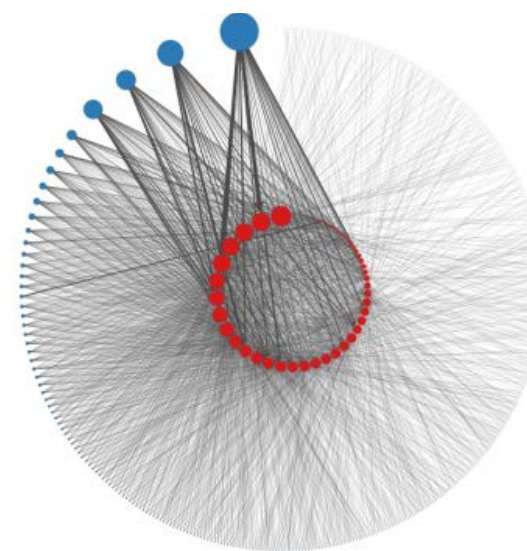



Effectiveness of masks and respirators against respiratory infections in healthcare workers: a systematic review and meta-analysis

*Vittoria Offeddu,
Chee Fu Yung,
Mabel Sheau Fong Low,
Clarence C Tam*

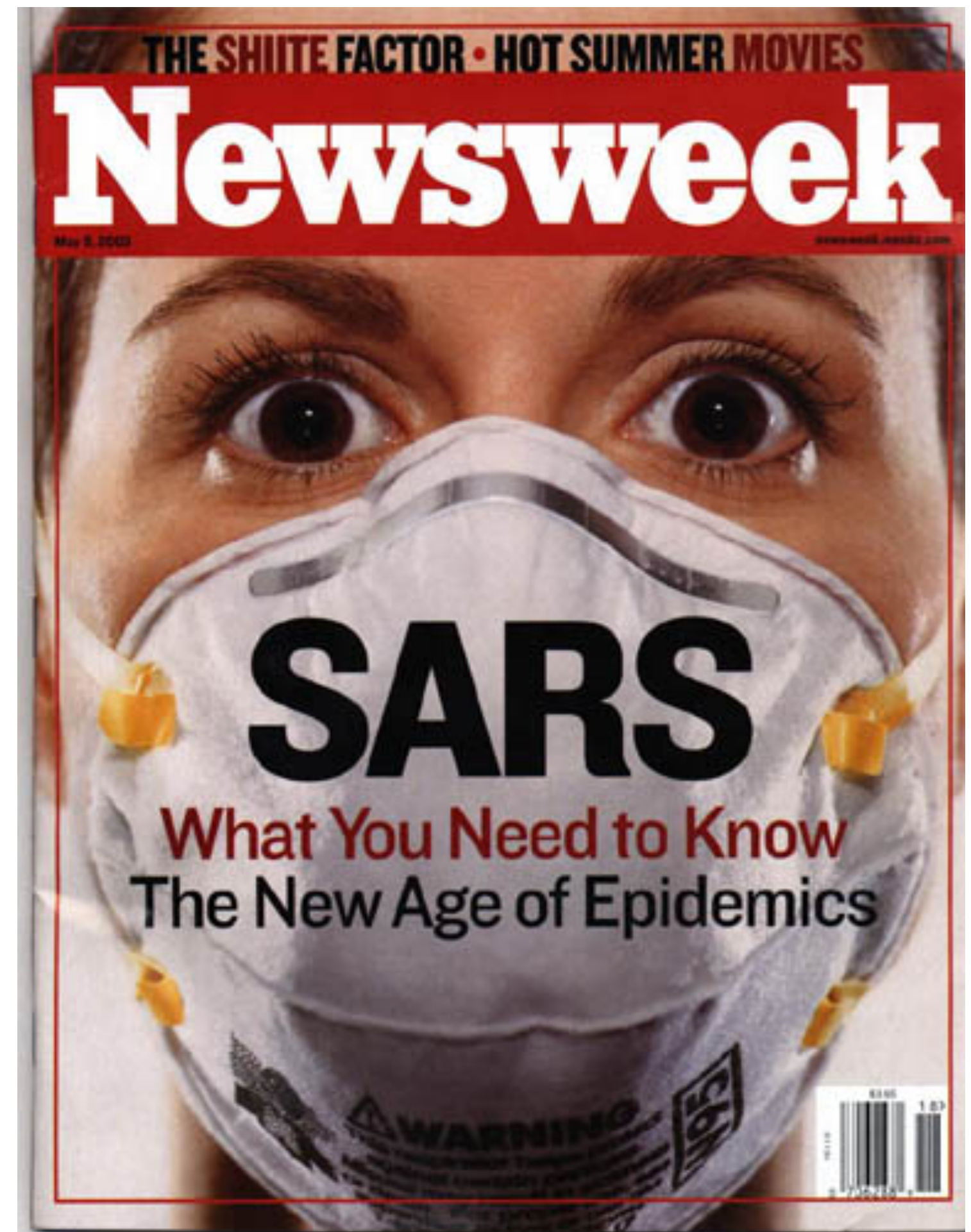


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Emergence of novel respiratory pathogens



Types of respiratory personal protective equipment (rPPE)



Medical masks



N95 respirators

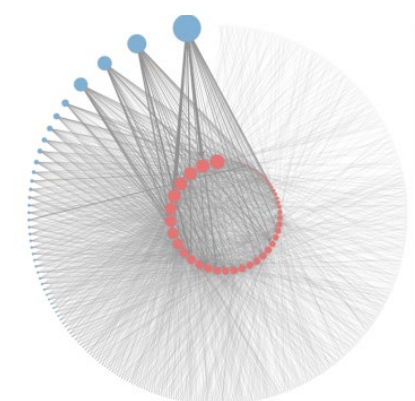


Images: CDC

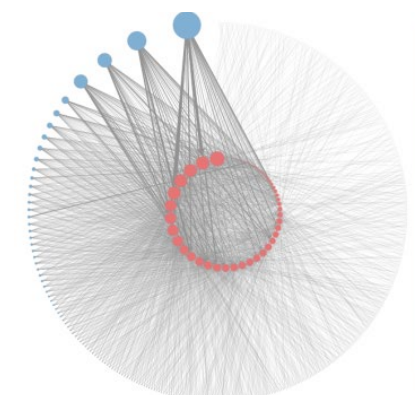
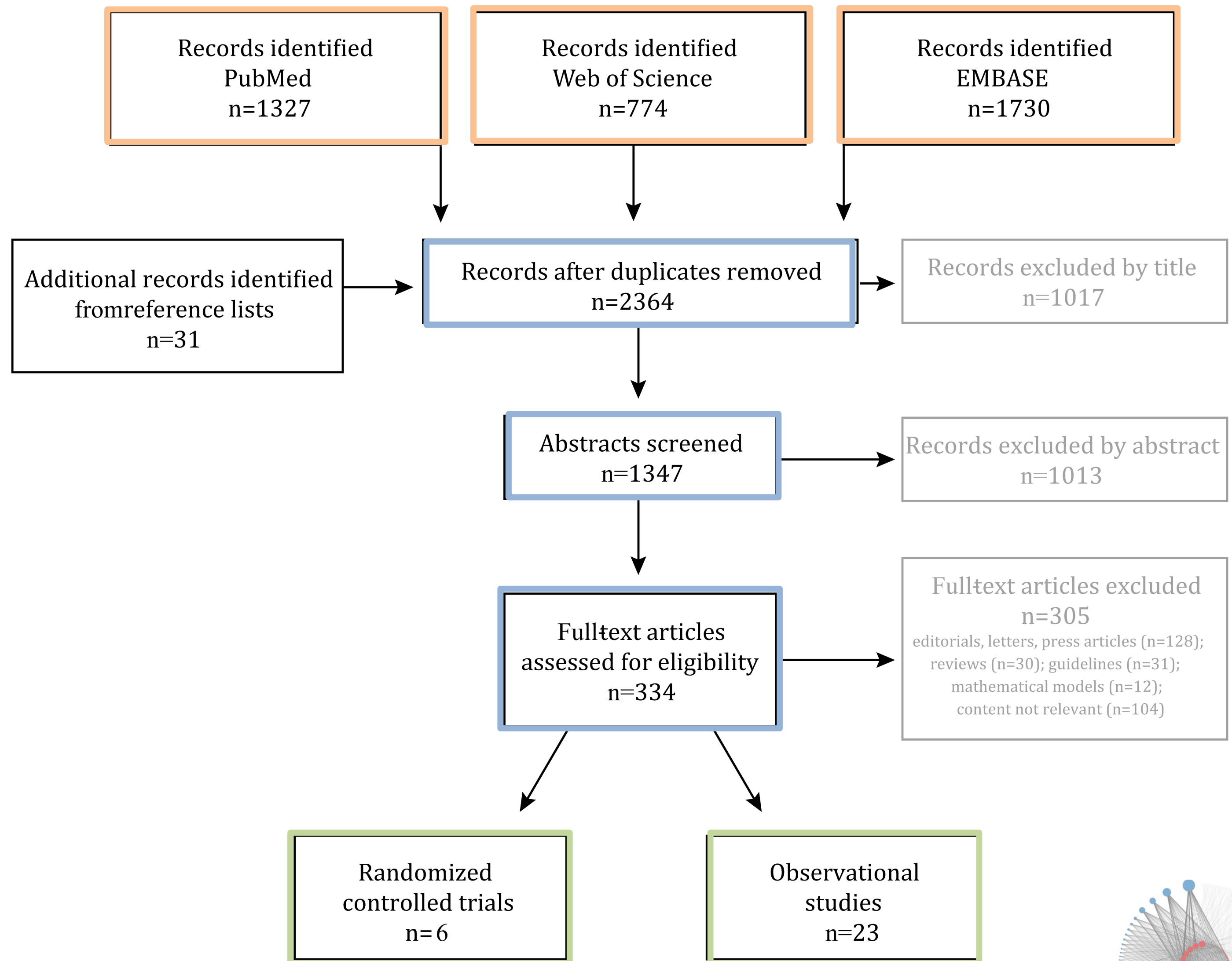
Objectives

