

# **STROBE**

**Strengthening the Reporting of  
Observational Studies in Epidemiology**

[www.strobe-statement.org](http://www.strobe-statement.org)

# Outline of talk

- Why do we need reporting guidelines?
- Lessons from CONSORT
- The STROBE initiative
- An invitation

# Importance of clear reporting

- Enables editors, readers, (journalists?) to evaluate what was done and assess the reliability and relevance of the findings
- Particularly important for observational studies
  - Vulnerable to bias and confounding
  - Reporting is often incomplete
  - Findings are often over-interpreted
  - Findings often generate health scares

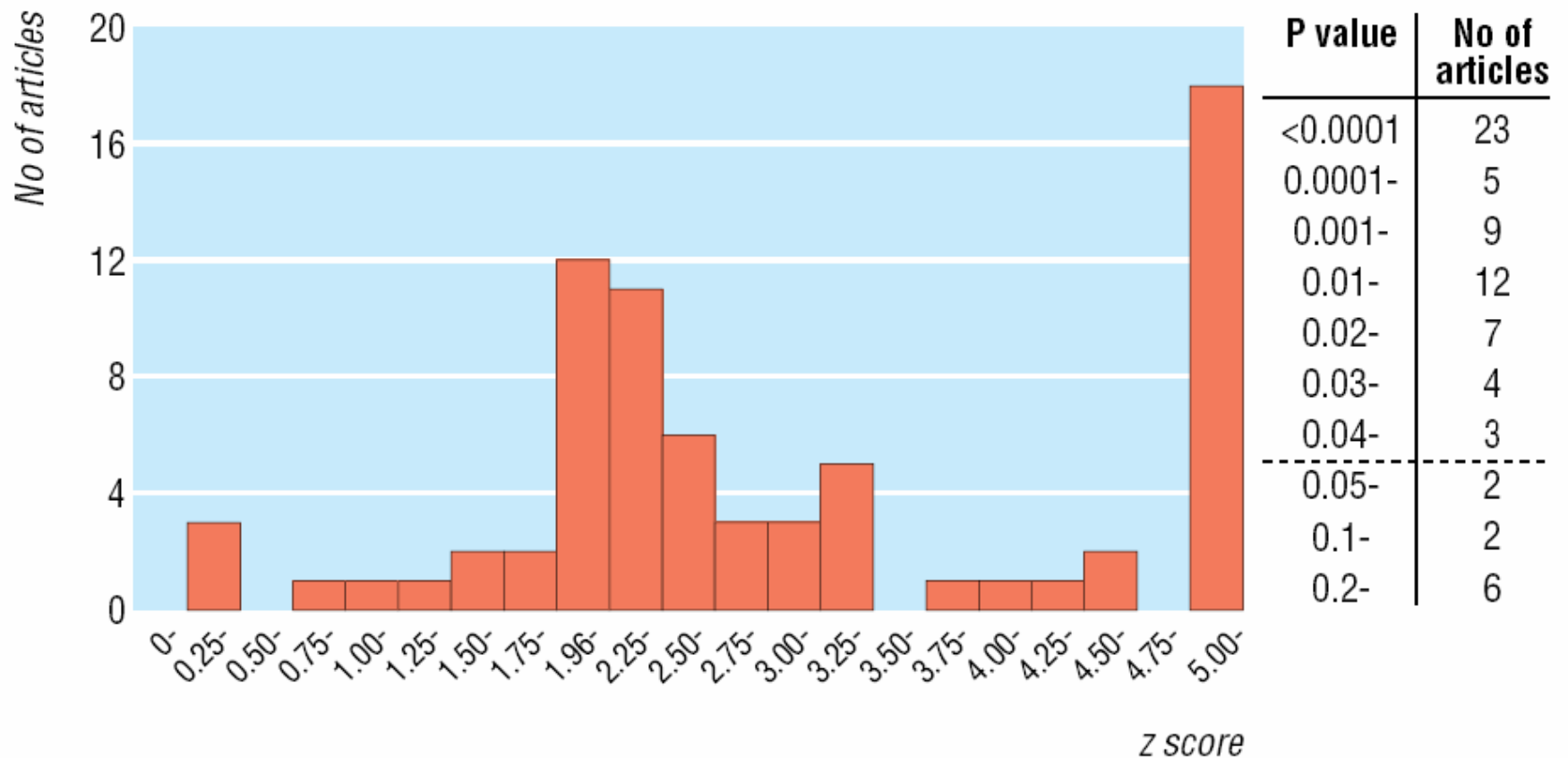
# Papers

## Issues in the reporting of epidemiological studies: a survey of recent practice

Stuart J Pocock, Timothy J Collier, Kimberly J Dandreo, Bianca L de Stavola, Marlene B Goldman, Leslie A Kalish, Linda E Kasten, Valerie A McCormack

