Synthetic reviews – An overview with examples from WSS sector

Hugh Waddington, Birte Snilstveit, Howard White, Lorna Fewtrell

3ie Synthetic Reviews Programme

- What works and why?
- How to assess the range of evidence on development programmes?

Contents of the presentation

1. Background to SR
2. Scoping the topic
3. Motivation for 3ie's WSS review
4. WSS theory
5. Search and inclusion criteria
6. Data collection
7. Results: impact
8. Results: causal chain analysis
9. Conclusions + additional materials

1. What is Synthetic Review (SR)?

- Synthetic reviews (SRs) examine the existing evidence on a particular intervention or programme
  - E.g. WSS, nutrition, education, health, micro-credit, social cohesion, HIV/AIDS, agriculture, etc…

- NOT standard literature review - aims to provide unbiased assessment of what works and why through systematic identification of relevant studies and synthesis of quantitative and qualitative evidence

- Draws on both Campbell/Cochrane Collaboration systematic review methodology and realist evaluation (context and behavioural mechanisms) focusing on:

1. Outcomes (intermediate/final) => assess WHETHER interventions/ programmes work and under which circumstances (context)
2. Analysis of causal chain => assess HOW and WHY interventions/ programmes work, or not, drawing on programme theory (behavioural change)

Key steps to conducting SR

1. Scoping to identify relevant topic: interventions, outcomes, existing literature, theory
2. Background: policy relevance, existing evidence, knowledge gaps
3. Theory: causal chain, factors influencing behavioural change
4. Rigorous search to identify published and unpublished sources and application of strict inclusion criteria, set out in Study Protocol
5. Systematic data collection and coding of information relating to:
    1. Intervention + comparison group
    2. Study quality (assessment of internal validity)
    3. Contextual factors (external validity)
    4. Outcomes (impact 'effect size')
    5. Causal chain (behavioural change)
6. Quantitative synthesis using meta-analysis, incl assessment of impact heterogeneity
7. Synthesis of quant/qual information relating to causal chain
8. Review updated as new evidence emerges

2. Scoping the topic

- Key elements of SR:
  - Interventions: Water supply/treatment, sanitation, hygiene
  - Populations: Children in low- and middle-income countries
  - Outcomes (intermediate & final): Diarrhoea disease morbidity, intervention adoption/compliance
  - Theory: Disease transmission model & behaviour change

- Assessment of relevant literature/evidence: Impact evaluations (experimental & quasi-exp design)
  - But also consider process evaluations, qualitative evidence

- What's already out there: 5 existing reviews & meta-evaluations (Fewtrell and Colford, 2004; Curtis and Cairncross, 2003, Clasen, 2007; Ejemot, 2008, IEG, 2008); more recent evidence

- Key factors to consider in locating topic: policy relevance, existing evidence, knowledge gaps

3. Motivation for 3ie's WSS review

- 1.1 billion people worldwide lack access to clean water, and 2.6 billion without adequate sanitation (WHO/UNICEF, 2004)
  => ill-health, death, poverty, illiteracy, inequities

- Diarrhoea is a major global child killer, responsible for an estimated 21% or 2.5 million deaths annually (Kosek et al, 2003)

- Communicable disease transmitted from unsanitary environment into human body and back

- 4 main types of interventions providing barriers to diarrhoeal disease transmission from environment to human body:

  - Water supply: new or improved supply at source or point-of-use
  - Water treatment: treatment/protection at source or point-of-use
  - Sanitation: provision of facilities (improved latrines, sewer connection)
  - Hygiene: soap, hygiene education

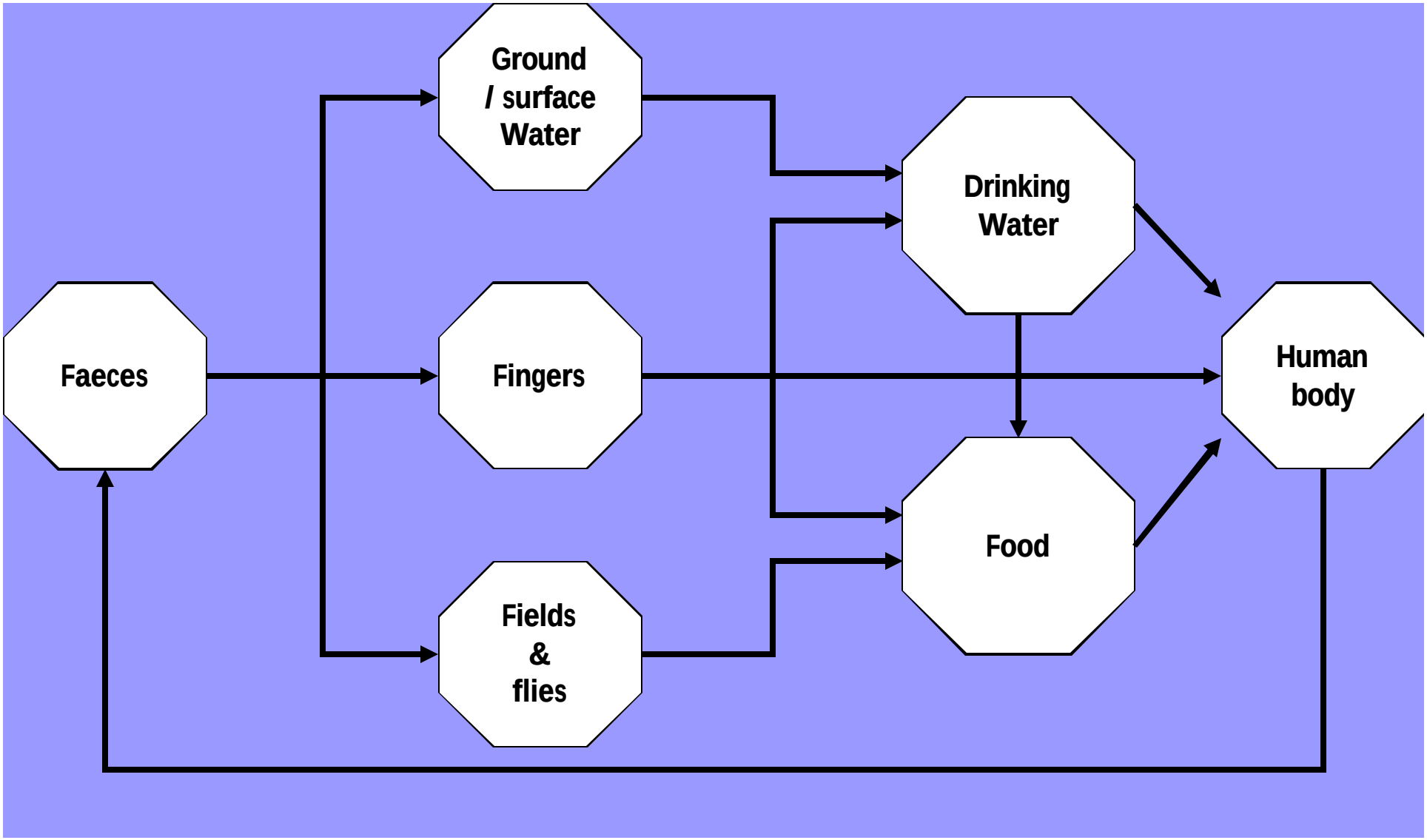
Evidence from previous reviews: implications for diarrhoea