*I) To **quantify the effectiveness** of different types of medical masks and respirators in reducing the risk of clinical or laboratory-confirmed respiratory outcomes among HCWs.*

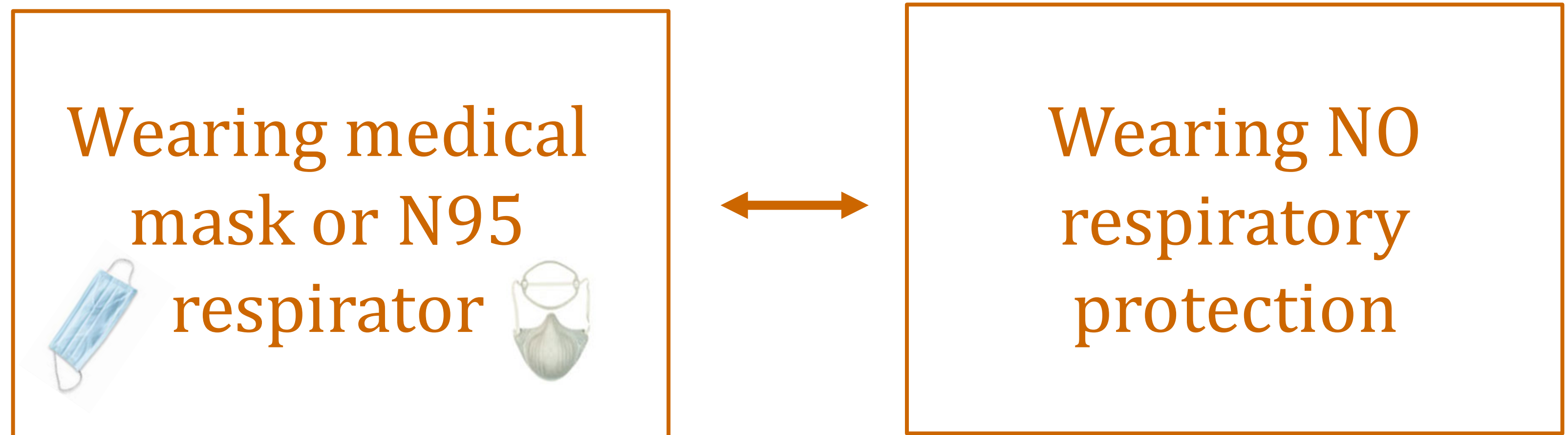
*II) To **compare the protective effect** of masks and N95 respirators against bacterial and viral infections separately*



Study selection



Meta-analysis (I)

