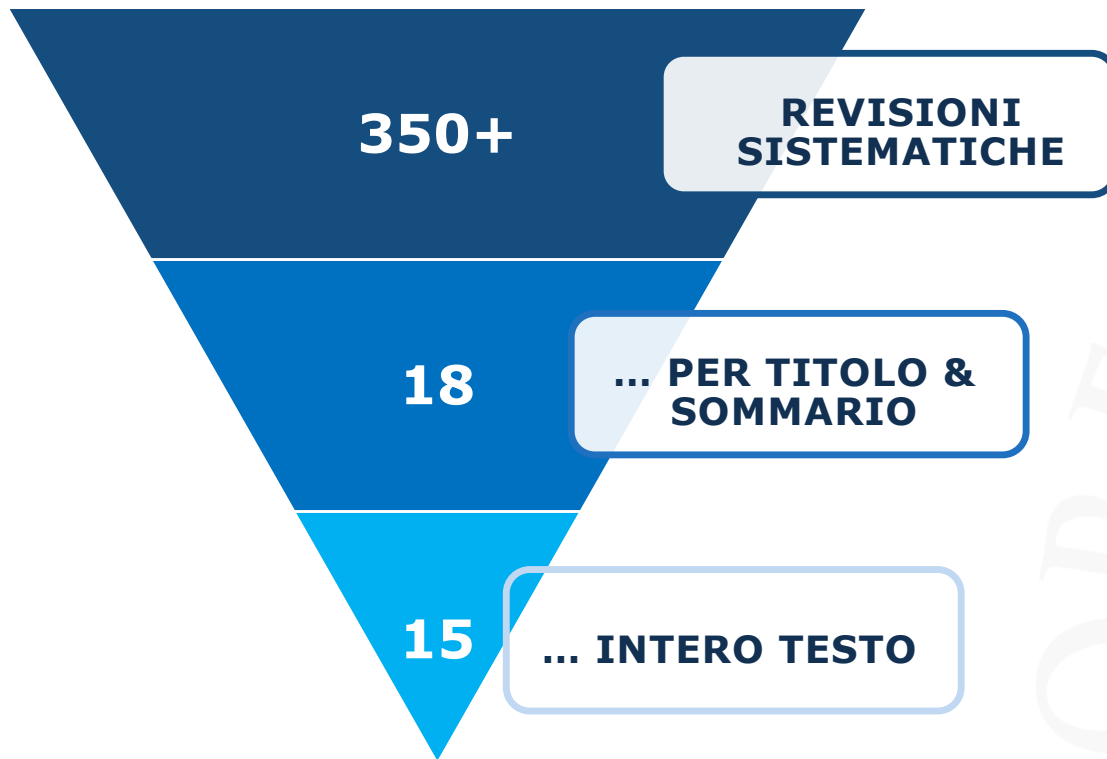
Fixed speed cameras and section control (point-to-point speed cameras) aim at reducing speed and thereby crashes. Excessive speed is a contributing factor to a large proportion of crashes, especially serious crashes, and speed reductions have consistently been found to be accompanied by considerable crash reductions. Example according to the power model that has been developed by

(or some limit above the speed limit) the vehicle owner (or driver) can be sanctioned.

Speed camera and section control programs differ in different countries in several ways. For example speed cameras may be in operation continuously or only at certain more or less predictable times (e.g., in Norway older speed cameras were equipped with mechanical cameras that were rotated between camera locations, Bagoy, 2011), there are varying thresholds for sanctioning car