*BMJ*, 2004

- 73 articles on cohort and case-control studies published in January 2001 in leading journals
- Many exposures, outcomes and subgroups, with selective reporting of “interesting” associations
- Choice of confounding variables often unclear



Distribution of P values for first primary result in each article and corresponding absolute values of standardised normal deviates z (two sided  $P=0.05$ ,  $0.01$ ,  $0.001$ , and  $0.0001$  correspond to  $z=1.96$ ,  $2.58$ ,  $3.29$ , and  $3.89$ , respectively)

# Sifting the evidence—what’s wrong with significance tests?

Jonathan A C Sterne, George Davey Smith

The findings of medical research are often met with considerable scepticism, even when they have apparently come from studies with sound methodologies that have been subjected to appropriate statistical analysis. This is perhaps particularly the case with respect to epidemiological findings that suggest that some aspect of everyday life is bad for people. Indeed, one recent popular history, the medical journalist James Le Fanu’s *The Rise and Fall of Modern Medicine*, went so far as to suggest that the solution to medicine’s ills would be the closure of all departments of epidemiology.<sup>1</sup>

One contributory factor is that the medical literature shows a strong tendency to accentuate the positive; positive outcomes are more likely to be reported than null results.<sup>2-4</sup> By this means alone a host of purely chance findings will be published, as by conventional reasoning examining 20 associations will produce one result that is “significant at  $P = 0.05$ ” by chance alone. If only positive findings are published then they may be mistakenly considered to be of

## Summary points

P values, or significance levels, measure the strength of the evidence against the null hypothesis; the smaller the P value, the stronger the evidence against the null hypothesis

An arbitrary division of results, into “significant” or “non-significant” according to the P value, was not the intention of the founders of statistical inference

A P value of 0.05 need not provide strong evidence against the null hypothesis, but it is reasonable to say that  $P < 0.001$  does. In the results sections of papers the precise P value should be presented, without reference to arbitrary thresholds

# What is newsworthy?

- Of 1193 original papers published in the *Lancet* and *BMJ* in two years 81 were reported in the *The Sun* or *The Times*
- Observational studies more likely to be reported than clinical trials (OR 6.6)
- Bad news more likely to be reported than good news (OR 1.7)
- Preferred topics: women's health, reproduction and cancer (OR 2.4 – 3.7)

# Recent history of reporting guidelines

1995-96	CONSORT	RCTs
1997-99	QUOROM	Meta-analyses
1997-00	MOOSE	Meta-analyses
1999-01	CONSORT II	RCTs
2000-03	STARD	Diagnostic studies
2003-04	TREND	Behavioural interventions
2004-07?	STROBE	Observational studies
2005-07?	PRISMA	Meta-analyses

(*Preferred Reporting Items for Systematic reviews and Meta-Analyses*)