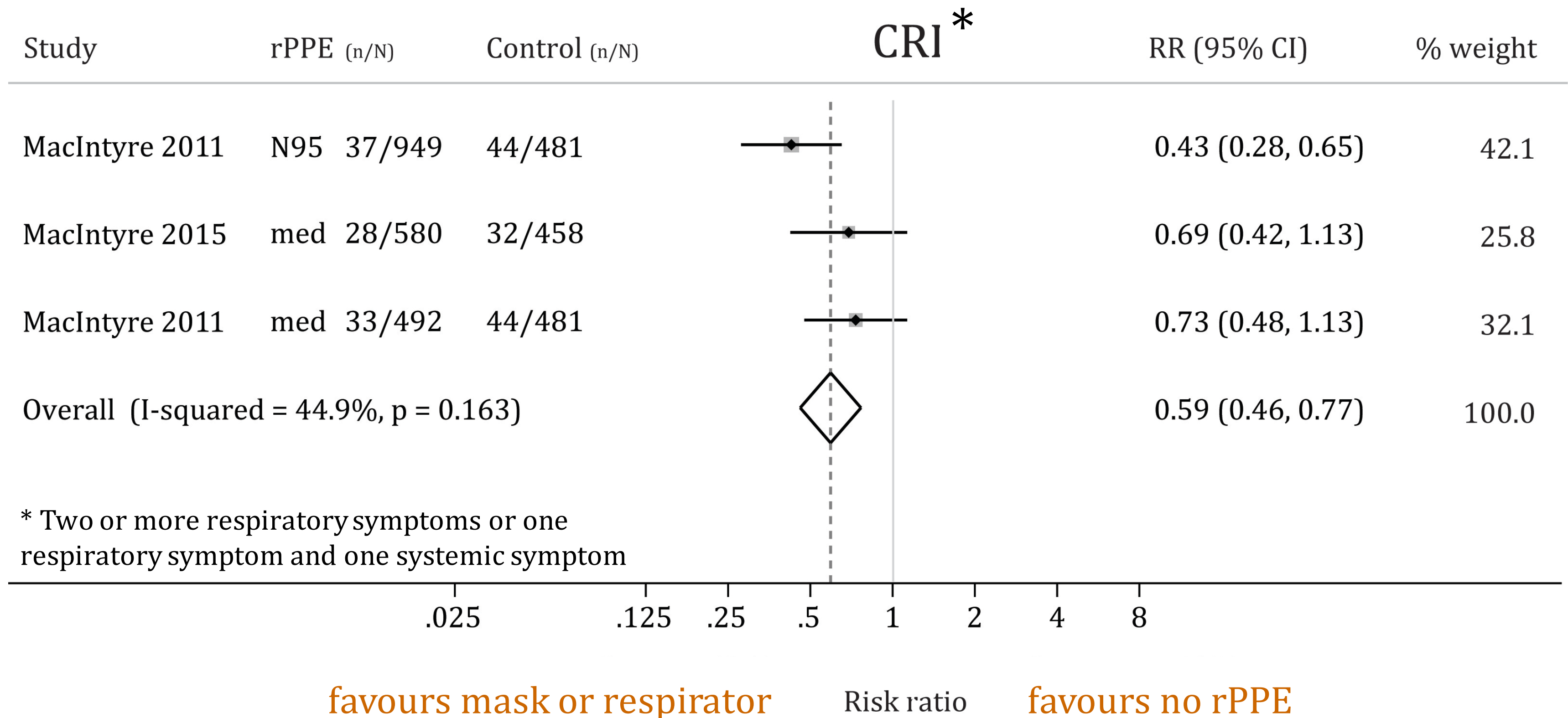


Clinical respiratory illness

Lab-confirmed viral respiratory infections

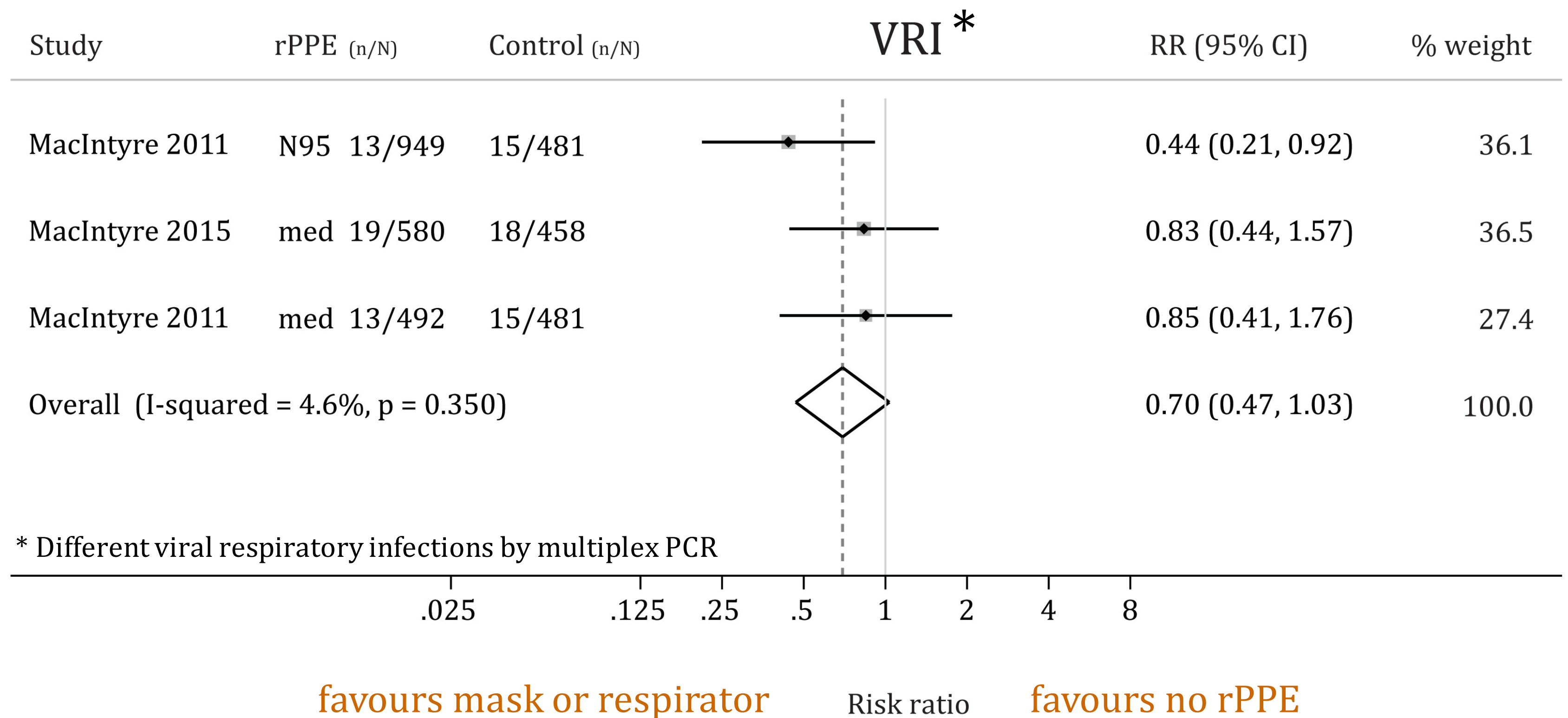
Mask or N95 respirator vs no rPPE

Clinical respiratory illness



Mask or N95 respirator vs no rPPE

Lab-confirmed viral respiratory infections



Meta-analysis (II)

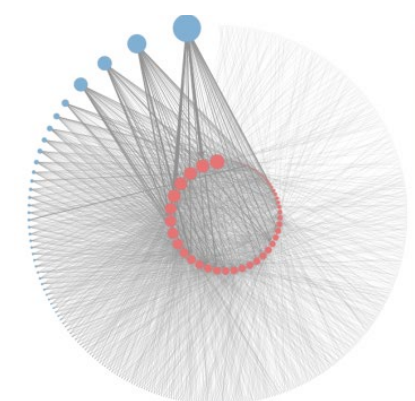
Wearing
N95 respirator



Wearing
medical mask

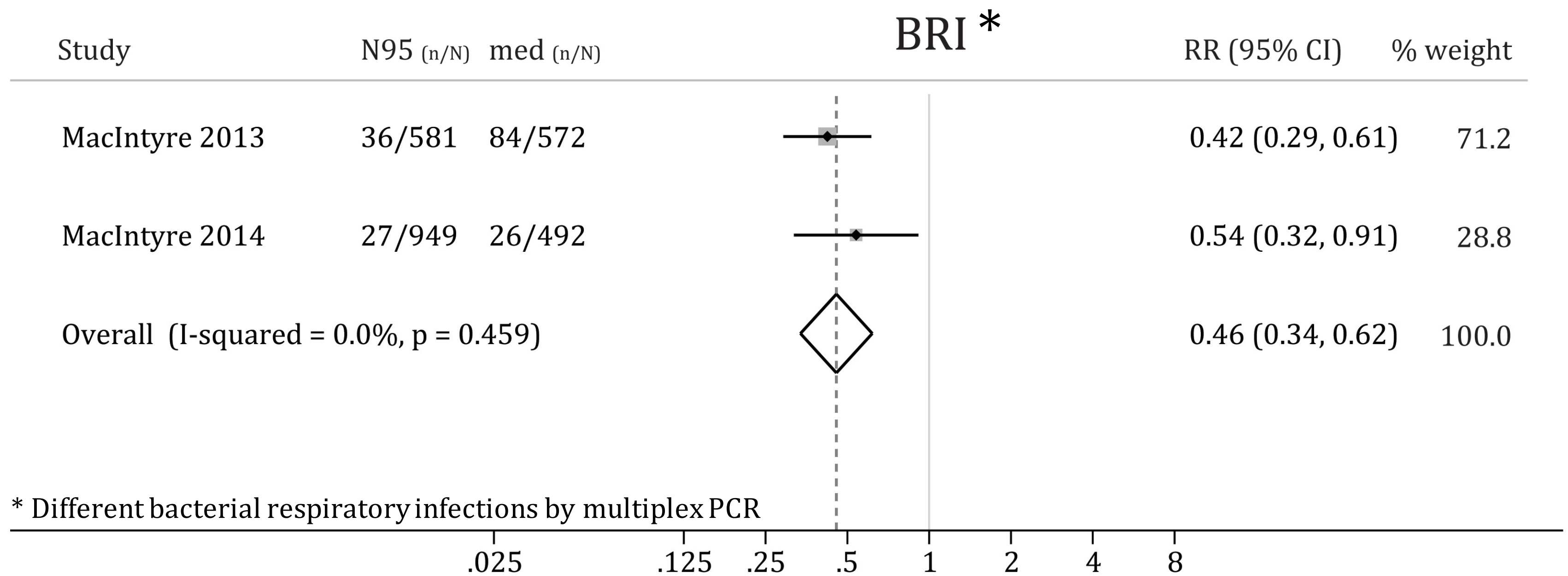


Lab-confirmed bacterial or viral respiratory infections



N95 respirator vs medical mask

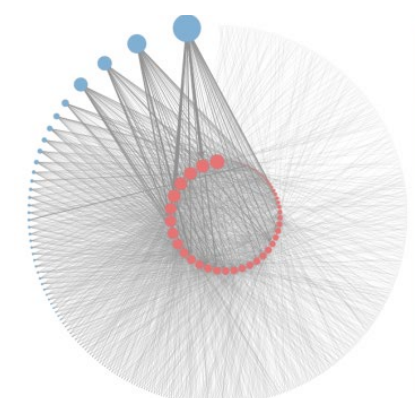
Lab-confirmed bacterial respiratory infections