Study	Year	Location	Crash Type	Effect Estimate (95% CI)
1	2008	Norway	Total crash numbers	-0.20 (-0.30, -0.10)
2	2009	Denmark	Total crash numbers	-0.15 (-0.25, -0.05)
3	2010	Sweden	Total crash numbers	-0.18 (-0.28, -0.08)
4	2011	Finland	Total crash numbers	-0.12 (-0.22, -0.02)
5	2012	Germany	Total crash numbers	-0.10 (-0.20, -0.00)
6	2013	France	Total crash numbers	-0.14 (-0.24, -0.04)
7	2014	Italy	Total crash numbers	-0.16 (-0.26, -0.06)
8	2015	Spain	Total crash numbers	-0.18 (-0.28, -0.08)
9	2016	Portugal	Total crash numbers	-0.20 (-0.30, -0.10)
10	2017	Greece	Total crash numbers	-0.22 (-0.32, -0.12)
11	2018	Turkey	Total crash numbers	-0.24 (-0.34, -0.14)
12	2019	Poland	Total crash numbers	-0.26 (-0.36, -0.16)
13	2020	Czech Republic	Total crash numbers	-0.28 (-0.38, -0.18)
14	2021	Slovakia	Total crash numbers	-0.30 (-0.40, -0.20)
15	2022	Hungary	Total crash numbers	-0.32 (-0.42, -0.22)
16	2023	Romania	Total crash numbers	-0.34 (-0.44, -0.24)
17	2024	Bulgaria	Total crash numbers	-0.36 (-0.46, -0.26)
18	2025	Serbia	Total crash numbers	-0.38 (-0.48, -0.28)
19	2026	Croatia	Total crash numbers	-0.40 (-0.50, -0.30)
20	2027	Slovenia	Total crash numbers	-0.42 (-0.52, -0.32)
21	2028	Lithuania	Total crash numbers	-0.44 (-0.54, -0.34)
22	2029	Latvia	Total crash numbers	-0.46 (-0.56, -0.36)
23	2030	Estonia	Total crash numbers	-0.48 (-0.58, -0.38)
24	2031	Belarus	Total crash numbers	-0.50 (-0.60, -0.40)
25	2032	Ukraine	Total crash numbers	-0.52 (-0.62, -0.42)
26	2033	Moldova	Total crash numbers	-0.54 (-0.64, -0.44)
27	2034	Russia	Total crash numbers	-0.56 (-0.66, -0.46)
28	2035	Georgia	Total crash numbers	-0.58 (-0.68, -0.48)
29	2036	Armenia	Total crash numbers	-0.60 (-0.70, -0.50)
30	2037	Azerbaijan	Total crash numbers	-0.62 (-0.72, -0.52)
31	2038	Kazakhstan	Total crash numbers	-0.64 (-0.74, -0.54)
32	2039	Kyrgyzstan	Total crash numbers	-0.66 (-0.76, -0.56)
33	2040	Tajikistan	Total crash numbers	-0.68 (-0.78, -0.58)
34	2041	Uzbekistan	Total crash numbers	-0.70 (-0.80, -0.60)
35	2042	Turkmenistan	Total crash numbers	-0.72 (-0.82, -0.62)
36	2043	Belgium	Total crash numbers	-0.74 (-0.84, -0.64)
37	2044	Netherlands	Total crash numbers	-0.76 (-0.86, -0.66)
38	2045	Germany	Total crash numbers	-0.78 (-0.88, -0.68)
39	2046	France	Total crash numbers	-0.80 (-0.90, -0.70)
40	2047	Italy	Total crash numbers	-0.82 (-0.92, -0.72)
41	2048	Spain	Total crash numbers	-0.84 (-0.94, -0.74)
42	2049	Portugal	Total crash numbers	-0.86 (-0.96, -0.76)
43	2050	Greece	Total crash numbers	-0.88 (-0.98, -0.78)
44	2051	Turkey	Total crash numbers	-0.90 (-1.00, -0.80)
45	2052	Poland	Total crash numbers	-0.92 (-1.02, -0.82)
46	2053	Czech Republic	Total crash numbers	-0.94 (-1.04, -0.84)
47	2054	Slovakia	Total crash numbers	-0.96 (-1.06, -0.86)
48	2055	Hungary	Total crash numbers	-0.98 (-1.08, -0.88)
49	2056	Romania	Total crash numbers	-1.00 (-1.10, -0.90)
50	2057	Bulgaria	Total crash numbers	-1.02 (-1.12, -0.92)