- Effectiveness: interventions providing WATER TREATMENT/SAFE STORAGE at point-of-use or safe HYGIENE practices are the most effective
- SOURCE WATER improvements ineffective (recontamination)
- SANITATION less effective
- MULTIPLE INTERVENTIONS do not tend to have bigger impacts than single interventions
  - ⇒ WHO (2003) conclude that point-of-use water treatment is the most cost-effective approach to reach the water MDG
- But more recent concerns regarding ADOPTION and SUSTAINABILITY of interventions requiring substantial behavioural change (water quality, hygiene) – barriers to diffusion.

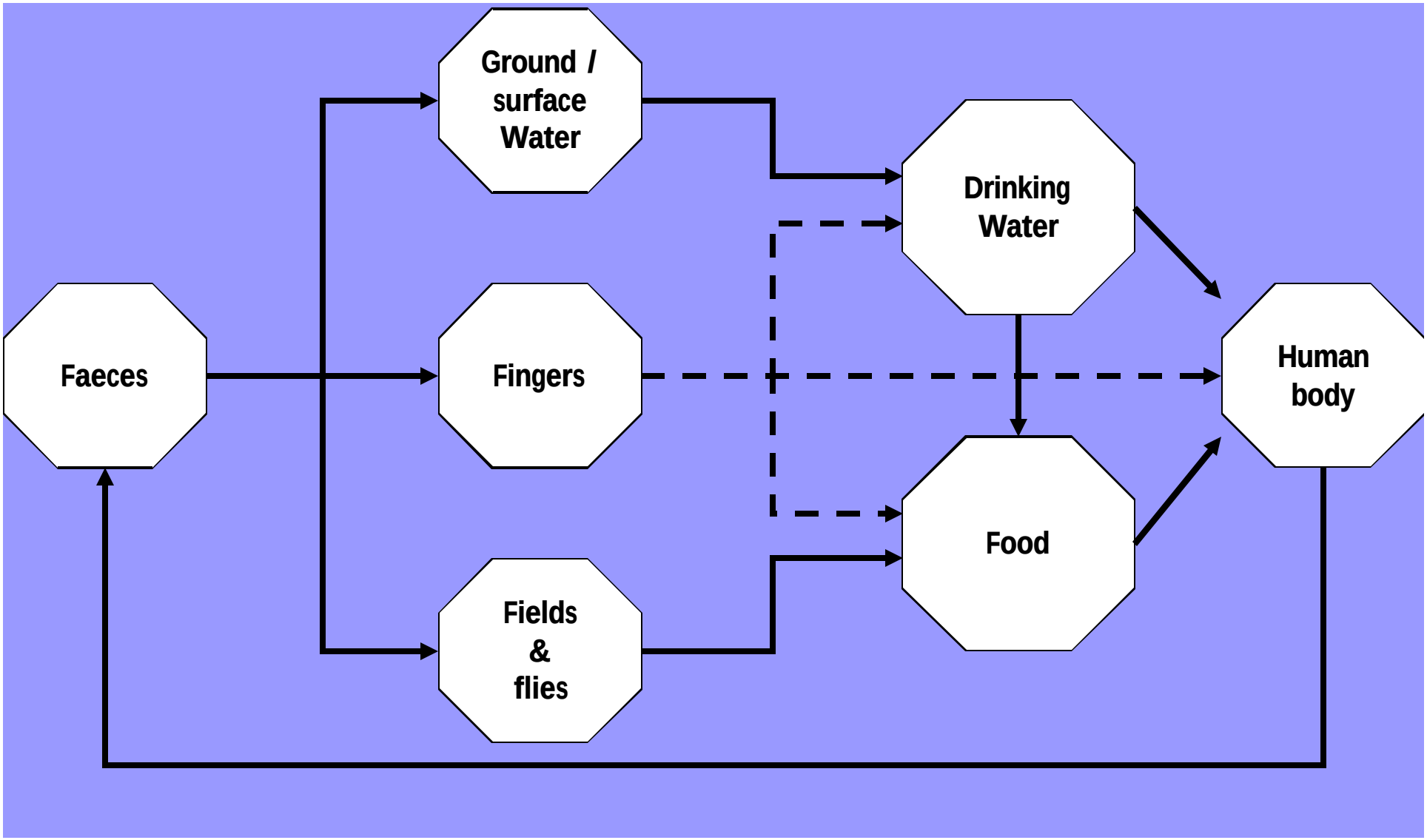
Objective: Update WSS evidence

- Assess whether existing ‘consensus’ stands up to inclusion of new studies and use of rigorous IEs only
- Examine impact heterogeneity: do outcomes vary by context?
- Examine underlying behaviour change mechanisms and sustainability