favours N95 respirator

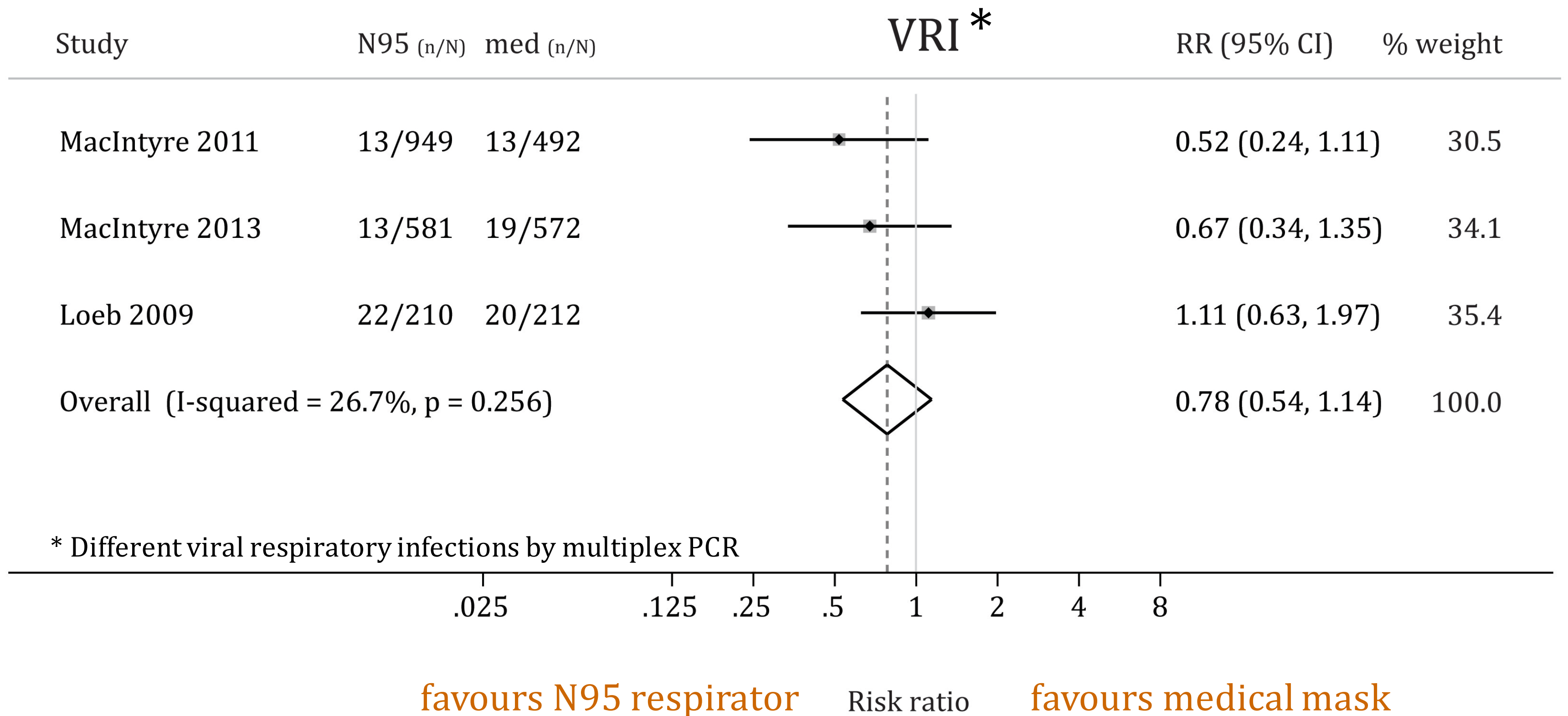
Risk ratio

favours medical mask



N95 respirator vs medical mask

Lab-confirmed viral respiratory infections



Limitations of RCTs

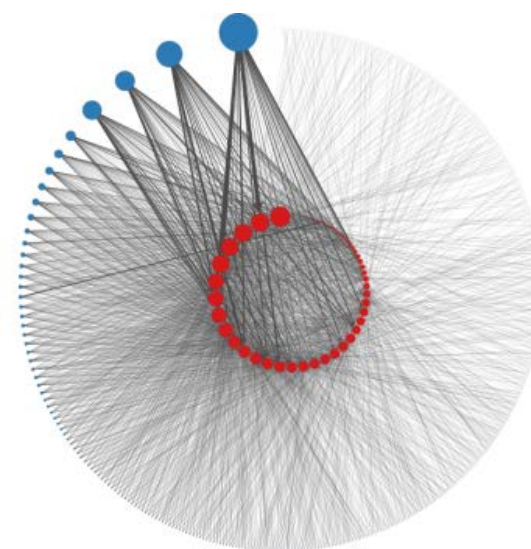
- Underpowered to estimate protection against low-incidence outcomes.
- Unmasked intervention and self-reported clinical outcomes.
- Convenience-selected controls.
- Source of infection not ascertained.
- Limited generalizability.

Outlook and recommendations

Multi-centre RCTs (Radonovich *et al.*, BMC Infect Dis. 2016)

- Specify rPPE brands and models
- Standardize definitions of compliance to rPPE use
- Audit compliance
- Ensure fit-testing and monitor fit-checking and discomfort (N95)

Questions?



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Previous research

No significant difference between **N95** and **medical masks** against

- laboratory-confirmed respiratory infection
- workplace absenteeism
- influenza-like illness

Smith *et al.*, CMAJ 2016 May 17;188(8):567-74

Literature search

Databases: PubMed, Web of Science, EMBASE

Inclusion

- Published RCTs/ observational studies in healthcare setting
- Any type of respiratory personal protective equipment (rPPE)
- Outcome: clinical or laboratory-confirmed respiratory outcomes

Exclusion

- Editorials, reviews, guidelines
- Simulated models
- Non-peer reviewed/ ongoing studies

Methods

Search terms

Intervention	Outcome	Population
mask*, facemask*, face mask, face masks, medical mask, medical masks, medical facemask, medical facemasks, medical face mask, medical face masks, surgical mask, surgical masks, surgical facemask, surgical facemasks, surgical face mask, surgical face masks, N95, N97, N99, FFP, FFP1, FFP2, FFP3, respirator, respirators, respiratory protection, respiratory protective device, respiratory protective devices, personal protective equipment, PPE, face protection, airborne precaution, airborne precautions, droplet precaution, droplet precautions, non-pharmaceutical intervention, non-pharmaceutical interventions	infection*, emerging infection, emerging infections, respiratory infection, respiratory infections, respiratory tract infection, respiratory tract infections, acute respiratory infection, acute respiratory infections, ARI, acute respiratory tract infection, acute respiratory tract infections, upper respiratory tract infection, upper respiratory tract infections, URTI, common cold, influenza, parainfluenza, flu, pandemic influenza, SARS, influenza-like illness, ILI, rhinovir*, adenovir*, coronavir*, RSV, respiratory syncytial virus, respiratory syncytial viruses, infection control, communicable disease control, infectious disease transmission, communicable disease transmission, cross infection, cross infections, cross-infection, cross-infections, HCAI, healthcare-associated infection, healthcare-associated infections, health care-associated infection, health care-associated infections, health-care-associated infection, health-care-associated infections	HCW*, healthcare worker, healthcare workers, health care worker, health care workers, health-care worker, health-care workers, healthcare professional, healthcare professionals, health care professional, health care professionals, health-care professional, health-care professional, health-care professional, health-care professional, nurse*, doctor*, practitioner*, practitioner*, staff, healthcare personnel, health care personnel, health-care personnel

Methods

Data extraction

- Author, publication year, journal, and location;
- Details of the study population and interventions;
- Study design and methods, including:
 - assessment of exposure and outcome
 - randomization procedures (RCTs)
 - details of comparison groups
 - follow-up procedures (where applicable)
 - statistical analysis
- Main results, conclusions, and limitations.

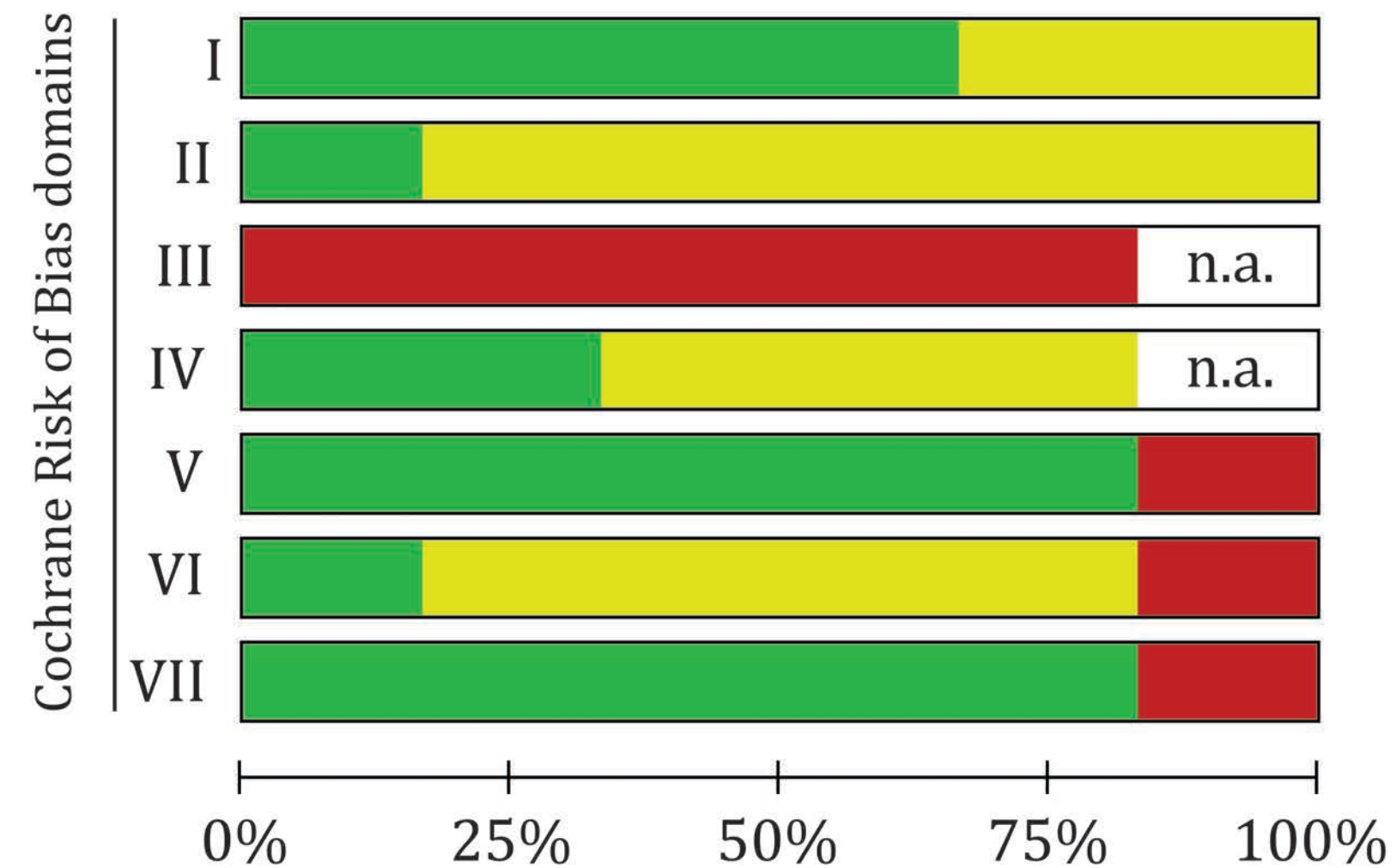
Methods

Quality assessment of RCTs: The Cochrane Risk of bias tool

A

	Cochrane Risk of Bias domains						
	I	II	III	IV	V	VI	VII
Jacobs 2009	?	?	—	n.a.	—	—	—
Loeb 2009	?	+	—	+	+	?	+
MacIntyre 2011	+	?	—	?	+	?	+
MacIntyre 2013	+	?	—	?	+	+	+
MacIntyre 2014	+	?	n.a.	?	+	?	+
MacIntyre 2015	+	?	—	+	+	?	+

B



Methods

Quality assessment of observational studies: Newcastle Ottawa scale SARS studies

	Newcastle Ottawa Scale score		
Case control studies	Selection	Comparability	Exposure
Chen 2009 ^{8}	██████		██
Lau 2004 ^{9}	██████	██	██
Liu 2009 ^{10}	██████	██	██
Ma 2004 ^{11}	██████	██	██
Yin 2004 ^{15}	██████	██	████
Seto 2003 ^{13}	██████	██	████
Nishiura 2005 ^{12}	██████	██	██
Teleman 2004 ^{14}	██████	██	██
Cohort studies	Selection	Comparability	Outcome
Loeb 2004 ^{16}	██████		██████
Nishiyama 2008 ^{17}	██████	██	████
Scales 2003 ^{18}	██████		██
Wilder-Smith 2005 ^{19}	██████		██████