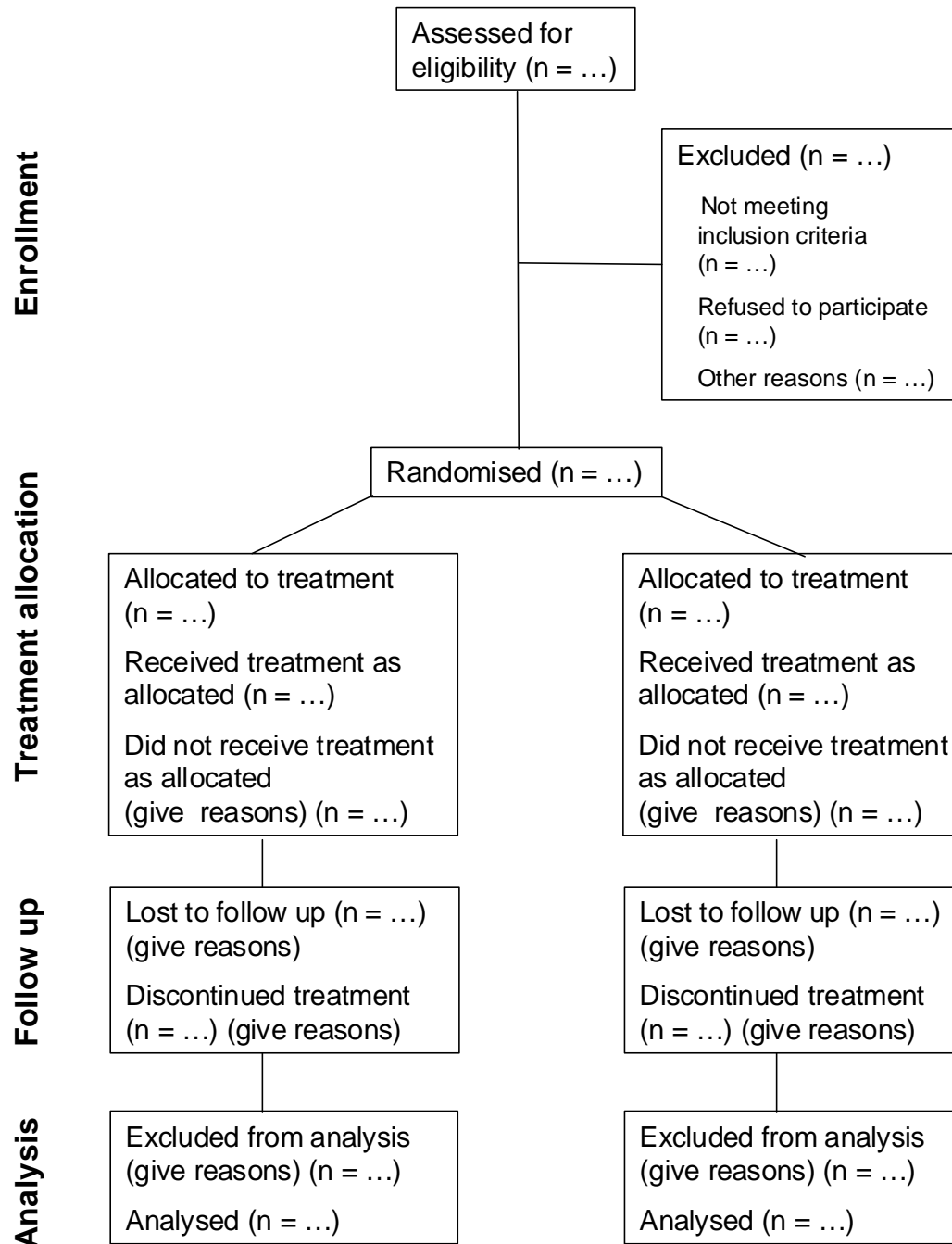
# CONSORT

## Consolidated Standards of Reporting Trials



[www.consort-statement.org](http://www.consort-statement.org)