4. Theory: Disease transmission pathways



E.g. hygiene barriers to disease transmission



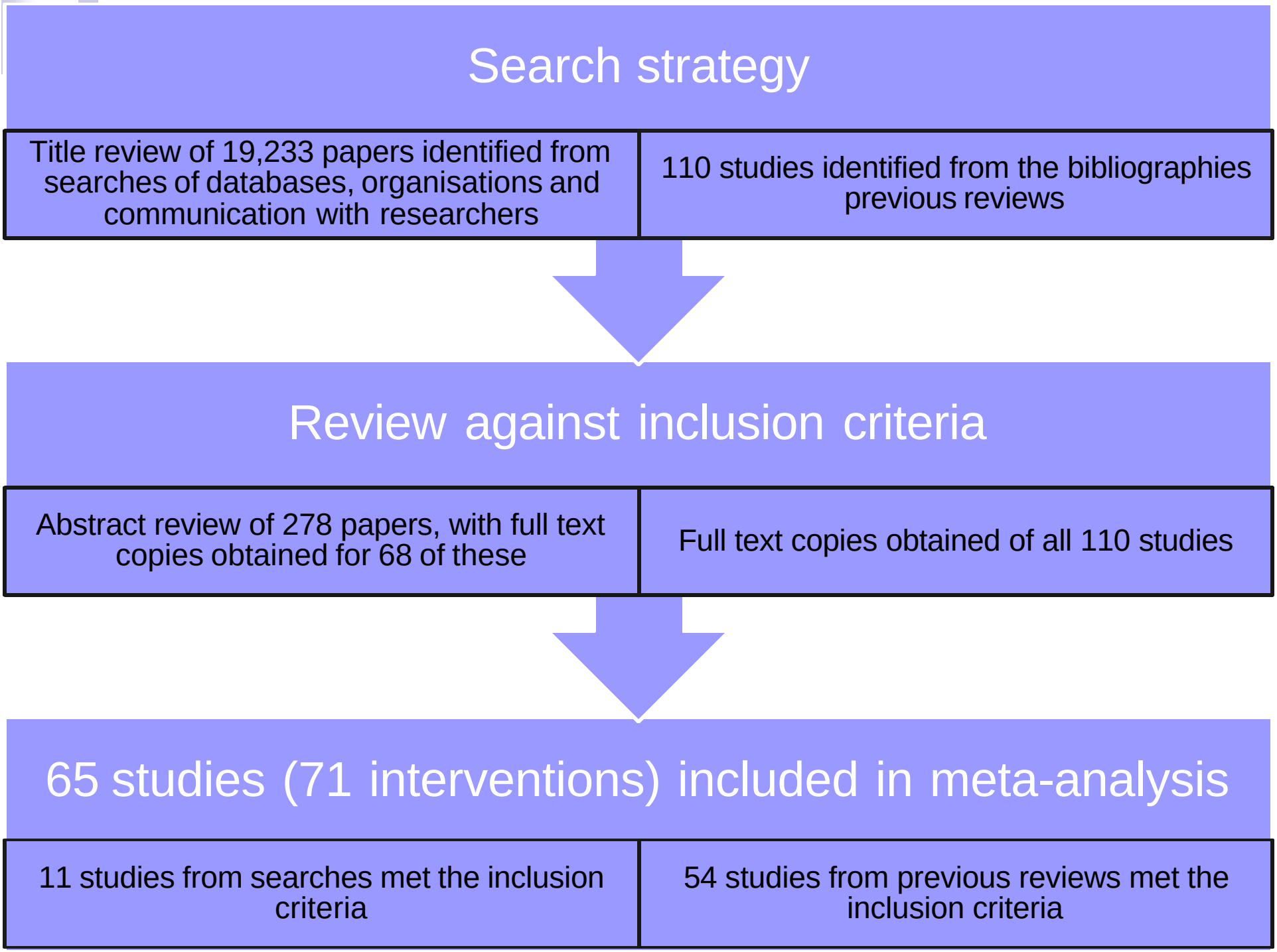
BUT, interventions are embedded in social systems determining adoption and impact in the real world

- Active interventions: adoption requires substantial behavioural change
- Adoption (compliance) determined by benefit-cost calculation
  - Health benefits may be not observed
  - Absence of other benefits (such as time-savings) may mean perceived benefits < costs
- Other factors influencing demand include income, education, taste/smell, agency, community factors (interpersonal networks/beliefs/herd behaviour)

5. Literature search and inclusion criteria

- Extensive search of published and unpublished sources
  - PubMed, Embase, LILACs, Web of Science
  - JOLIS, IDEAS, British Library for Development Studies (BLDS), Cochrane Library, scholar.google
  - Personal communication with leading researchers
  - Hand-search, back-referencing and citation tracking

- Inclusion criteria:
  - IEs measuring impact of intervention on diarrhoea morbidity using experimental (RCTs) and quasi-experimental methods
  - reported specific water, sanitation, and/or hygiene intervention(s);
  - were conducted in low- or middle-income countries;
  - use an infant or child as the unit of observation; and
  - estimate impact on diarrhoea morbidity, measured under non-outbreak conditions.


Search strategy
Title review of 19,233 papers identified from searches of databases, organisations and communication with researchers
110 studies identified from the bibliographies previous reviews
Review against inclusion criteria
Abstract review of 278 papers, with full text copies obtained for 68 of these
Full text copies obtained of all 110 studies
65 studies (71 interventions) included in meta-analysis
11 studies from searches met the inclusion criteria
54 studies from previous reviews met the inclusion criteria

6. Data collection and coding

- Information collected on:
  - Treatment & comparison group
  - Internal validity: study design; study quality (recall <2 weeks, standard definition of diarrhoea, assessment of confounders)
  - Context: study period, location, baseline disease exposure
  - Causal chain: access, knowledge, adoption (compliance); quantitative & qualitative information
  - Impact: effectiveness + statistical precision

- Effectiveness measured using (risk/prevalence/odds) ratio:

Ratio =	$\frac{\text{Disease t}}{\text{Disease c}}$	< 1	treatment effective
		= 1	treatment ineffective/harmful