51	2058	Serbia	Total crash numbers	-1.04 (-1.14, -0.94)
52	2059	Croatia	Total crash numbers	-1.06 (-1.16, -0.96)
53	2060	Slovenia	Total crash numbers	-1.08 (-1.18, -0.98)
54	2061	Lithuania	Total crash numbers	-1.10 (-1.20, -1.00)
55	2062	Latvia	Total crash numbers	-1.12 (-1.22, -1.02)
56	2063	Estonia	Total crash numbers	-1.14 (-1.24, -1.04)
57	2064	Belarus	Total crash numbers	-1.16 (-1.26, -1.06)
58	2065	Ukraine	Total crash numbers	-1.18 (-1.28, -1.08)
59	2066	Moldova	Total crash numbers	-1.20 (-1.30, -1.10)
60	2067	Russia	Total crash numbers	-1.22 (-1.32, -1.12)
61	2068	Georgia	Total crash numbers	-1.24 (-1.34, -1.14)
62	2069	Armenia	Total crash numbers	-1.26 (-1.36, -1.16)
63	2070	Azerbaijan	Total crash numbers	-1.28 (-1.38, -1.18)
64	2071	Kazakhstan	Total crash numbers	-1.30 (-1.40, -1.20)
65	2072	Kyrgyzstan	Total crash numbers	-1.32 (-1.42, -1.22)
66	2073	Tajikistan	Total crash numbers	-1.34 (-1.44, -1.24)
67	2074	Uzbekistan	Total crash numbers	-1.36 (-1.46, -1.26)
68	2075	Turkmenistan	Total crash numbers	-1.38 (-1.48, -1.28)
69	2076	Belgium	Total crash numbers	-1.40 (-1.50, -1.30)
70	2077	Netherlands	Total crash numbers	-1.42 (-1.52, -1.32)
71	2078	Germany	Total crash numbers	-1.44 (-1.54, -1.34)
72	2079	France	Total crash numbers	-1.46 (-1.56, -1.36)
73	2080	Italy	Total crash numbers	-1.48 (-1.58, -1.38)
74	2081	Spain	Total crash numbers	-1.50 (-1.60, -1.40)
75	2082	Portugal	Total crash numbers	-1.52 (-1.62, -1.42)
76	2083	Greece	Total crash numbers	-1.54 (-1.64, -1.44)
77	2084	Turkey	Total crash numbers	-1.56 (-1.66, -1.46)
78	2085	Poland	Total crash numbers	-1.58 (-1.68, -1.48)
79	2086	Czech Republic	Total crash numbers	-1.60 (-1.70, -1.50)
80	2087	Slovakia	Total crash numbers	-1.62 (-1.72, -1.52)
81	2088	Hungary	Total crash numbers	-1.64 (-1.74, -1.54)
82	2089	Romania	Total crash numbers	-1.66 (-1.76, -1.56)
83	2090	Bulgaria	Total crash numbers	-1.68 (-1.78, -1.58)
84	2091	Serbia	Total crash numbers	-1.70 (-1.80, -1.60)
85	2092	Croatia	Total crash numbers	-1.72 (-1.82, -1.62)
86	2093	Slovenia	Total crash numbers	-1.74 (-1.84, -1.64)
87	2094	Lithuania	Total crash numbers	-1.76 (-1.86, -1.66)
88	2095	Latvia	Total crash numbers	-1.78 (-1.88, -1.68)
89	2096	Estonia	Total crash numbers	-1.80 (-1.90, -1.70)
90	2097	Belarus	Total crash numbers	-1.82 (-1.92, -1.72)
91	2098	Ukraine	Total crash numbers	-1.84 (-1.94, -1.74)
92	2099	Moldova	Total crash numbers	-1.86 (-1.96, -1.76)
93	2100	Russia	Total crash numbers	-1.88 (-1.98, -1.78)
94	2101	Georgia	Total crash numbers	-1.90 (-2.00, -1.80)
95	2102	Armenia	Total crash numbers	-1.92 (-2.02, -1.82)
96	2103	Azerbaijan	Total crash numbers	-1.94 (-2.04, -1.84)
97	2104	Kazakhstan	Total crash numbers	-1.96 (-2.06, -1.86)
98	2105	Kyrgyzstan	Total crash numbers	-1.98 (-2.08, -1.88)
99	2106	Tajikistan	Total crash numbers	-2.00 (-2.10, -1.90)
100	2107	Uzbekistan	Total crash numbers	-2.02 (-2.12, -1.92)