# CONSORT flow chart



Academic Emergency Medicine	Current Controlled Trials in Cardiovascular Medicine	Journal of the American College of Surgeons
Acta Neurologica Scandinavia	Diabetes Care	Journal of the American Geriatrics Society
Advances in Neonatal Care	Diseases of the Colon & Rectum	Journal of the American Medical Association
African Journal of Medicine	Dynamic Medicine	Journal of the American Podiatric Medical Association
AIDS	East African Medical Journal	Journal of the American Society of Nephrology
Alcohol and Alcoholism	Health International	Journal of the Canadian Chiropractic Association
Alternative Therapies in Health and Medicine	Equine Veterinary Journal	Journal of the Canadian Dental Association
American Journal of Occupational Therapy	European Journal of Anaesthesiology	Journal of the National Cancer Institute
Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders	European Journal of Cancer	Journal of the Society of Laparoendoscopic Surgeons
Anesthesiology	European Journal of Oral Sciences	Kinetoplastid Biology and Disease
Annals of Behavioral Medicine	European Journal of Vascular and Endovascular Surgery	Kuwait Medical Journal
Annals of Clinical Microbiology and Antimicrobials	Environmental Health: A Global Access Science Source	Lancet (The)
Annals of Emergency Medicine	Eye	Lancet Oncology (The)
Annals of Family Medicine	Foot (The)	Malawi Medical Journal
Annals of General Hospital Psychiatry	Gastroenterology	Mayo Clinic Proceedings
Annals of Internal Medicine	Gujarat Medical Journal	Medical Acupuncture
Annals of Neurology	Gut	Medical Immunology
Annals of Oncology	Health Psychology	Medical Journal of Australia
Annals of Rheumatic Diseases	Heart	Molecular Pathology
Archives of Dermatology	Hepatobiliary & Pancreatic Diseases International	Movement Disorders
Archives of Disease in Childhood	Huisarts & Wetenschap	National Medical Journal of India
Archives of Family Medicine	Human Reproduction	Nederlands Tijdschrift voor Geneeskunde
Archives of General Psychiatry	Indian Journal of Dermatology	Neurology
Archives of Internal Medicine	Indian Journal of Pharmacology	Neurology India
Archives of Neurology	Indian Pediatrics	Neuropsychology
Archives of Ophthalmology	Intensive Care Medicine	New England Journal of Medicine
Archives of Otolaryngology	International Endodontic Journal	New Zealand Journal of Medical Laboratory Science
Archives of Pathology and Laboratory Medicine	International Journal of Clinical Oncology	Nutrition Journal
Archives of Pediatrics & Adolescent Medicine	International Journal of Endodontics	Obstetrics and Gynecology
Archives of Surgery	International Journal of Surgery	Onkologie
Armenian Medical Review Journal	International Journal of Phytotherapy and Phytopharmacology	Ophthalmic and Physiological Optics
Arthritis Research & Therapy	International Urogynecology Journal and Pelvic Floor Dysfunction	Ophthalmology
Atencion Primaria	Japanese Journal of Clinical Oncology	Palliative Medicine
Australian and New Zealand Journal of Surgery	Journal of Alternative & Complementary Medicine	Pediatric Pulmonology
Bandolier	Journal of Bone & Joint Surgery	Pediatrics
BioMagnetic Research and Technology	Journal of Clinical Pathology	Physical Therapy Review
Brazilian Journal of Cardiovascular Surgery	Journal of Endodontics	Phytomedicine
British Dental Journal	Journal of Experimental & Clinical Cancer Research	PLoS Medicine
British Journal of Dermatology	Journal of Family Planning & Reproductive Health Care	Psychosomatic Medicine
British Journal of Obstetrics & Gynaecology	Journal of General Internal Medicine	Radiotherapy & Oncology
British Journal of Ophthalmology	Journal of Geriatric Care	Reproductive Biology and Endocrinology
British Journal of Surgery	Journal of Health Services Research and Policy	Resuscitation
BMJ	Journal of Hepatology	Revista Brasileira de Cirurgia Cardiovascular
Canadian Journal of Anesthesia	Journal of Immune Based Therapies and Vaccines	Revista Espanola de Alergol Immunol Clinica
Canadian Journal of Emergency Medicine	Journal of Manipulative & Physiological Therapeutics	Revista Espanola de Salud Publica
Canadian Journal of Infectious Diseases	Journal of Medical Internet Research	Revista Sanidad Militar de Mexico
Canadian Journal of Neurological Sciences	Journal of Neurological Science (Turkey)	Rheumatology
Canadian Journal of Occupational Therapy	Journal of Neurology, Neurosurgery & Psychiatry	Rinsho Hyoka (Clinical Evaluation)
Canadian Journal of Respiratory Therapy	Journal of Nuclear Medicine	Sau Paulo Medical Journal
Canadian Medical Association Journal	Journal of Nutrition	Scandinavian Journal of Gastroenterology
Cancer	Journal of Orthodontics	Der Schmerz
Cardiovascular Diabetology	Journal of Pediatric Orthopaedics	Sexually Transmitted Infections
Cardiovascular Ultrasound	Journal of Pediatrics	Spine
Chinese Medical Journal	Journal of Postgraduate Medicine	Thrombosis Journal
Climacteric	Journal of Psychiatry	Ugeskrift for Laeger
Clinical and Molecular Allergy	Journal of Reproductive Medicine	Veterinary Journal (The)
Clinical Chemistry	Journal of Spinal Cord Injury	World Journal of Surgical Oncology
Clinical Oral Investigations	Journal of Stroke	Zeitschrift für ärztliche Fortbildung und Qualitätssicherung
Comparative Hepatology	Journal of Trauma	
Cost Effectiveness and Resource Allocation	Journal of Vascular Medicine and Biology	