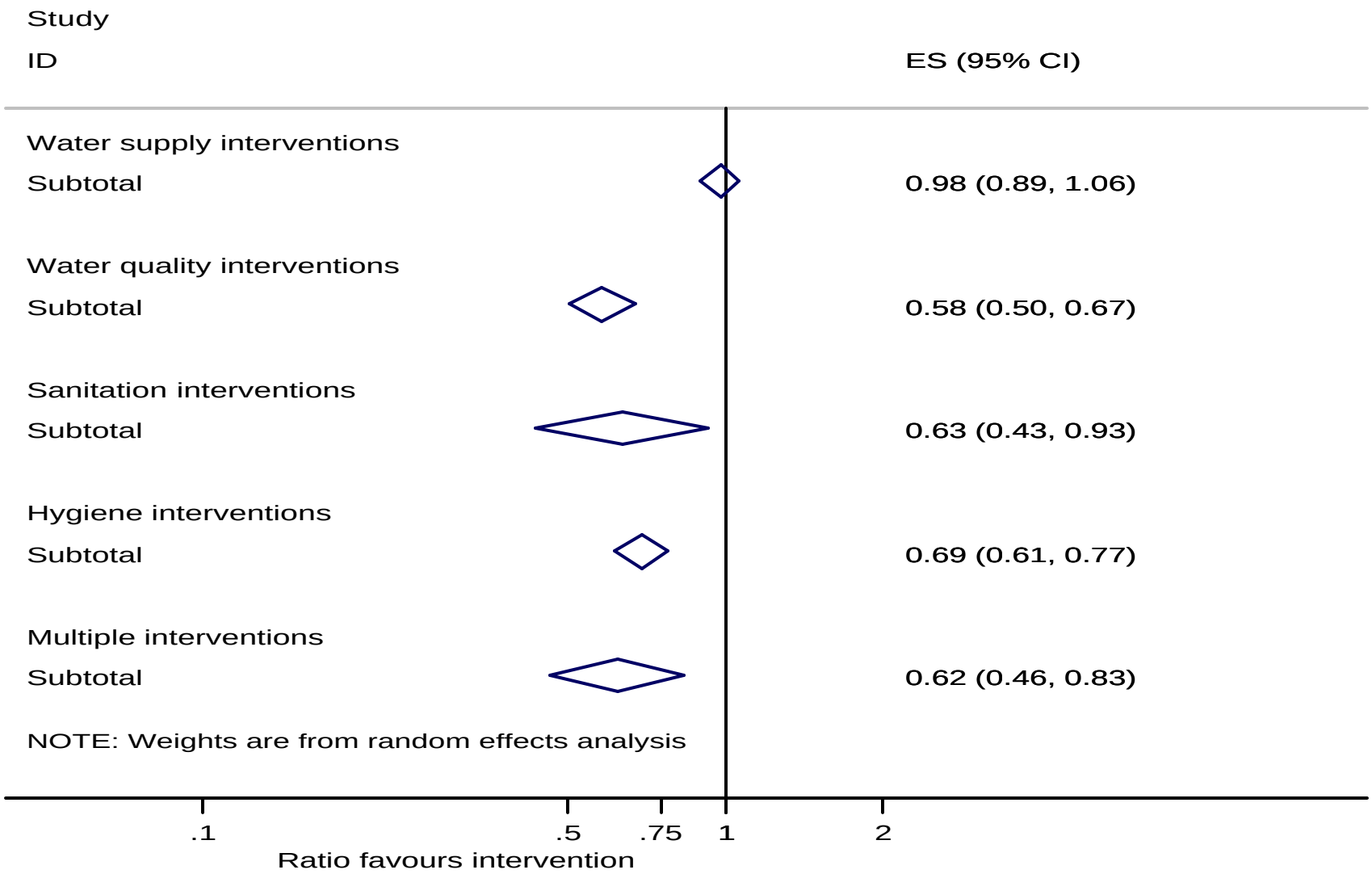
Information on the interventions

	Total num	*Num RCTs*	*Total sample*	*Ave sample*	*Ave length (months)*
Water supply	**8**	**0**	**61,000**	**7,700**	**19**
Water treatment	**31**	**27**	**14,500**	**450**	**11**
Point of use (POU)	28	25	12,000	400	8
Source	3	2	2,500	800	12
Sanitation	**8**	**0**	**13,500**	**2,200**	**30**
Hygiene	**17**	**5**	**18,000**	**1,100**	**8**
Hand-washing with soap	9	3	5,000	600	9
Education	8	2	13,000	1,600	7
Multiple interventions	7	2	13,000	2,200	23
TOTAL	71	34	136,000	1,900	15

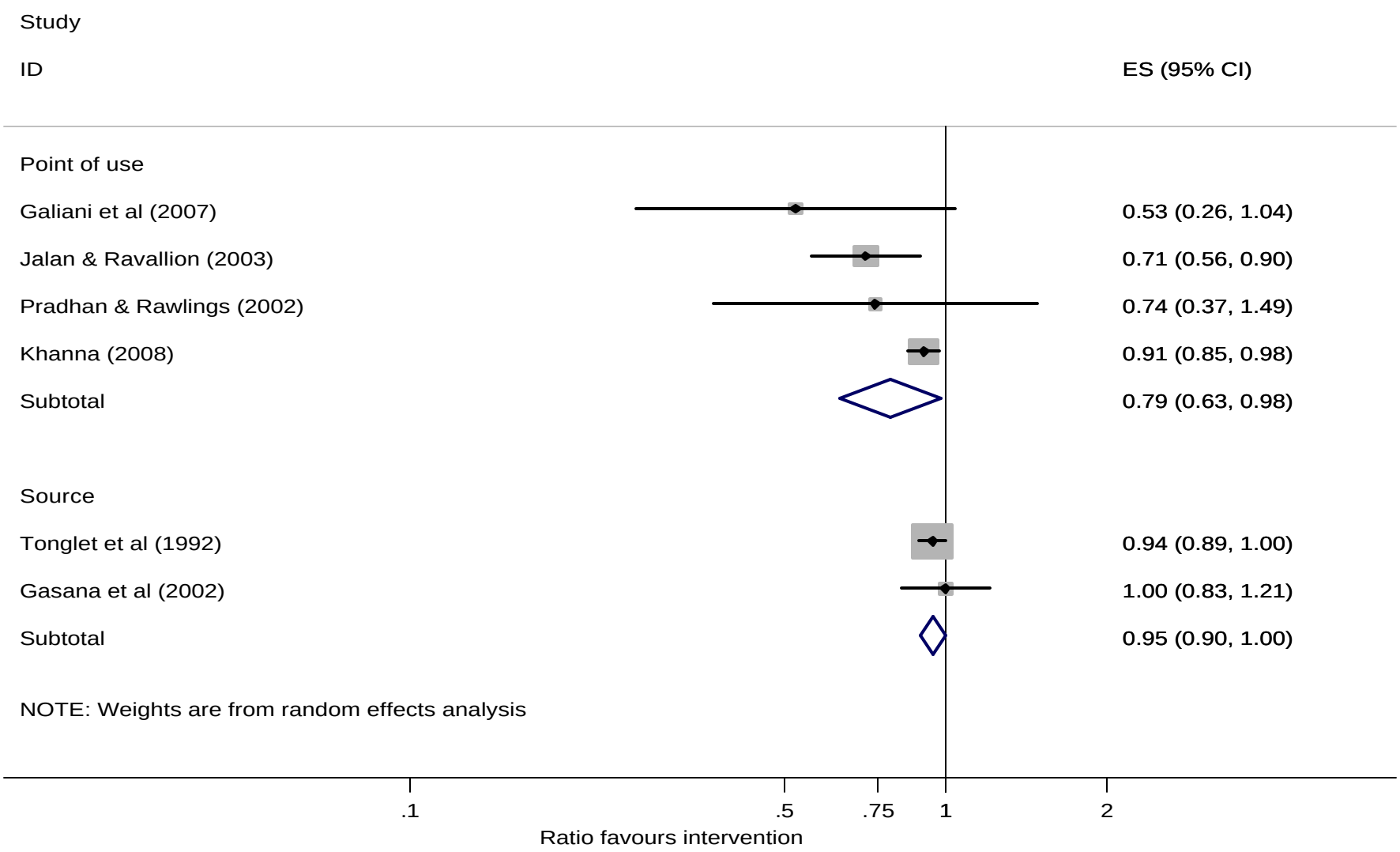
7. Results

- Effectiveness results synthesised using meta-analysis (random effects, inverse-variance weighted)
- Examination of impact heterogeneity: assessment of sustainability
- Examination of causal chain: quantitative and qualitative information relating to adoption (compliance)