101	2108	Turkmenistan	Total crash numbers	-2.04 (-2.14, -1.94)
102	2109	Belgium	Total crash numbers	-2.06 (-2.16, -1.96)
103	2110	Netherlands	Total crash numbers	-2.08 (-2.18, -1.98)
104	2111	Germany	Total crash numbers	-2.10 (-2.20, -2.00)
105	2112	France	Total crash numbers	-2.12 (-2.22, -2.02)
106	2113	Italy	Total crash numbers	-2.14 (-2.24, -2.04)
107	2114	Spain	Total crash numbers	-2.16 (-2.26, -2.06)
108	2115	Portugal	Total crash numbers	-2.18 (-2.28, -2.08)
109	2116	Greece	Total crash numbers	-2.20 (-2.30, -2.10)
110	2117	Turkey	Total crash numbers	-2.22 (-2.32, -2.12)
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116	2123	Bulgaria	Total crash numbers	-2.34 (-2.44, -2.24)
117	2124	Serbia	Total crash numbers	-2.36 (-2.46, -2.26)
118	2125	Croatia	Total crash numbers	-2.38 (-2.48, -2.28)
119	2126	Slovenia	Total crash numbers	-2.40 (-2.50, -2.30)
120	2127	Lithuania	Total crash numbers	-2.42 (-2.52, -2.32)
121	2128	Latvia	Total crash numbers	-2.44 (-2.54, -2.34)
122	2129	Estonia	Total crash numbers	-2.46 (-2.56, -2.36)
123	2130	Belarus	Total crash numbers	-2.48 (-2.58, -2.38)
124	2131	Ukraine	Total crash numbers	-2.50 (-2.60, -2.40)
125	2132	Moldova	Total crash numbers	-2.52 (-2.62, -2.42)
126	2133	Russia	Total crash numbers	-2.54 (-2.64, -2.44)
127	2134	Georgia	Total crash numbers	-2.56 (-2.66, -2.46)
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129	2136	Azerbaijan	Total crash numbers	-2.60 (-2.70, -2.50)
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132	2139	Tajikistan	Total crash numbers	-2.66 (-2.76, -2.56)
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141	2148	Portugal	Total crash numbers	-2.84 (-2.94, -2.74)
142	2149	Greece	Total crash numbers	-2.86 (-2.96, -2.76)
143	2150	Turkey	Total crash numbers	-2.88 (-2.98, -2.78)
144	2151	Poland	Total crash numbers	-2.90 (-3.00, -2.80)
145	2152	Czech Republic	Total crash numbers	-2.92 (-3.02, -2.82)
146	2153	Slovakia	Total crash numbers	-2.94 (-3.04, -2.84)
147	2154	Hungary	Total crash numbers	-2.96 (-3.06, -2.86)
148	2155	Romania	Total crash numbers	-2.98 (-3.08, -2.88)
149	2156	Bulgaria	Total crash numbers	-3.00 (-3.10, -2.90)
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152	2159	Slovenia	Total crash numbers	-3.06 (-3.16, -2.96)
153	2160	Lithuania	Total crash numbers	-3.08 (-3.18, -2.98)
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161	2168	Armenia	Total crash numbers	-3.24 (-3.34, -3.14)
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165	2172	Tajikistan	Total crash numbers	-3.32 (-3.42, -3.22)
166	2173	Uzbekistan	Total crash numbers	-3.34 (-3.44, -3.24)
167	2174	Turkmenistan	Total crash numbers	-3.36 (-3.46, -3.26)
168	2175	Belgium	Total crash numbers	-3.38 (-3.48, -3.28)
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170	2177	Germany	Total crash numbers	-3.42 (-3.52, -3.32)
171	2178	France	Total crash numbers	-3.44 (-3.54, -