Methods

Quality assessment of observational studies: the Newcastle Ottawa scale pH1N1 studies

	Newcastle Ottawa Scale score		
Case control studies	Selection	Comparability	Exposure
Zhang 2012 ^{20}	██████	███	███
Deng 2010 ^{21}	███	███	███
Cohort studies	Selection	Comparability	Outcome
Cheng 2010 ^{22}	unclear	unclear	unclear
Jaeger 2011 ^{23}	██████		███
Cross-sectional studies	Selection	Comparability	Outcome
Chokephaibulkit 2013 ^{24}	███	██	██████
Toyokawa 201 ^{25}	███		██████
Other studies			
Ang 2010 ^{26}	n.a	n.a	n.a
Wise 2011 ^{27}	n.a	n.a	n.a

Methods

Quality assessment of observational studies: the Newcastle Ottawa scale

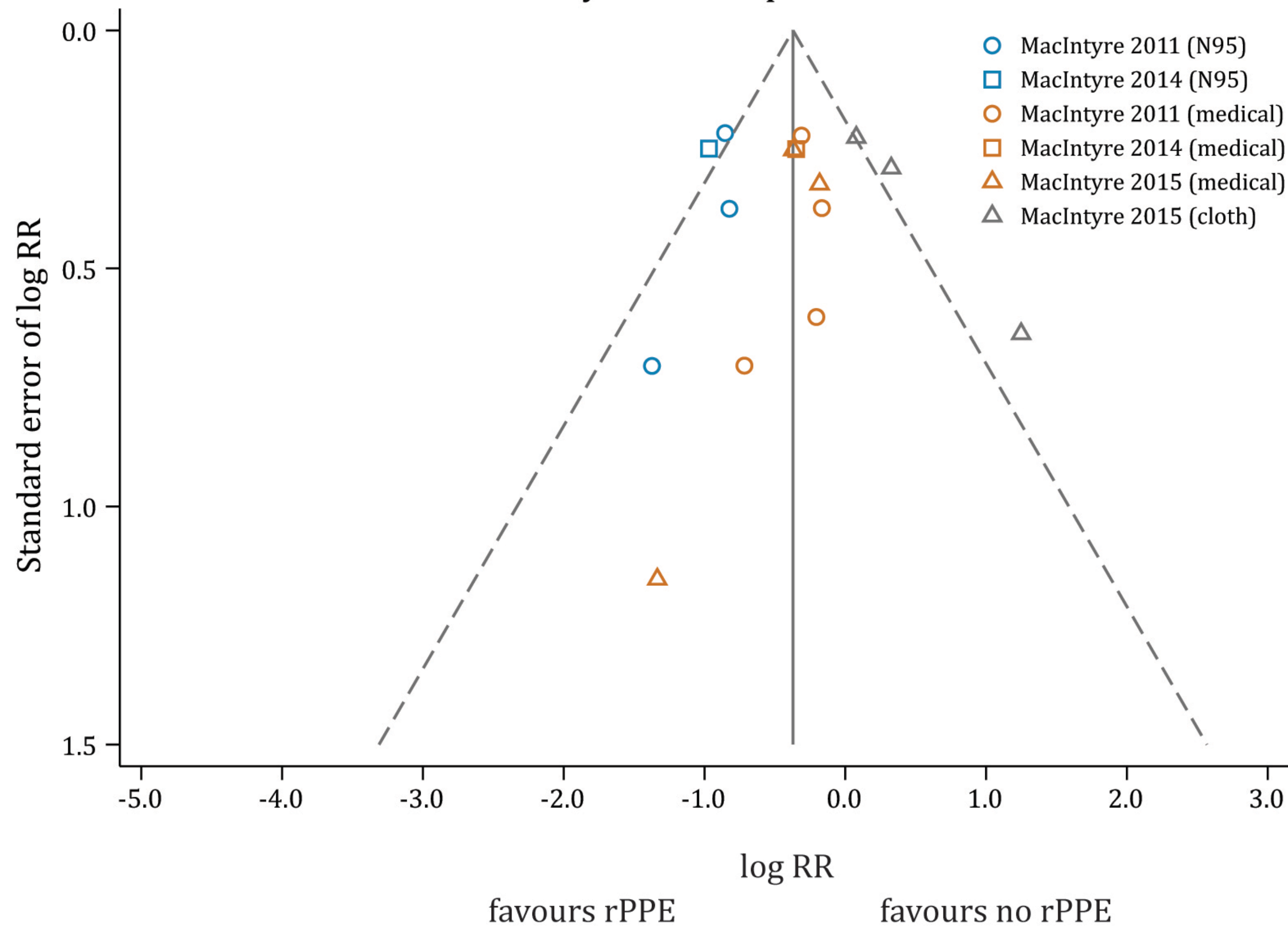
Other outcomes

	Newcastle Ottawa Scale score		
Case control studies	Selection	Comparability	Exposure
Al-Asmary 2007 ^{28}	★★★★		★
Cross-sectional studies	Selection	Comparability	Outcome
Ng 2009 ^{29}	★★★★	★	★
Yang 2011 ^{30}	★★★★	★	★

Publication bias: RCTs (I)

A

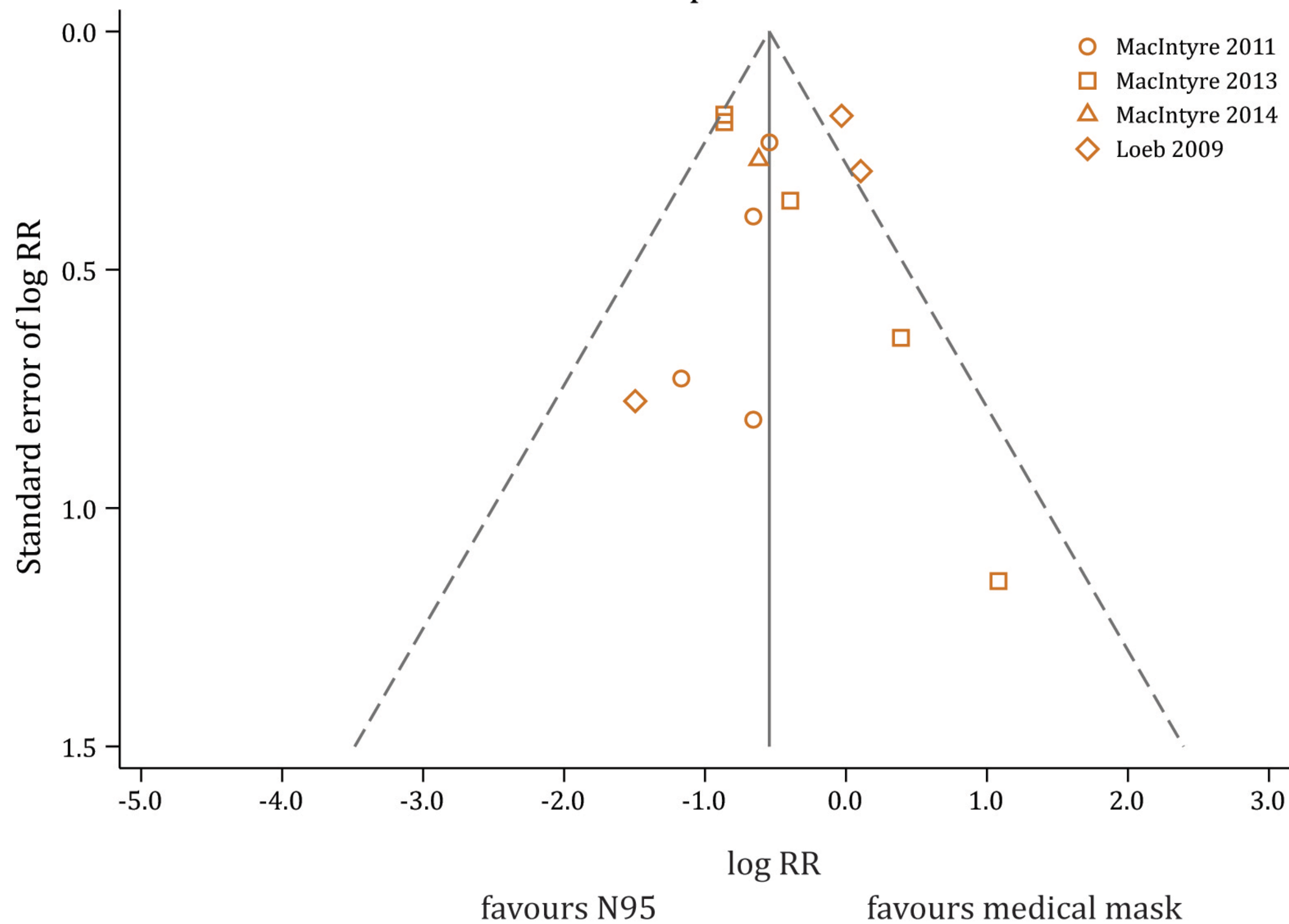
RCTs: effect of any rPPE compared to no rPPE