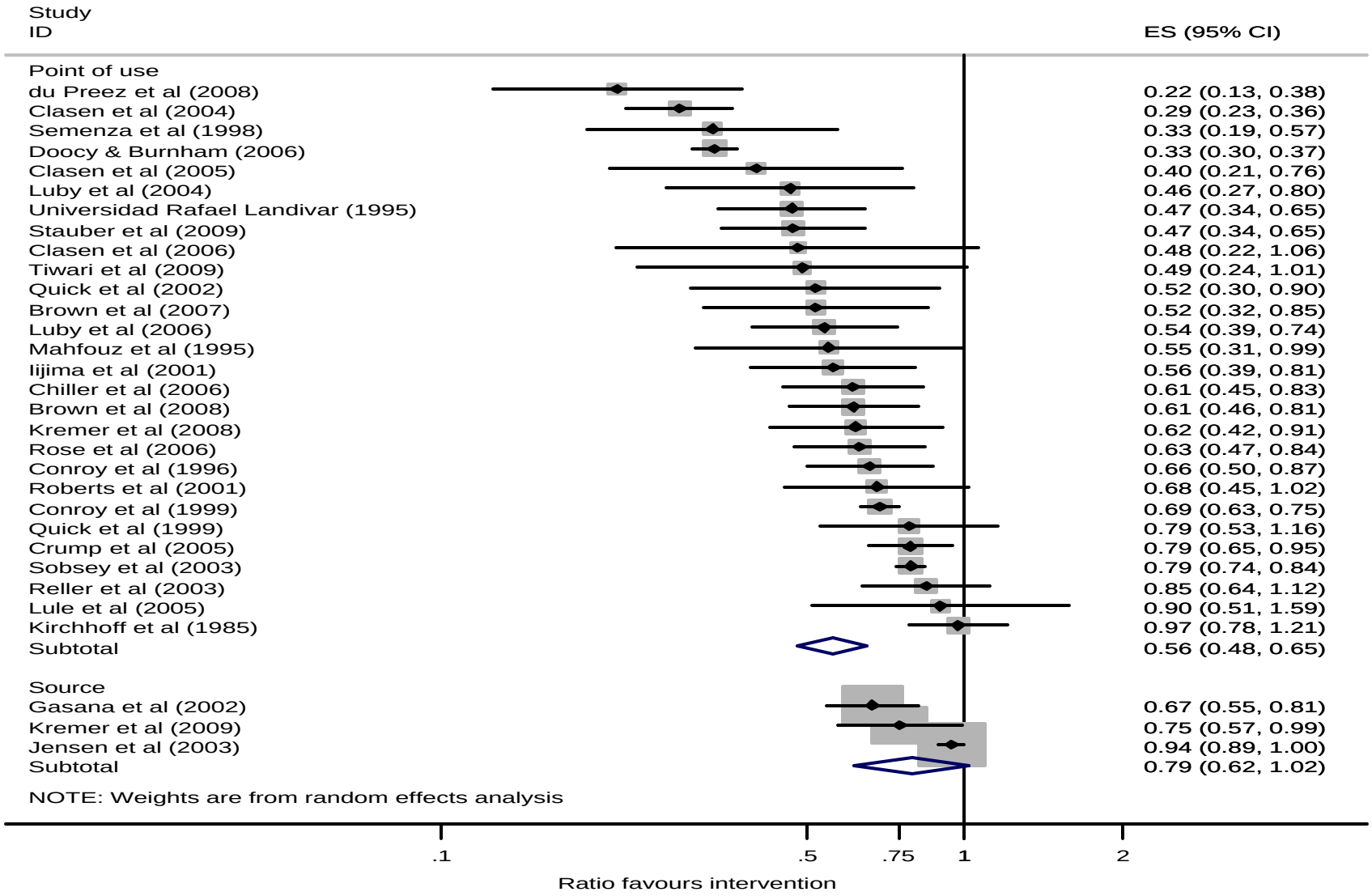
Summary of results across interventions



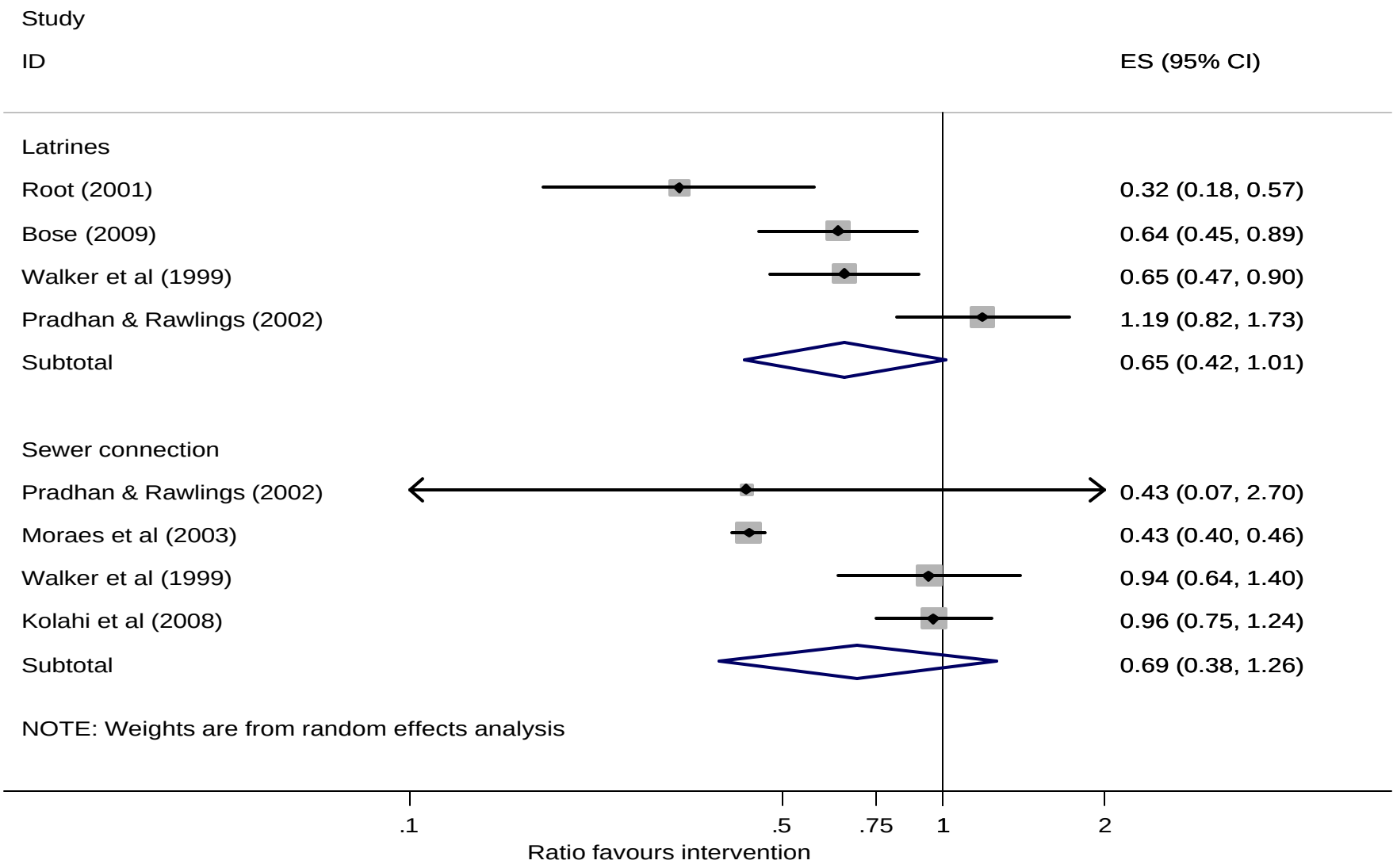
Effectiveness: Water supply interventions