Revisione Sistemática – metodo



 **Focus:** Revisioni sistematiche

 **Perché?**
Numerosi lavori con domanda di ricerca simile

 **Contesto:** Paesi ad alto reddito

 **Qualità scientifica:**
Riviste internazionali *peer-reviewed*

 **Sistemi Automatici di Controllo:**
Autovelox / T-Red

 **Screening:**
Titolo, Sommario e Testo completo

Revisione Sistemática – risultati chiave

 **Eterogeneità elevata:** contesto, implementazione e metodo dello studio

 **Ampio intervallo di riduzione** degli scontri (5% - 70%)

 **Variabilità** nell'efficacia fra **scontri lievi** e **scontri gravi e mortali**

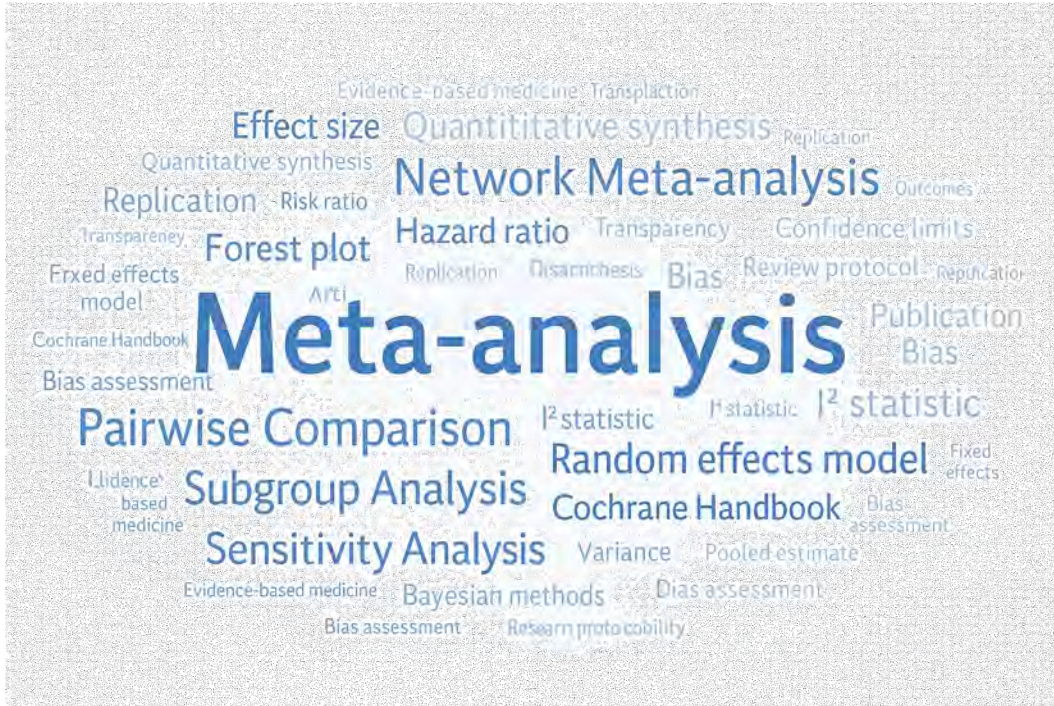


SCONTI
CON FERITI



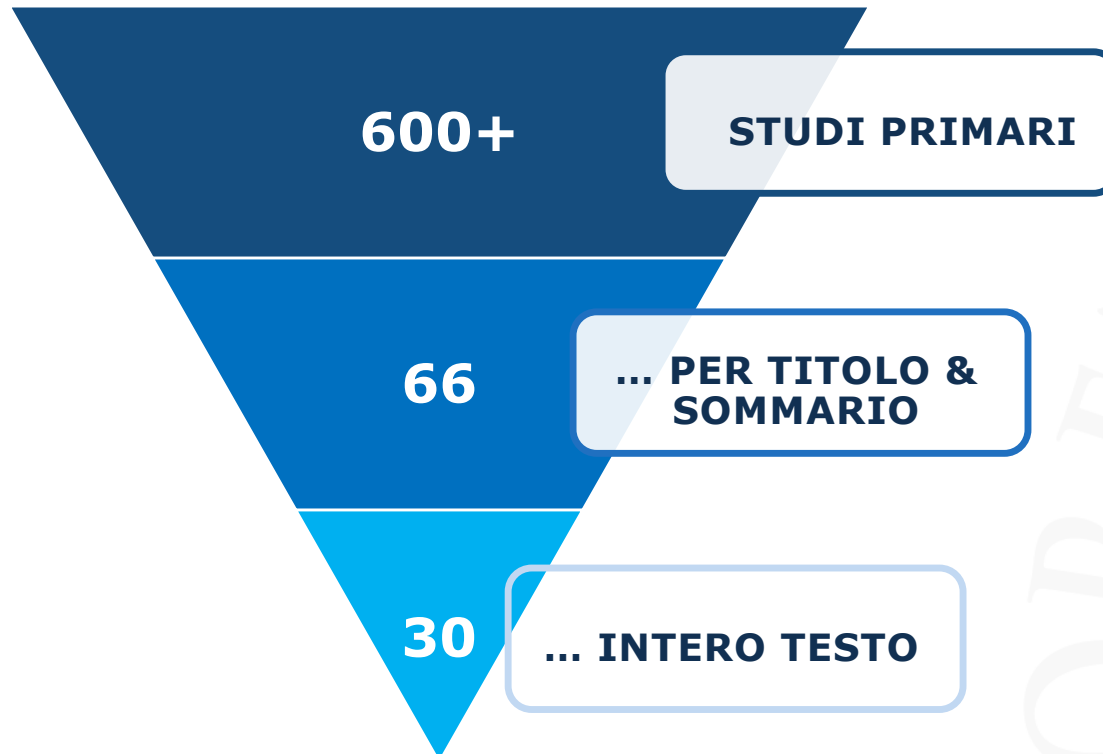
SCONTI CON
FERITI GRAVI
E MORTALI

Metanalisi – definizione



Tecnica statistica che **pesa e combina**
gli **effetti di studi indipendenti** per
stimare un effetto complessivo,
valutare **eterogeneità** e **ridurre**
l'incertezza.