The NEW ENGLAND  
JOURNAL of MEDICINE

„In manuscripts that report on randomized clinical trials, authors should provide a flow diagram in CONSORT format and all of the information required by the CONSORT checklist. When restrictions on length prevent the inclusion of some of this information in the manuscript, it should be provided in a separate document submitted with the manuscript. The CONSORT statement, checklist, and flow diagram are available at <http://www.consort-statement.org>.“

Instructions for authors, January 2005

# Wide support for CONSORT

- 175 journals
- Editorial groups:
  - Council of Science Editors
  - World Association of Medical Editors
  - International Committee of Medical Journal Editors
- Funding bodies
  - Canadian Institutes of Health Research

# Randomisation consists of two parts

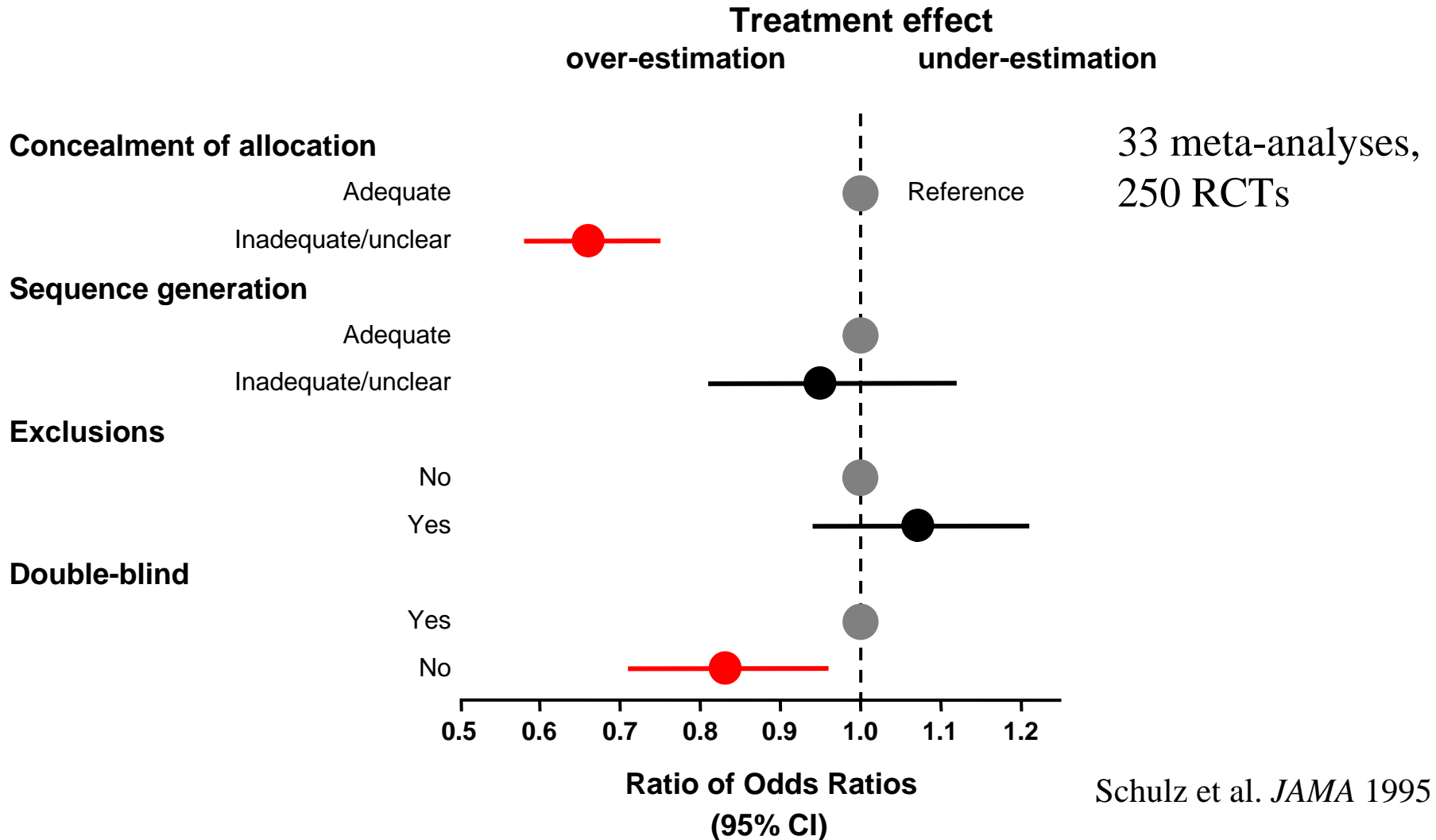
## 1. Generation of unbiased allocation sequence

- Adequate if sequences are suitable to prevent selection bias:
  - random numbers, drawing of lots, tossing a coin, shuffling cards, throwing dice etc.

