Title:
Indoor air pollution from unprocessed solid fuel use and pneumonia risk in under-5 children: systematic review and meta-analysis

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The following tables and information are provided in this document:

- Further description of procedure for independent review and resolution of quality assessment scores
- APPENDIX TABLE A: Solid fuel use and ALRI in children less than 5 years of age.
- APPENDIX TABLE B: Studies providing information on risk of Respiratory Syncytial Virus (RSV) illness
- References

Procedure for independent review and resolution of quality assessment scores:
Twenty five studies were included in the review (24 providing suitable estimates for the meta-analysis), and three additional studies provided information on risk of Respiratory Syncytial Virus (RSV) illness. Please refer to the main paper (web version) for full details of the search strategy, flow chart for the review, and a summary of the key design features of the studies included.

Data extraction and quality score assignment was carried out by at least two independent reviewers, in all cases including one each at the University of Liverpool and the University of California, Berkeley. The results of quality scores were compared, and are summarised in Table 1:

Table 1: Quality score agreement among reviewers before reconciliation

Difference in scores	Main review (including meta-analysis) (n=25) [Appendix Table A]	RSV studies (n=3) [Appendix Table B]
0	8 (32%)	1
1	11 (44%)	-
≥2	6 (24%)	2

Of the twenty five studies in the main review (Appendix Table A), 23 were reviewed by two reviewers working independently, the remaining two (one cohort, one case control) by three assessors. The differences in quality scores ranged from 0 – 4, and were 2 or more for six studies (24%), before reconciliation (only one of these was greater than 2). For the RSV studies (Appendix Table B), two were assessed by 2 reviewers and one by 3 reviewers.

The following protocol was used for resolving differences and deriving the final score assignment. If the difference of quality score was zero or 1, the assessments were accepted and for a difference of 1, the average score was assigned (this included, in some cases, the average of scores for the 3 reviewers). For any differences of more than 1, the reviewers exchanged information by email and telephone, where necessary, in order to resolve the differences.

If, following this reconciliation procedure, a difference of more than 1 persisted, a third person (one of the other reviewers who had not previously extracted or quality-assessed that particular study), would be asked to review and attempt to resolve to a 1 point difference. If resolution to within 1 point still could not be achieved, an average of the three scores would be taken as the final score and a note added regarding the lack of consensus among reviewers for that particular study. In the event, resolution was achieved for all studies without recourse to a third person.

After reconciliation, 16 studies had a difference of 1 and the rest were scored at the same level (difference of zero).

Appendix Table A: Solid fuel use and ALRI in children less than 5 years of age.

DHS = Demographic and Health Survey (ORC Macro); MLR = multivariate logistic regression; UMLR = unconditional; CMLR = conditional (for matched studies); GEE = Generalised estimating equations; CPHR = Cox proportionate hazards regression; CXR = chest X-ray; VA = Verbal autopsy; SES = Socio-economic status; ETS = environmental tobacco smoke; OR = odds ratio; URI = upper respiratory infection; AURI = acute URI; LRI = lower respiratory infection; ALRI = acute LRI; IAP = indoor air pollution; CO = carbon monoxide.