Metanalisi – metodo



 **Fonti:** Studi primari (post-2000)

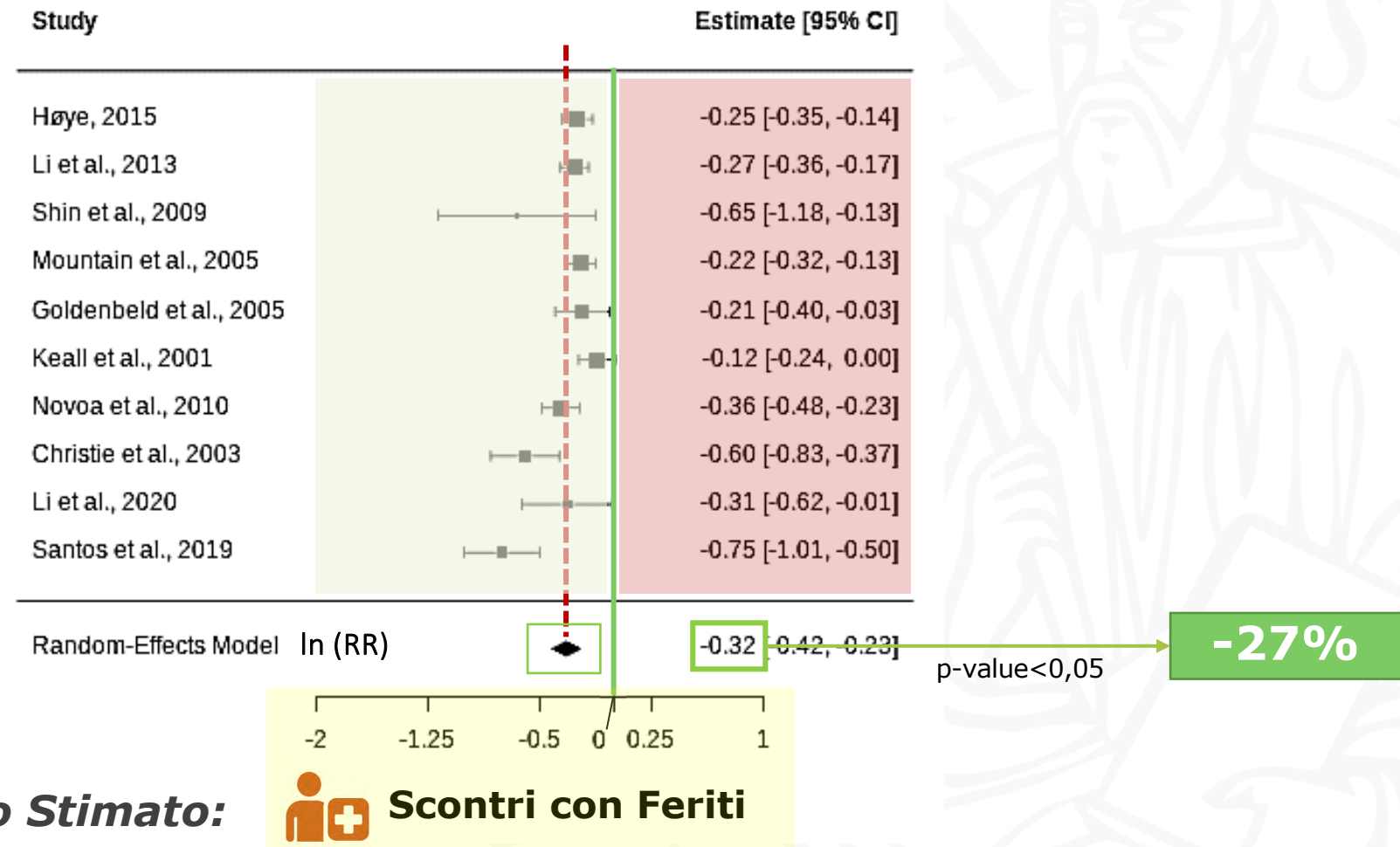
 **Contesto:** Paesi ad alto reddito

 **Qualità scientifica:**
Riviste internazionali