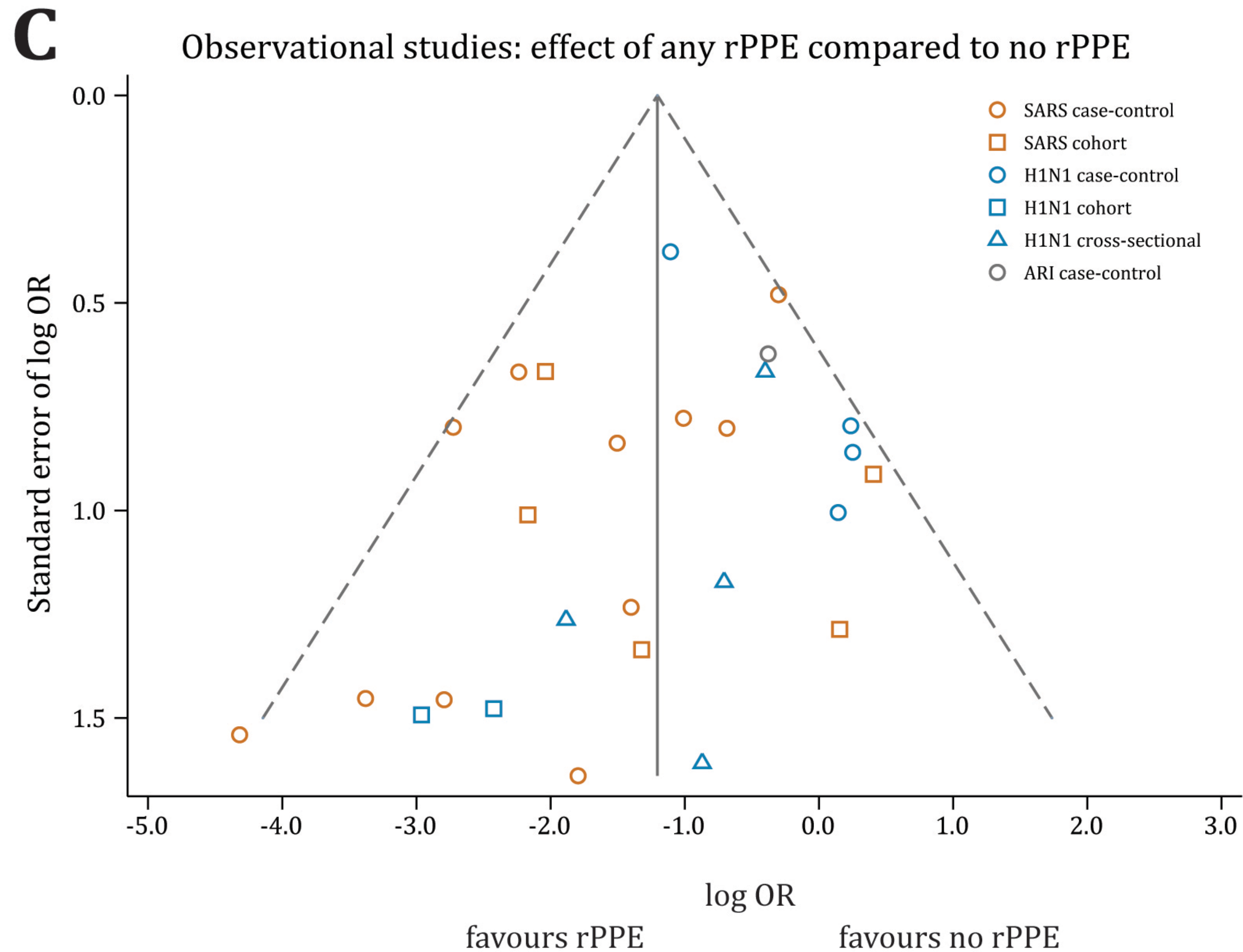
Publication bias: RCTs (II)