## 2. Concealment of allocation sequence

- Adequate if assignment cannot be foreseen:
  - central randomisation, coding of drugs in hospital pharmacy, numbered, sealed, opaque envelopes etc

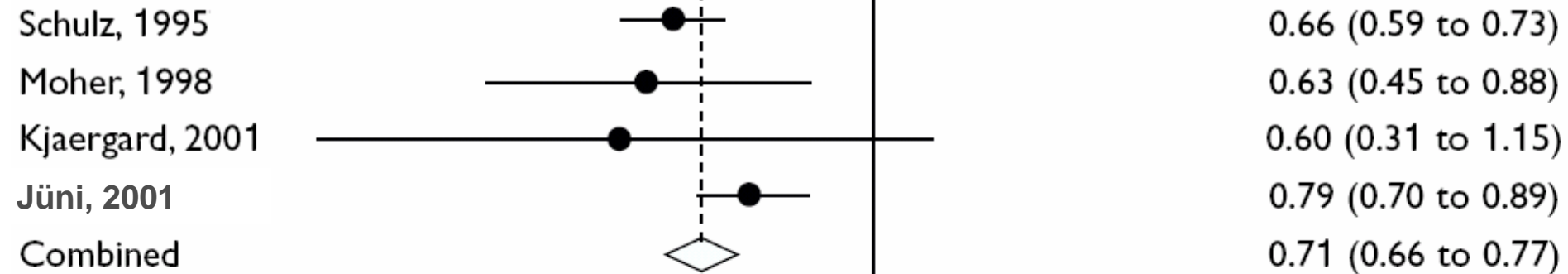
# Empirical evidence of bias



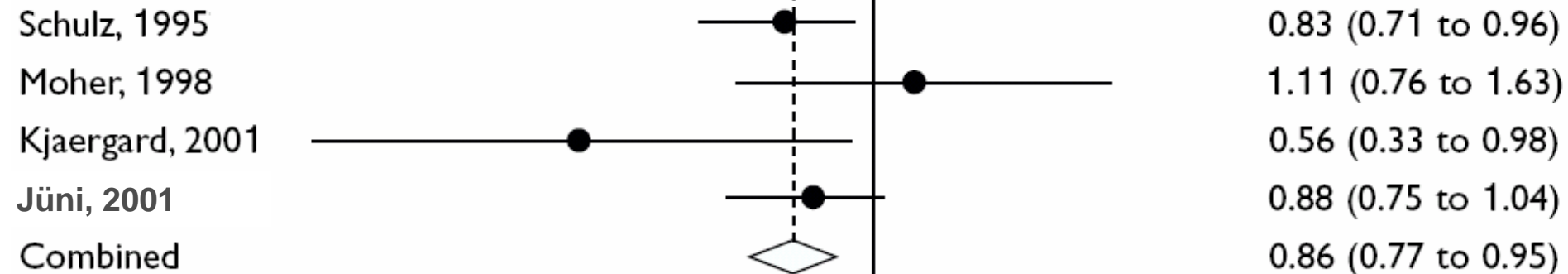
# Empirical evidence of bias

Ratio of effect estimates (95% CI)

## Inadequate/unclear vs adequate concealment of allocation



## Not double-blind vs double-blind



0.30 0.50 0.75 1.00 2.00

Ratio of effect estimates (95% CI)

Jüni, *BMJ* 2001

# Extensions to CONSORT

- The revised CONSORT statement for reporting randomized trials: explanation and elaboration. *Annals of Internal Medicine* 134:663-94, 2001 Apr 17.
- Better reporting of harms in randomized trials: an extension of the CONSORT statement. *Annals of Internal Medicine* 141:781-8, 2004 Nov 16.
- CONSORT statement: extension to cluster randomised trials. *BMJ* 328:702-8, 2004 Mar 20
- Still no reporting guidelines for crossover trials....