di rilievo *peer-reviewed*

 **Sistemi Automatici di Controllo:**
Autovelox / T-Red

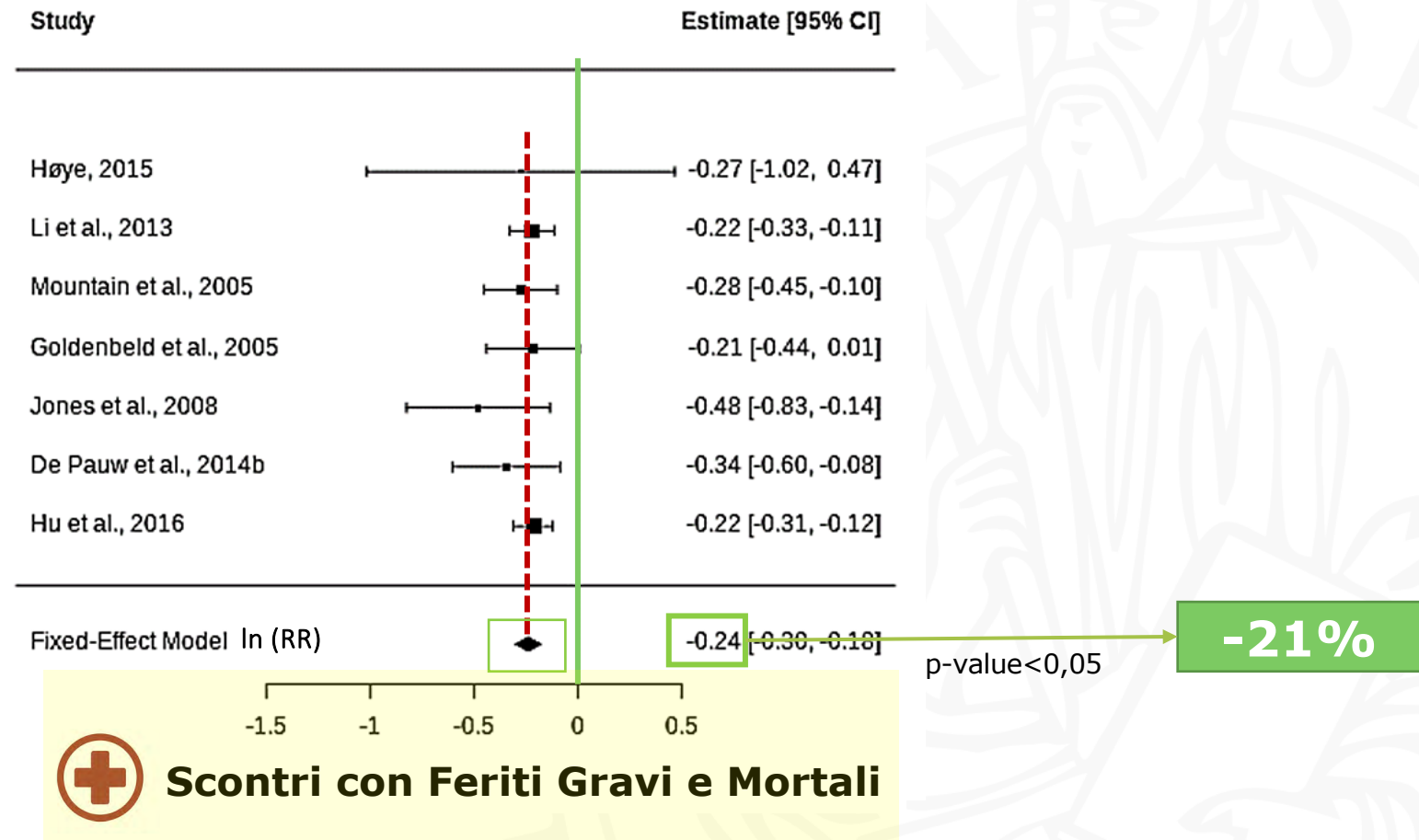
 **Screening:**
Titolo, Sommario e Testo completo