B

RCTs: effect of N95 compared to medical mask

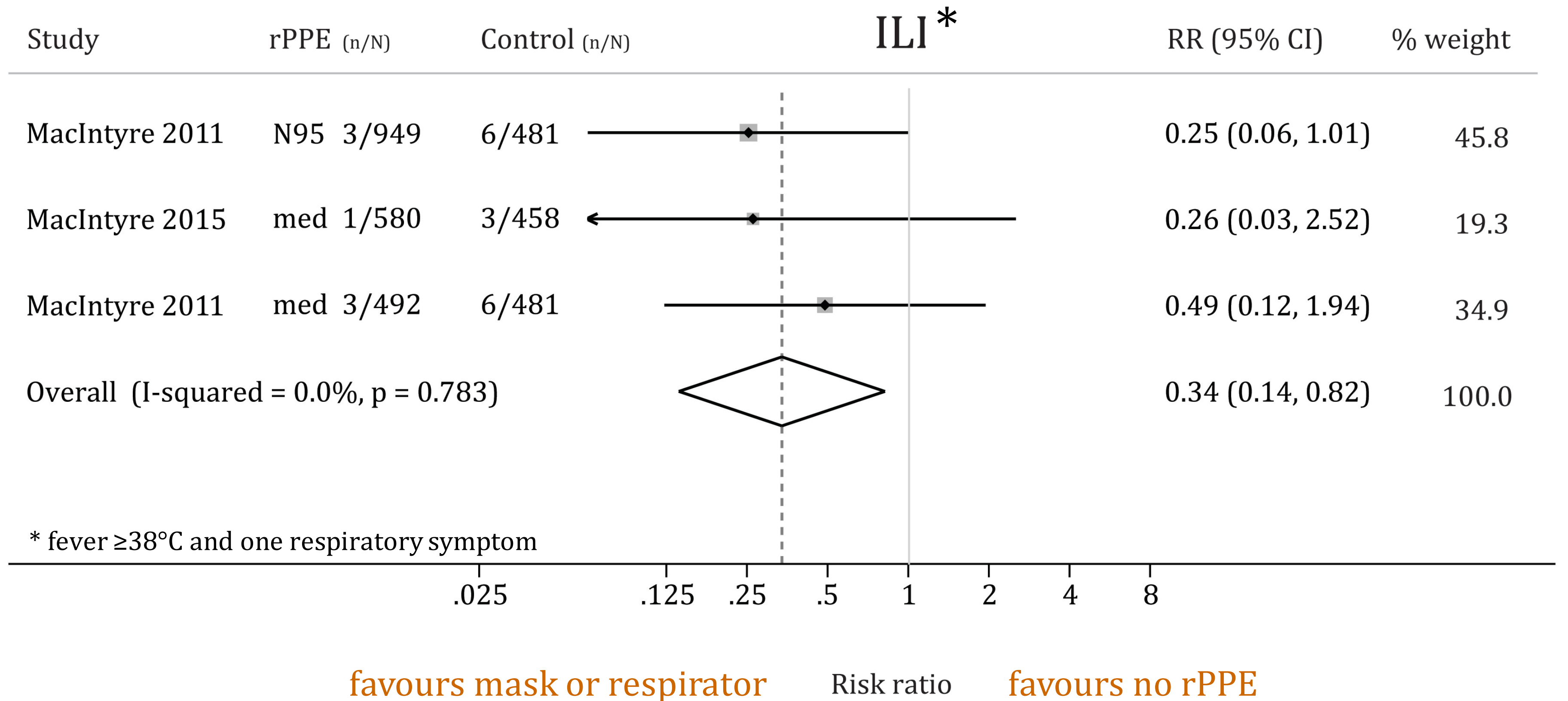


Publication bias: observational studies



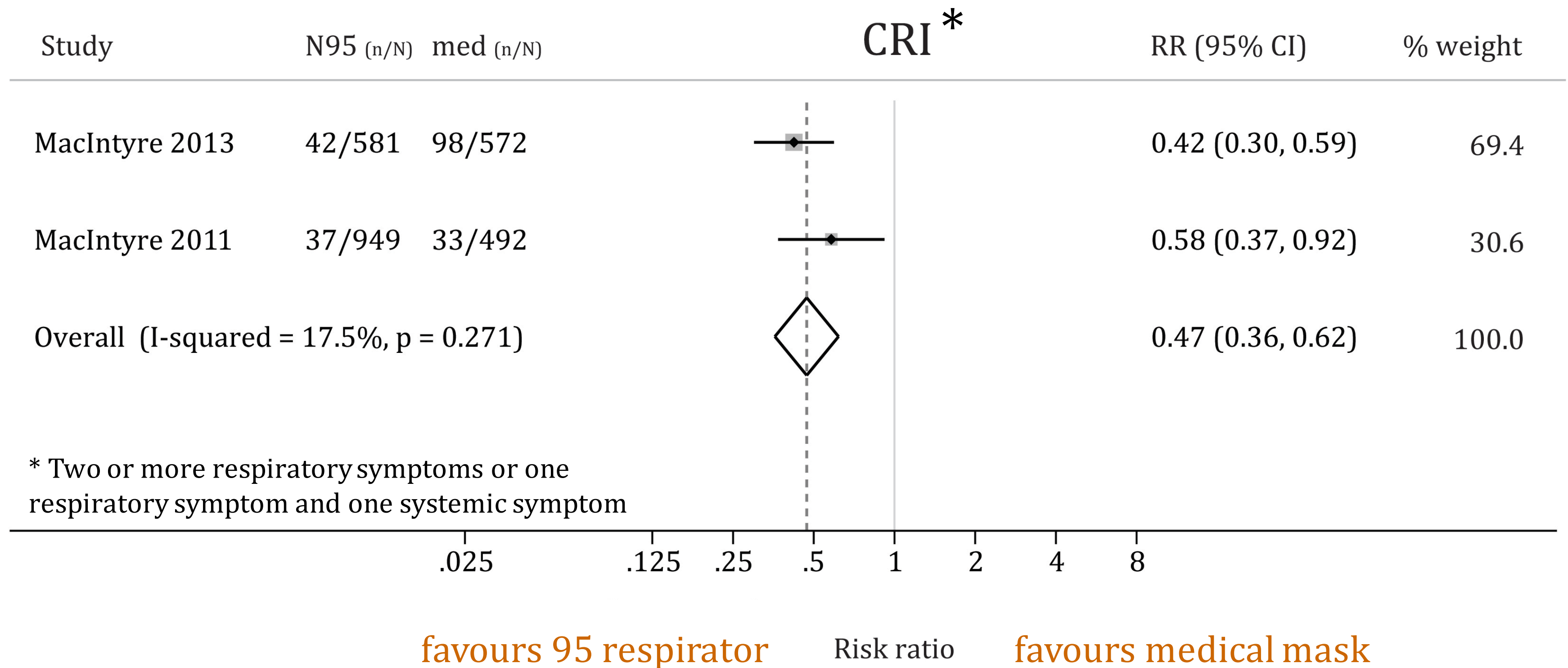
Mask or N95 respirator vs no rPPE

Influenza-like illness



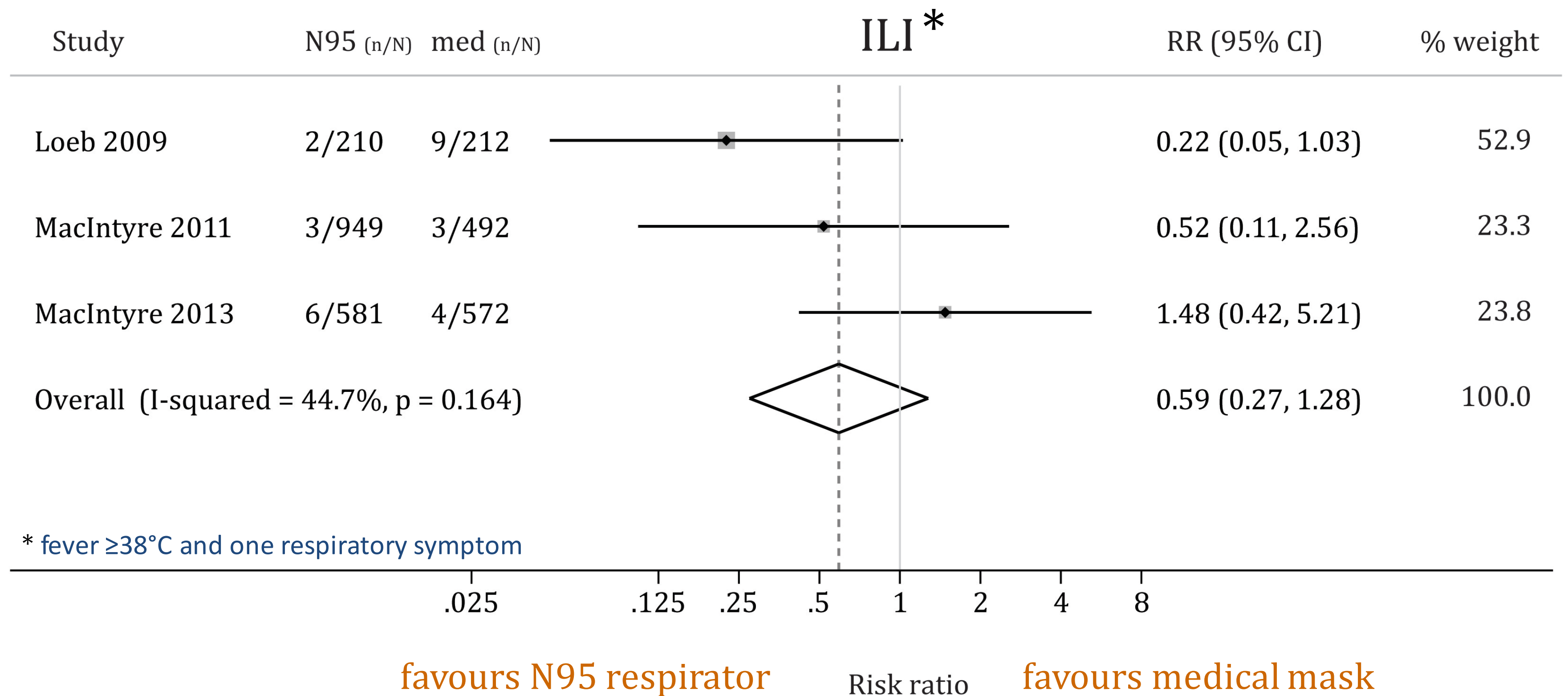
RCTs: N95 respirator vs medical mask

Clinical respiratory illness



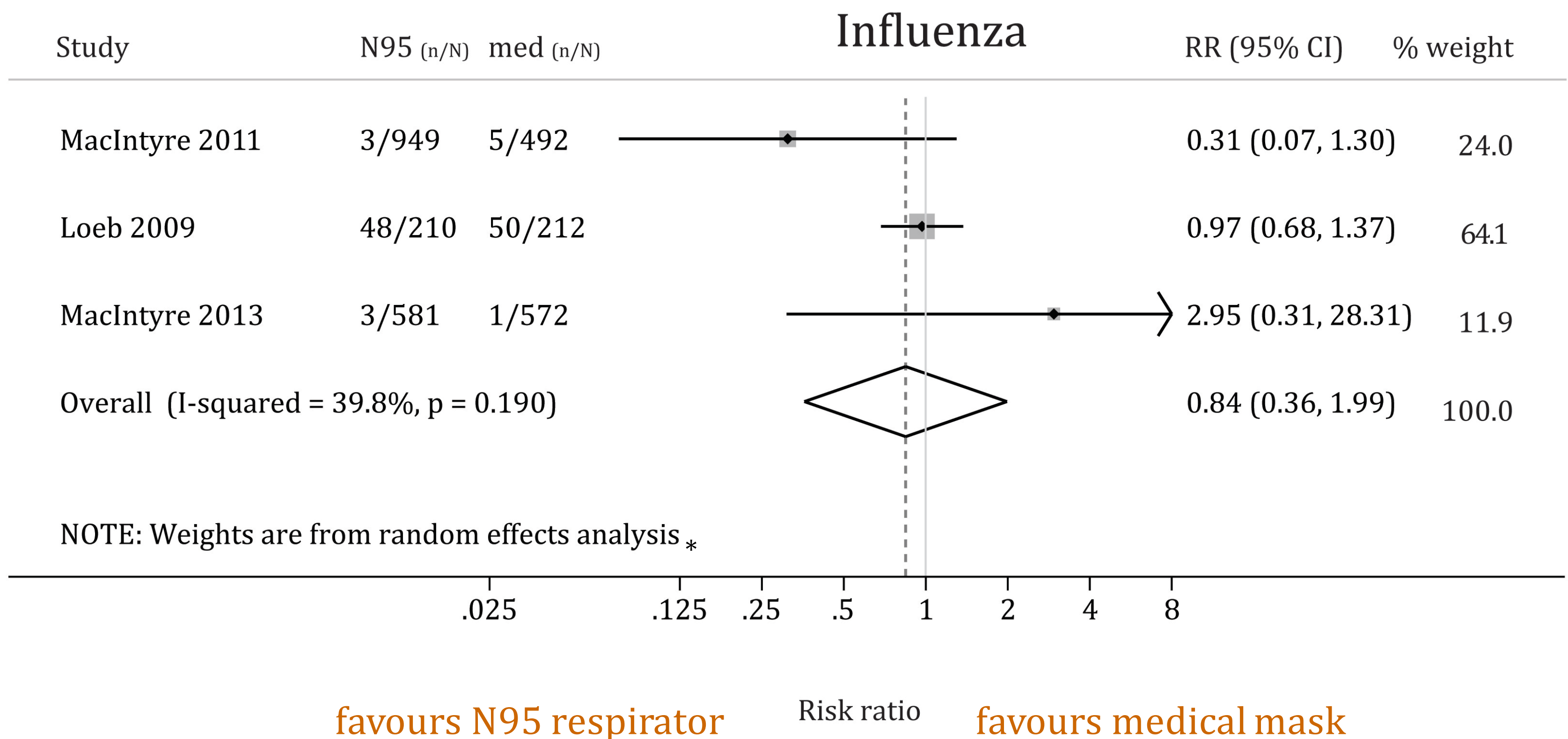
RCTs: N95 respirator vs medical mask

Influenza-like illness



RCTs: N95 respirator vs medical mask

Laboratory-confirmed influenza



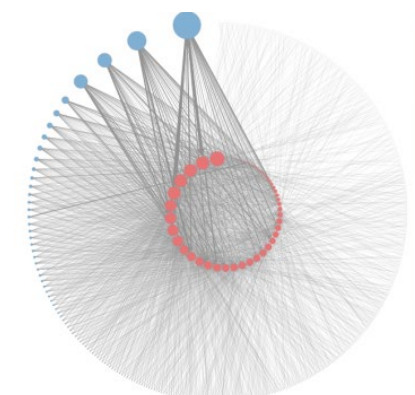
* For $I^2 > 60\%$ and p-value for heterogeneity < 0.05