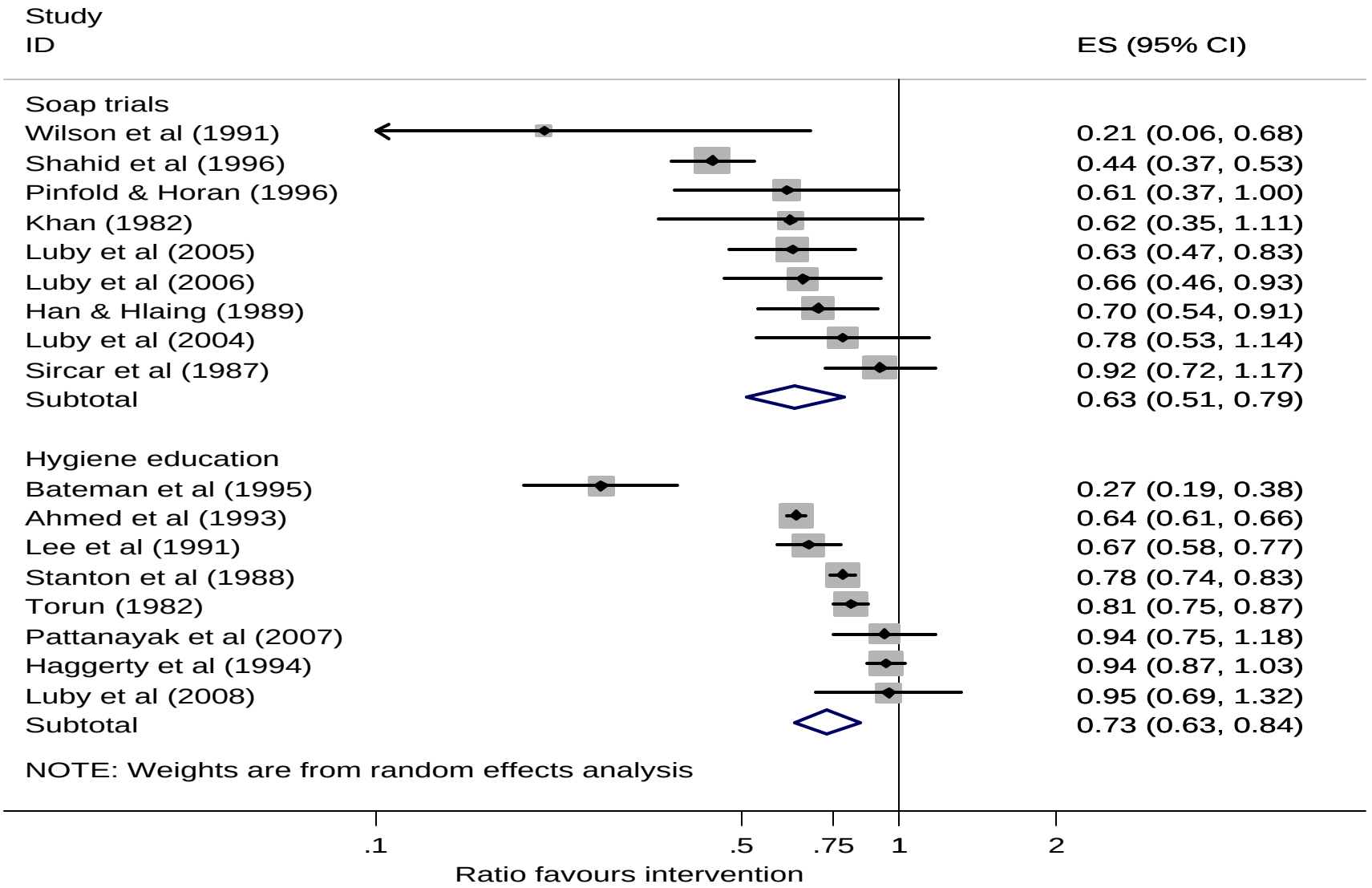
Effectiveness: Water treatment interventions