Metanalisi – risultati per *Autovelox Fissi e Mobili*



Legenda: RR - Risk Ratio

Metanalisi – risultati per *Autovelox Fissi e Mobili*

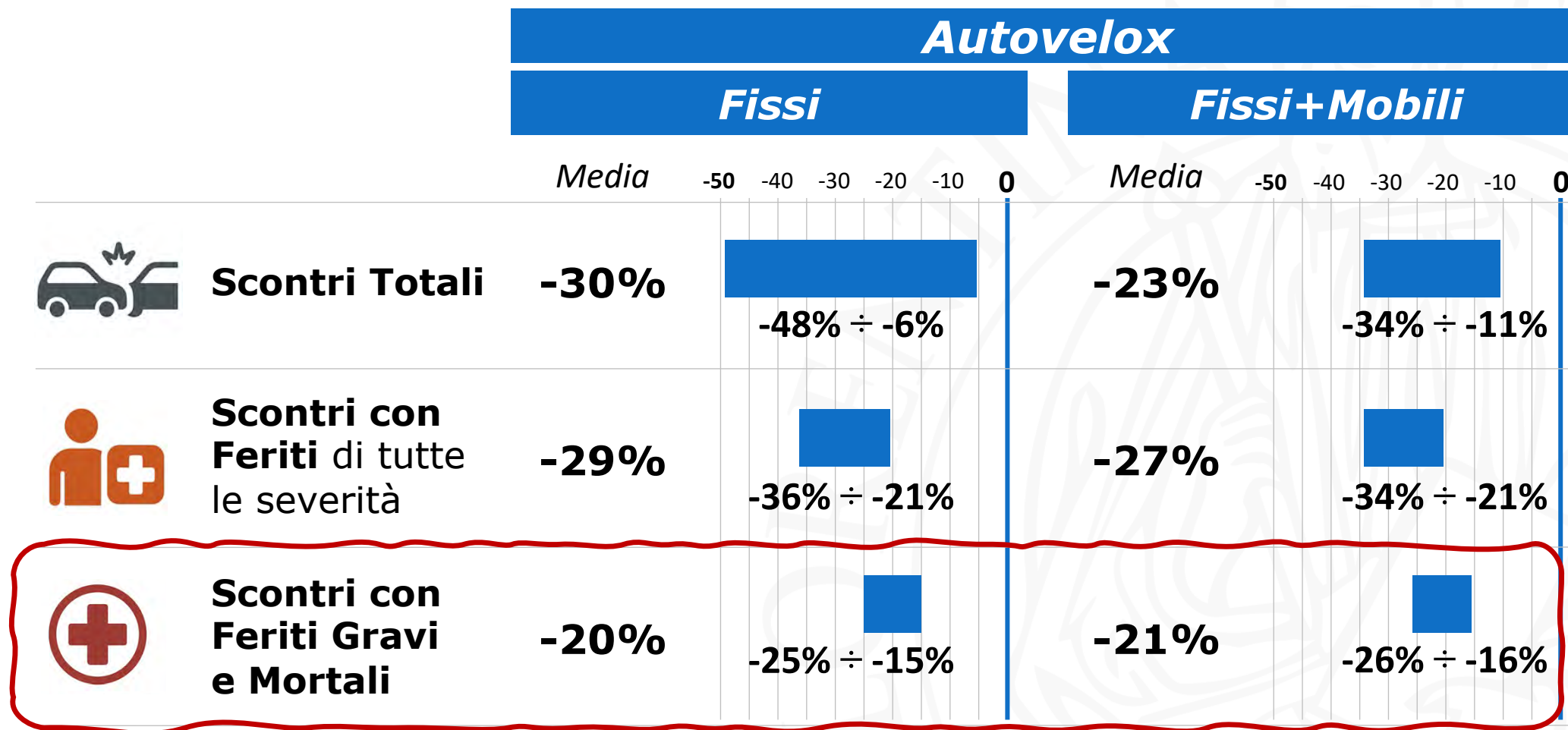


Legenda: RR - Risk Ratio

Metanalisi – limitazioni

-  **Eterogeneità reale** → differenze metodologiche tra studi piccoli e grandi (es. contesti, metodologia, popolazioni).
-  **Qualità degli studi** → studi piccoli potrebbero mostrare metodi meno robusti e risultati più estremi.
-  **Small-study effect** → tendenza generale degli studi di piccole dimensioni a riportare effetti più grandi rispetto a quelli più ampi.

Metanalisi – risultati



Conclusioni



- La presenza di **autovelox riduce** in modo **significativo** gli **Scontri con Feriti, Feriti Gravi e Morti** ($p\text{-value} < 0,05$), con una di **riduzione** complessiva che va **dal 15% al 36%**.



- Gli **Scontri con Feriti Gravi e Morti** si riducono **dal 15% al 26%**,
cioè fino a $\frac{1}{4}$ in meno.



Grazie per l'attenzione

**Sistemi per il controllo automatico della velocità.
Valutazione dell'efficacia nella prevenzione degli scontri stradali.**

Gruppo di Ricerca

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