Meta-analysis of observational studies

Wearing medical
mask or N95
respirator

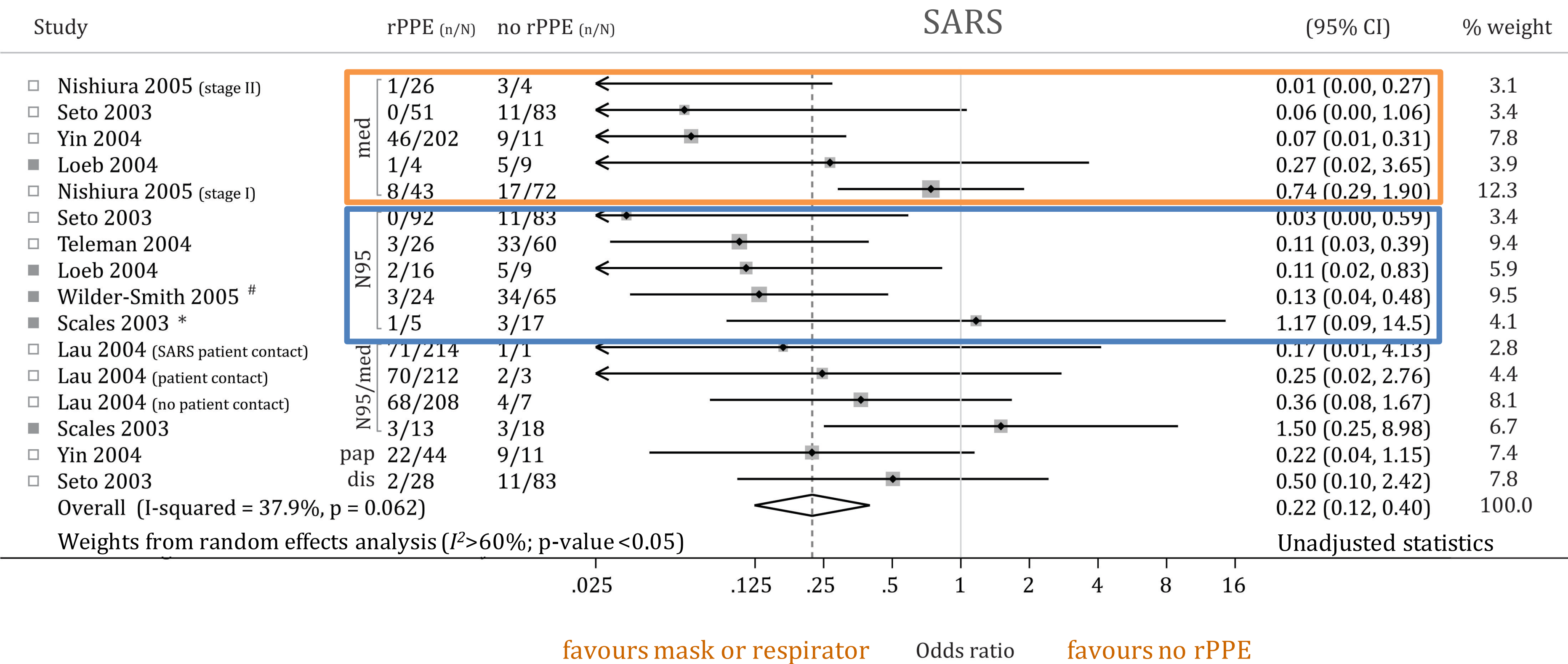


Wearing NO
respiratory
protection



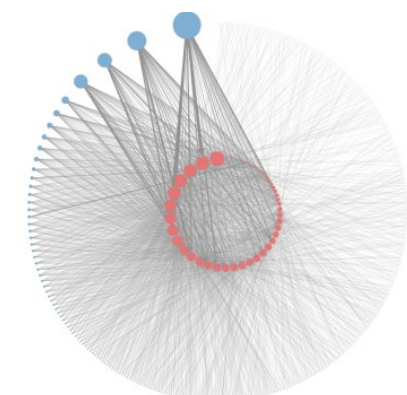
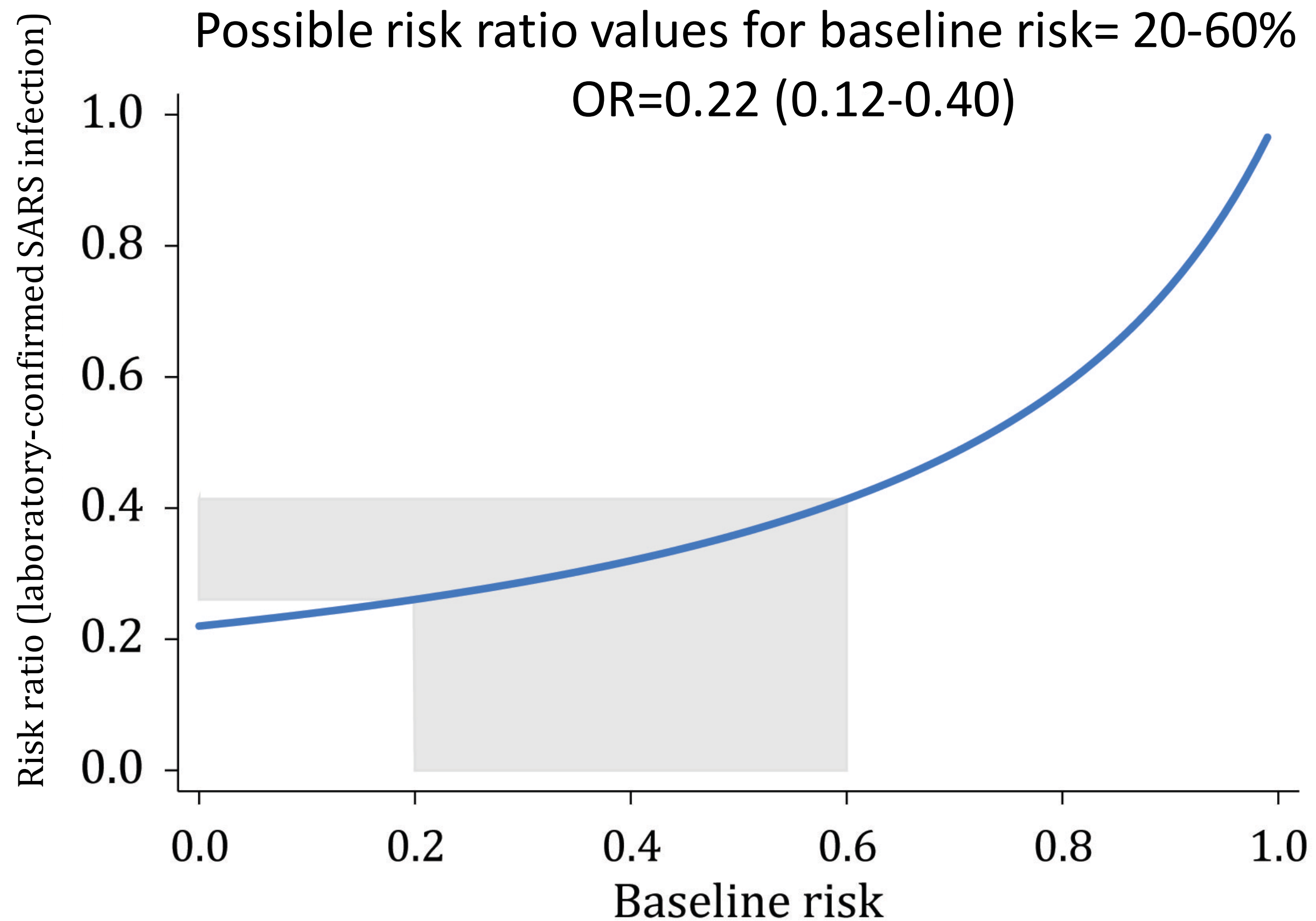
Observational: Mask or N95 respirator vs no rPPE

Lab-confirmed SARS-infection



Observational: Mask or N95 respirator vs no rPPE

Lab-confirmed SARS



Conclusion from observational studies

- N95 respirators and medical masks can reduce the risk of SARS by 60-75%.
- No significant difference between the two, but evidence of protection through medical masks inconsistent within and across studies.

Limitations of the meta-analysis

- Unaccounted differences in exposure and compliance rates of rPPE use.
- Potential decreases in infectiousness over the course of the outbreak.
- Unadjusted estimates
 - Account for other potential confounders, *e.g.* concurrent interventions, seasonal influenza vaccination, hand-washing habits, contact with respiratory secretions
 - Indicate the baseline risk of disease.