# Reporting on on flow of trial participants in *Lancet* and *NEJM*

<u>Number of persons:</u>	<u>Lancet</u>	<u>NEJM</u>	<u>P</u>
Assessed for eligibility	46%	36%	0.19
Found to be eligible	66%	43%	0.002
Randomised	93%	79%	0.009
Receiving treatment as allocated	74%	46%	0.001
Completing trial	94%	70%	0.001
Included in main analysis	94%	95%	0.72

# Factors in success of CONSORT

- Collaborative, open, ongoing process
- Membership of Group
  - Methodologists
  - Trialists
  - **Editors**
- Focus on reporting rather than conduct
- ‘Evidence-based’
- Evaluations of impact
- High profile publications

# History of STROBE

- Presentation of idea at World Epidemiology Conference in Montreal (August 2003)
- Constitution of core group
- Grant application to European Science Foundation May 2003 (further funding from UK Medical Research Council)
- Workshop in Bristol September 2004
- Seven 1-2 day meetings of the core group, to date
- E-mail consultations with larger group of collaborators
- Draft checklist posted on website in May 2005

# STROBE collaborators

- Co-ordinating group
  - Erik von Elm, Douglas Altman, Matthias Egger, Stuart Pocock, Peter Gøtzsche, Jan Vandenbroucke
- Methodologists and practitioners
  - Maria Blettner, Geneviève Chêne, Gian Luca Di Tanna, Peter C. Gøtzsche, Sander Greenland, Metin Gulmezoglu, Bruno Ledergerber, Richard Lilford, David Moher, Hal Morgenstern, Dietrich Rothenbacher, Caroline Sabin, Lale Say, James J. Schlesselman, Jonathan Sterne

- Journal editors

- George Davey Smith (*IJE*)

- Frank Davidoff (*Annals of Internal Medicine*)

- Ana Garcia (*JECH*)

- Phil Greenland (*Archives of Internal Medicine*)

- Astrid James (*The Lancet*)

- Giselle Jones (*BMJ*)

- Hooman Momen (*Bulletin WHO*)

- Margaret McCann (*Epidemiology*)

- Alfredo Morabia (*Sozial- und Präventivmedizin*)

- Cynthia Mulrow (*Annals of Internal Medicine*)

- Drummond Rennie (*JAMA*)

- Kenneth Rothman (*Epidemiology*)

# Dissemination

- Short paper (1800 words) and STROBE statement to be published simultaneously in several general and specialist journals during 2007
- “Explanation and Elaboration” paper (currently about 22,000 words!) currently being worked on.

# Check list of 22 items

- Title & abstract
- Introduction
- Methods
- Results
- Discussion
- Restrict to cohort, case-control and cross-sectional studies