A.1 Cross sectional studies

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 13]
Mishra 2003[1] Zimbabwe Urban and rural, altitude variable Conducted 1999	**Age < 60 months** 3,559 children, in two-stage cluster national sample of Zimbabwe for DHS, with probability proportional to size.	Recall by mother at interview of illness with cough in prior 2 weeks. ALRI present if child was breathing faster than usual, with short, rapid breaths. **Parent recall**	Interview survey of main fuels used for cooking. Used to group responses into 3 exposure levels: High – wood, dung, straw Medium – kerosene, charcoal Low – LPG, natural gas, electricity. **Exposure prevalence: 66% in high pollution group**	Adjustment using MLR, including: SES (standard of living index in 3 categories based on: vehicle, bike, TV, telephone, fridge, piped water, flush toilet, electricity, modern floor material); mother's education; age and sex of child; birth order; stunting; mother's age at childbirth; mother's religion; region of country. **Adequate adjustment**	**Adjusted OR for biomass vs. clean fuel (gas, electricity) and for kerosene/charcoal vs. clean fuel:** Low (reference) Medium: 1.33 (0.64, 2.77) High: 2.20 (1.16, 4.19) OR 4% higher in girls (NS)	Stars = 5/13 ALRI assessment relies on parental recall of lower respiratory signs. Adjustment for confounding does not include ETS (but authors state women rarely smoke in Zimbabwe), or breastfeeding. Authors note that co-linearity prevented adjustment for urban/rural residence, but consider that region and SES adjustment would largely address this.
Mishra 2005[2] India Urban and rural, altitude variable Conducted 1989-90	**Age < 36 months** 29,768 children, in national multi-stage cluster sample of India, carried out for 1989-90 National Family Health Survey.	Recall by mother at interview of illness with cough in prior 2 weeks. ALRI present if child was breathing faster than usual, with short, rapid breaths. **Parent recall**	Interview survey of main fuels used for cooking and heating. Used to group responses into 3 exposure levels: High – wood, dung, crop wastes Medium – mix of biofuels and cleaner fuels Low – biogas, electricity, LPG, kerosene. **Exposure prevalence: 64% used biomass fuels**	Adjustment using MLR, including: SES (housing, kitchen type, crowding, standard of living); mother's education; ETS; nutritional status; child's age and sex; birth order; region; urban or rural residence; caste; mother's age at childbirth. **Good adjustment**	**Adjusted OR for biomass vs. clean fuel (gas, electricity, kerosene) and for mixed fuels vs. clean fuel:** Low (reference) Medium: 1.41 (1.17, 1.70) High: 1.58 (1.28, 1.95) Separate analysis for males and females, results very similar.	Stars = 5.5/13 ALRI assessment relies on parental recall of lower respiratory signs. Adjustment for confounding does not include breast feeding and vaccination.
Wichmann 2006[3] South Africa Urban and rural, altitude variable	**Age < 60 months** 4,679 children, in national multistage probability proportional to size cluster sample for 1998 DHS for South Africa.	Recall by mother at interview of illness with cough with rapid breathing in prior 2 weeks. **Parent recall**	Use of fuel for cooking & heating: high pollutant if wood/dung used along with other fuels; medium pollutant if charcoal paraffin used with electricity/gas; low pollutant if electricity/gas used exclusively. **Exposure prevalence: 39% in**	Adjustment using MLR, including: SES (standard of living); mother's education; child's age and sex; children in house; urban or rural; ethnicity; mother's age at birth; birth order. **Adequate adjustment**	**Adjusted OR for some wood/dung vs. exclusive clean fuel (gas, electricity) and for some charcoal/paraffin vs. exclusive clean fuel:** Low (reference) Medium: 1.26 (1.00, 1.58) High: 1.29 (1.02, 1.62)	Stars = 5.5/13 ALRI assessment relies on parental recall of lower respiratory signs. Adjustment for confounding does not include breast feeding and vaccination, nutritional status, ETS. Exposure groups included

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 13]
Conducted 1998			**'high pollution' category**			mixed use of fuels.