Effectiveness: Sanitation interventions



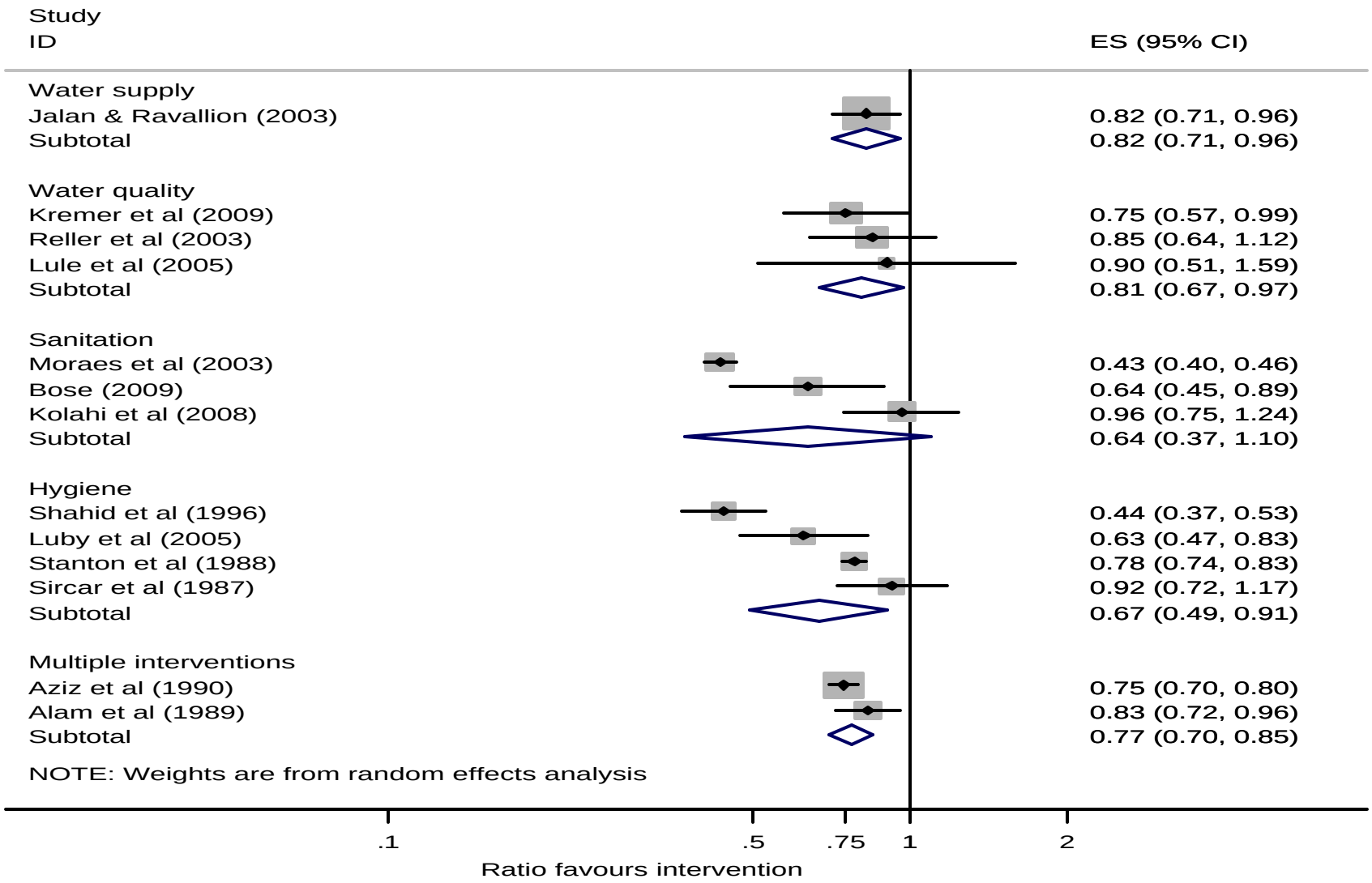
Effectiveness: Hygiene interventions



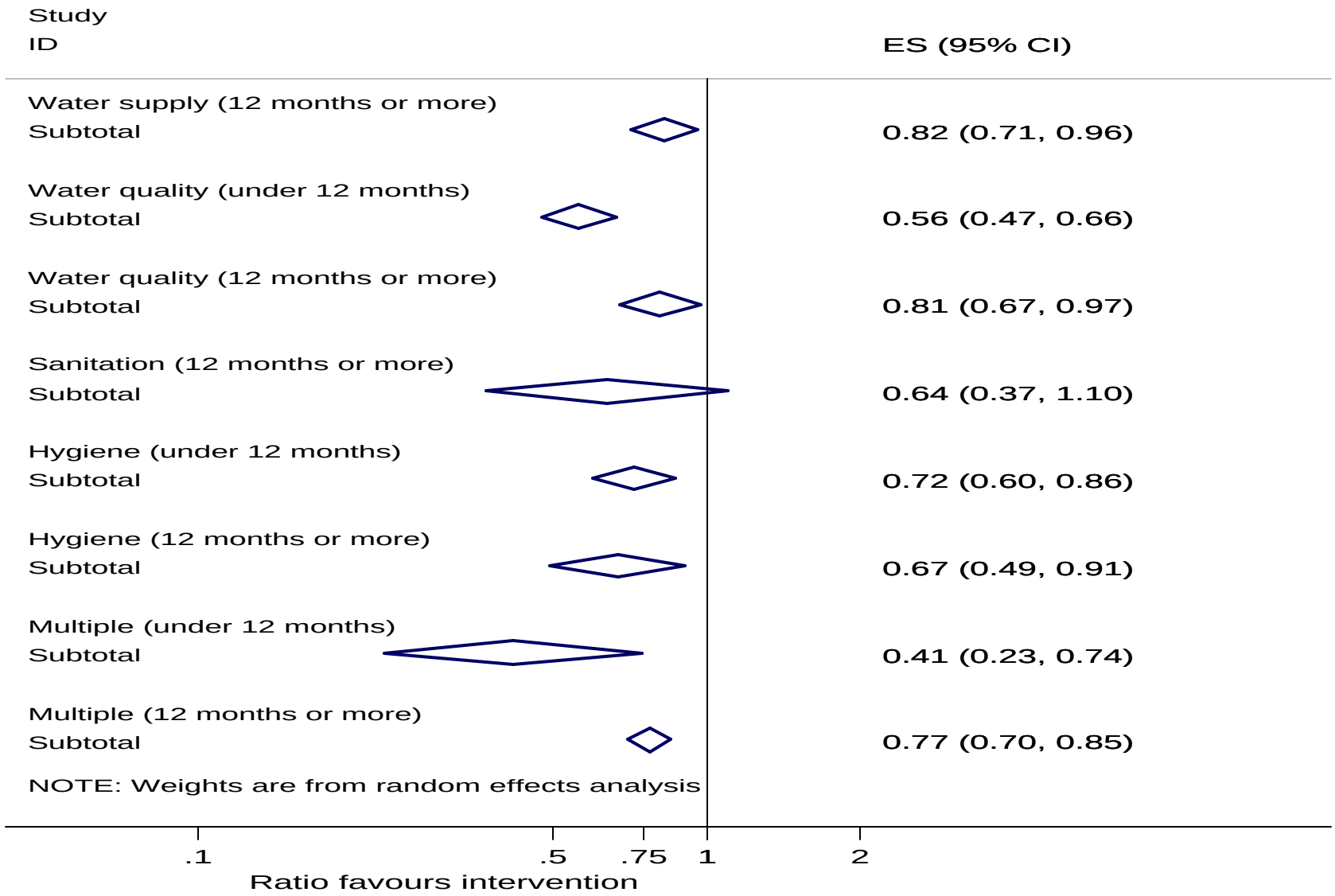
Sustainability over time

- Water supply and sanitation: studies conducted over large samples, multiple-years
- Water treatment and hygiene: replicability demonstrated, but smaller samples and shorter-term
- Evidence on long-term sustainability limited
  - Only 5 follow-up studies assess health impact over one year after intervention completed
  - Only 3 studies (water quality) assess compliance more than a year after trial ended
- Analysis: examination of effectiveness by study length (meta-analysis)