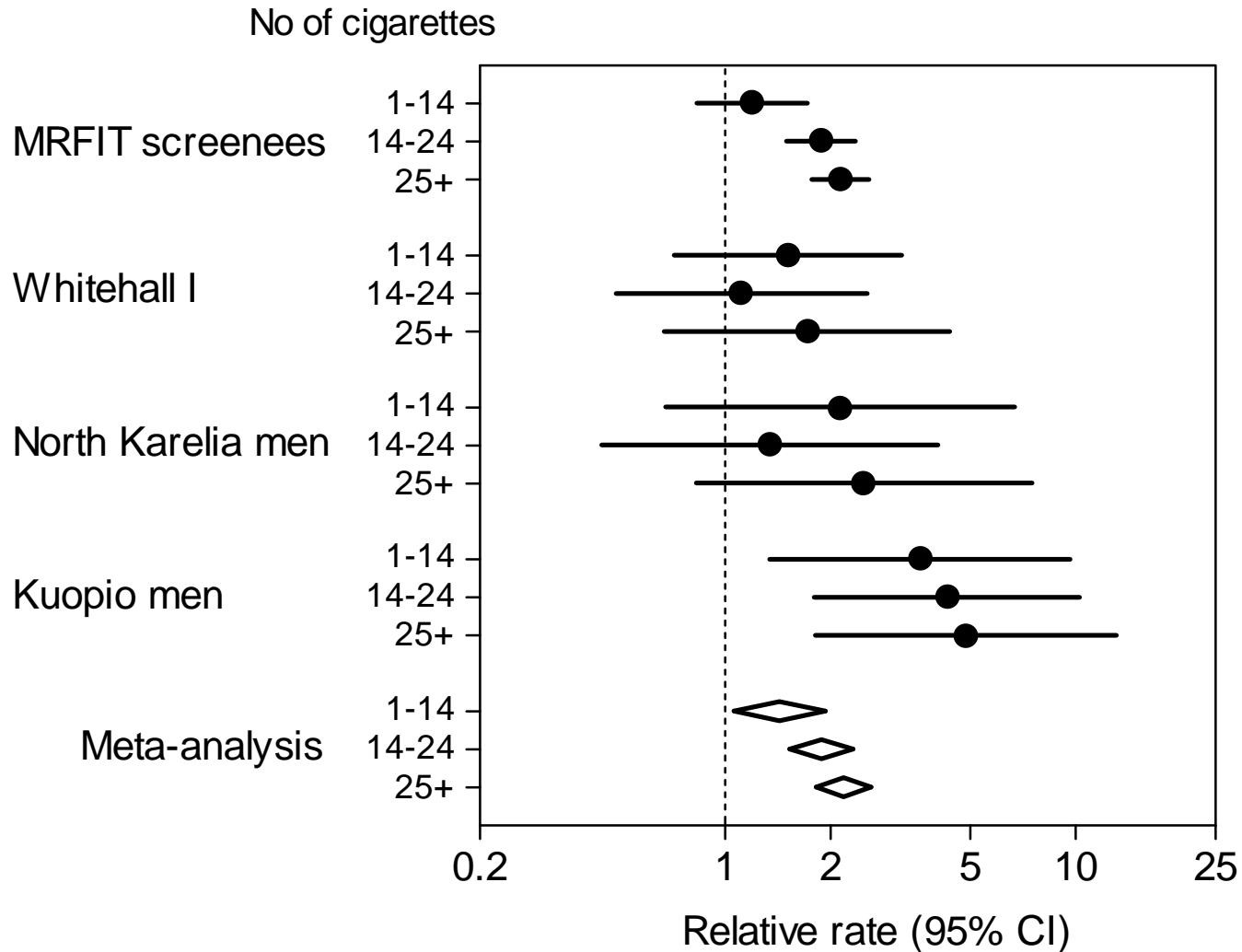
**“STROBE is neither a tool for assessing the quality of submitted or published manuscripts, nor a strict guideline that should be followed ad verbatim”**

	<i>Item #</i>	<i>Cohort study</i>	<i>Case-control study</i>	<i>Cross-sectional study</i>
<b>METHODS</b>				
<b><i>Study design</i></b>	4	Present key elements of study design		
<b><i>Setting</i></b>	5	Describe the setting, locations and relevant dates including periods of recruitment, exposure, follow-up or data collection		
<b><i>Participants</i></b>	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up.	(a) Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	(a) Give the eligibility criteria, and the sources and methods of selection of participants
		(b) For matched studies, give matching criteria and number of exposed and unexposed.	(b) For matched studies, give matching criteria and, number of controls per case.	
<b><i>Variables</i></b>	7	Clearly define all outcomes, exposures, predictors, potential confounders and effect modifiers. Give diagnostic criteria, if applicable.		

	<i>Item #</i>	<i>Cohort study</i>	<i>Case-control study</i>	<i>Cross-sectional study</i>
<b><i>Statistical methods</i></b>	12	(a) Describe all statistical methods including those used to control for confounding.		
		(b) Describe any methods used to examine subgroups and interactions		
		(c) Explain how missing data were addressed.		
		(d) If applicable, explain how loss to follow-up was addressed.	(d) If applicable, explain how matching of cases and controls was addressed.	(d) If applicable, describe analytical methods taking account of sampling strategy.
		(e) Describe any sensitivity analyses.		

	<i>Item #</i>	<i>Cohort study</i>	<i>Case-control study</i>	<i>Cross-sectional study</i>
<b><i>Outcome data</i></b>	15	Report numbers of outcome events or summary measures over time.	Report numbers in each exposure category, or summary measures of exposure	Report numbers of outcome events or summary measures.
<b><i>Main results</i></b>	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g. 95% confidence intervals). Make clear which confounders were adjusted for and why they were included.		
		(b) Report category boundaries when continuous variables are categorized.		
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.		

# Smoking and suicide



# Smoking and homicide

- Non-smoker 1.00
- 1-2 packs/day 1.71 (1.29-2.28)
- 2+ packs/day 2.04 (1.32-3.15)

**Comments welcome!**

[www.strobe-statement.org](http://www.strobe-statement.org)

# Acknowledgements

- STROBE
- CONSORT
- QUOROM/PRISMA
- International Journal of Epidemiology