Water treatment: less effective after 1 year



Sustainability: high quality studies



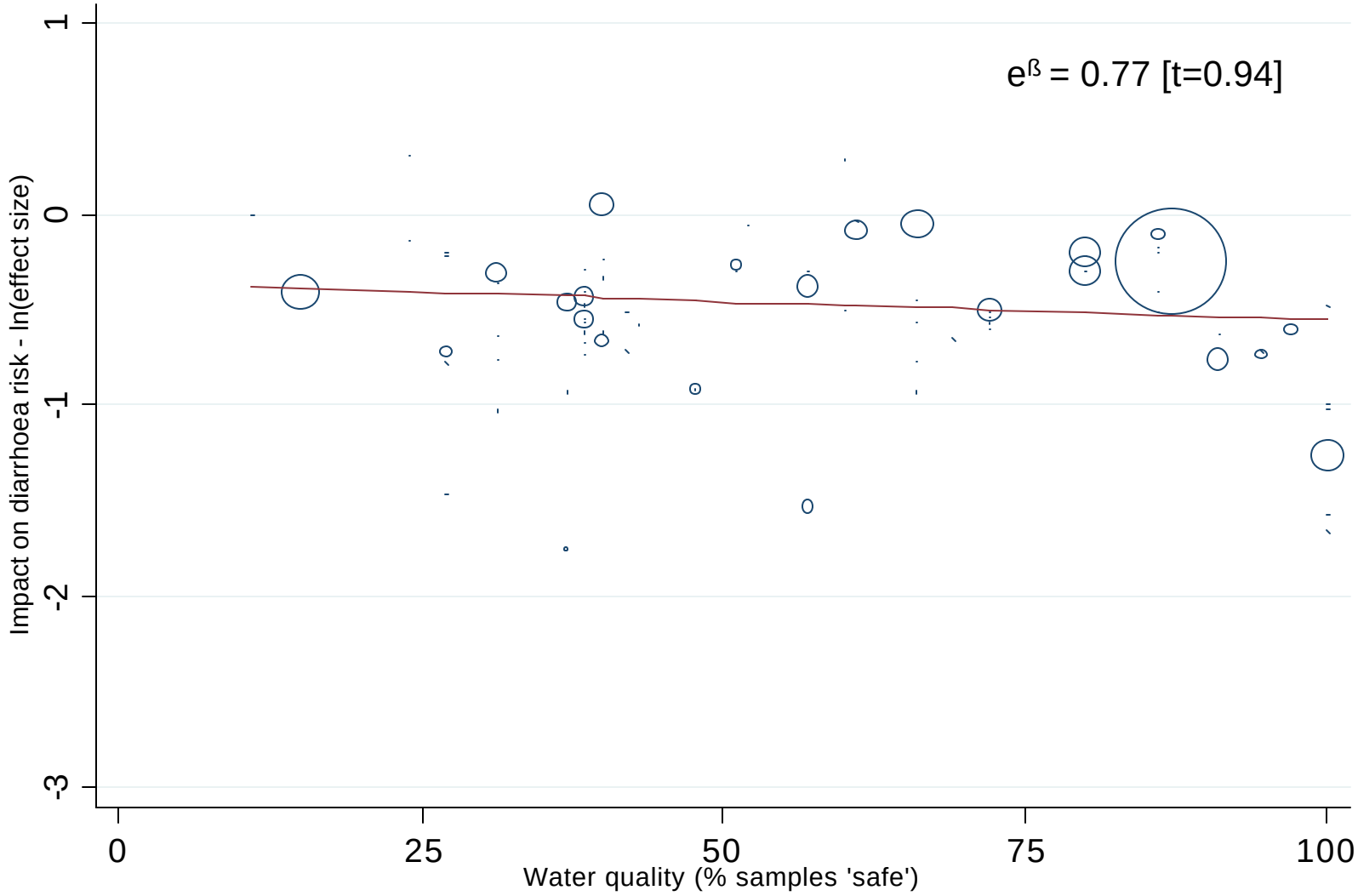
8. Causal chain analysis

- Evidence sought on why interventions work (or fail to work): collection of quantitative and qualitative information relating to causal chain - access, knowledge transmission, compliance (behaviour change)

- Quantitative information: most studies collect some data on compliance, at various levels:
  - Water supply, sanitation, hygiene: mainly degree of physical access or observed practice - compliance data low quality & not readily comparable
  - Water quality: 'water quality' bacteriological content, residual chlorine and/or observed use

- POU Water treatment:
  - Meta-regression suggests weak relationship between compliance and effectiveness
  - ⇒ Together with information on placebo-effect, conflict of interest and publication bias, suggests bias in existing trial evidence

Quantitative assessment: compliance and effectiveness not closely correlated



Evidence suggests compliance, and therefore impact, falls over time

- Follow-up studies of successful POU water treatment trials were conducted after the trial ended:
  - Ceramic filter provision in Cambodia; 3 years later only 31% households were still using the filters (Brown et al, 2007)
  - Pasteurisation in Kenya; 4 years later only 30% continued to pasteurise their water (Iijima et al, 2001)
  - Programme promoting POU water disinfectant in Guatemala 1 year later; repeated use among only 5% of households from original trials (Luby et al, 2008).
  - Water filters in Bolivia; compliance 67%; but assessment made only 4 months after trial ended (Clasen et al, 2006)

Qualitative information: reasons for low compliance

- Some studies provide hypothesis on why intervention effective, but few collect data to examine this empirically

- Diffusion theory (Rogers, 2005) suggests compliance low because:
  - Reduction in diarrhoea not observed or seen as substantial enough benefit to warrant costs (money/time)
  - Adoption of innovations (social change) is a slow process (early adopters vs laggards)
  - Other factors important (e.g. taste/smell, time-savings)

Only one study evaluated the reasons for low compliance

- Source water treatment (UV filtration) in Mexico, conducted 5 years after programme initiation (de Wilde et al 2008)
  - No impact on diarrhoea incidence - only 2/21 communities met all requirements for effective programme performance
  - Community capacity to manage, physical faults or under-valuing of safe water by users were NOT found to be limiting the intervention's effectiveness
  - Constraints (money & time) and availability of other sources, meant households chose more convenient water sources

9. Conclusions

- Impact:
  - Water supply interventions least effective (although piped water to household effective)
  - POU water treatment very effective under trial conditions, but concerns about longer-term compliance, sustainability and therefore impact
  - Sanitation as effective as hygiene – but more studies (esp experimental) needed
  - Multiple interventions: more evidence from factorial studies needed

- No one single intervention for improving access to water and sanitation for reducing diarrhoeal disease:
  - The ‘right’ solution is the one that fits the (social, economic) context
  - Planners must emphasise behavioural factors, particularly where these are of overriding importance to adoption and sustainability

Thank you

- WSS report available for download at:

  http://www.3ieimpact.org/admin/pdfs2/17.pdf

- Review methods/examples:

  www.cochrane-handbook.org/

  www.campbellcollaboration.org/systematic_reviews/index.php

  www.3ieimpact.org/syntheticreviews