A.2 Case control studies

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
Kossove 1982[4] South Africa Urban, altitude 700 metres Conducted in 1980	**Age < 13 months**. 132 cases and 18 controls, sampled from outpatient clinic in Pietermaritzburg, Natal, S Africa.	Cases chosen 'randomly' (but not stated how): selected from those with respiratory distress and signs severe enough to warrant X-ray. Based on physician diagnosis, included wheezing bronchitis and pneumonia (proportions of each not stated). Pneumonic changes on CXR in 68%. Controls: OPD attendees with non–respiratory illness. **Physician diagnosis**	Interview at time of illness, asked: "Does the child stay in the smoke?" Majority of households in the study cook with wood on open fires (% not specified). **Exposure prevalence: 33% of control children 'stayed in smoke'.**	No formal adjustment for confounding, but a number of relevant factors examined: SES (monthly wage, whether mother married; parents unemployed); ETS; breast feeding; family history of wheezing; mean age of children (5.4 months cases, 3.4 months controls); number of siblings. **No adjustment**	**Unadjusted OR for comparison of children 'staying in smoke' with those who do not:** 4.77 (1.51, 16.46)	Stars = 3.5/12 Selection of cases may not really have been random, and potentially biased. As not all (68%) of cases had pneumonic changes on CXR, radiological diagnosis was not the main outcome. Very small control group. Exposure assessment vague. Lack of adjustment for confounding (but factors examined were similar in both groups, apart from children's age).
Collings 1990[5] Zimbabwe Urban and rural, altitude 1700 metres Conducted prior to 1987	**Age 1 to 36 months**. 244 cases, all children presenting to Marondera hospital with lower respiratory tract disease over a 15 month period. 500 controls: children seen consecutively in the local maternal child health clinic (well baby clinic).	Cases: physician diagnosed, using WHO criteria of clinical and radiological signs (chest X-ray taken, but positive result presumably not required for all cases). 159 broncho-pneumonia; 70 lobar pneumonia; 13 bronchiolitis; 1 bronchiectasis; 1 lung abscess. Neonatal respiratory distress syndrome excluded. Controls: children seen consecutively in local maternal and child health clinic. **Physician diagnosis**	Questionnaire on cooking facilities and exposure to wood smoke. 73.4% of controls used open wood fire (rest used paraffin, gas or electricity). Respirable particulate matter (PM) samples taken in kitchens of 40 children: 20 with LRTI and 20 with URTI, over 2 hours during cooking. Blood sample for carboxy-haemoglobin in same 20 ALRI and 20 AURI cases. **Exposure prevalence: 73% controls use open wood fire**	No adjustment for confounding, but the following studied in univariate analysis: Father's occupation; overcrowding, urban/rural residence; mother's smoking; breast feeding; school age siblings. Several variables have chi-squared close to 3.84 on 1 df, indicating potential for confounding. **No adjustment**	**Unadjusted OR for comparison of wood fire with cleaner fuels:** 2.14 (1.41, 3.36) Levels of PM higher in homes of children with LRI (n=18, PMresp = 1998 $\mu g/m^3$) vs. those with URI (n=15, 546 $\mu g/m^3$), $p<0.01$. COHb did not differ between ALRI and AURI cases.	Stars = 4.5/12 Use of a well baby control group for comparison with hospital cases may introduce bias. Poor description of wood smoke exposure, and study of PM is between ALRI and AURI, not between those reported as exposed and unexposed. No adjustment of OR, with evidence that key confounding variables were associated with the outcome.
Johnson 1992[6] Nigeria, Ibadan Urban, altitude 200 metres Conducted	**Age 2 weeks to <60 months.** Cases: 103 consecutive ALRI admissions to the University College hospital on week-days (max 4 cases per week).	Cases were hospitalised patients (principally recruited from children's emergency room) for ALRI diagnosis (croup, bronchiolitis, pneumonia and empyema thoracis) based on clinical, X-ray, and bio-laboratory workup.	Cases and controls interviewed recording nutritional status, household and socio-economic variables (including nature of kitchen fuel(s) and location of cooking area(s). Details entered onto pre-coded	No adjustment for confounding but the following looked at in univariate analysis and found to be non-significant: crowding; parental income; maternal education;	**Unadjusted OR for type of cooking fuel used, firewood vs. petroleum products:** 0.80 (0.36, 1.78) **Unadjusted OR for**	Stars = 4/12 Firewood vs. petroleum OR used in meta-analysis. As controls were selected (in part) from immunisation clinic there may be some bias due to higher SES and hence less solid fuel use. No

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
1985-86	Controls: 103 age matched controls selected within 4 days of case recruitment. "Apparently well" children attending Welfare Clinic for immunisations, attending for elective surgery, or routine follow-up for non-respiratory ailments. Excluded any illness with duration >28 days.	Controls were "apparently well" age and sex matched children attending Infant Welfare Clinic for immunisations without respiratory illness. **Physician diagnosis**	questionnaire. Type of cooking fuel used at home (firewood or "petroleum products"; kerosene, gas). Also, location of cooking area (in living/ sleeping area or open space/ separate area). **Exposure prevalence: in controls, firewood used by 19%; cooking done in sleeping/living area in 33%**	nutritional status and current smoking. **Not adjusted**	**location of cooking area: living/sleeping area vs. open space/ separate area:** 1.45 (0.75, 2.81)	further information or discussion in paper. As only 19% used firewood for cooking, the higher prevalence exposure (cooking in same room as used for sleeping and living) was not used for meta-analysis as at least 50% of these homes would not be cooking on firewood.
As above	**Age 2 weeks to <60 months.** Case fatality n= 103	Cases: Death in hospital among ALRI patients (see above). **Deaths: cause determined from clinical information**	Interview for type of cooking fuel used at home (see above).	(see above) **Not adjusted**	**Unadjusted OR for deaths among cases: wood vs. kerosene and gas:** 12.3 (2.57, 58.60)	Stars = 4/12 (see above) Not included in meta-analysis as OR is an internal comparison of cases, and death may be influenced by factors affecting timing and severity of illness at admission. Result discussed in section on risk of fatal pneumonia.
Mtango 1992[7] Tanzania Rural, Bagamoyo District, altitude close to sea level Conducted 1986-87	**Age < 60 months** Cases: 610 deaths. ALRI = 154; other deaths = 456. Controls: 1160 healthy population controls, selected using multistage random cluster sampling. Children with ALRI (cough, respiratory rate >50) excluded.	All deaths in district during period were eligible, and ascertained using village based surveillance. Cause determined by VA, and health records (where available). Missed deaths checked through census at end of period: 67% of all deaths found this way, which implies VA done very late for many. Compared VA cause of death with recorded diagnosis in n=106 children seen at dispensary: of 35 pneumonia deaths on VA, 25 (71%) had this diagnosis at dispensary. **Deaths: cause determined by verbal autopsy**	Interview of family about type of fuel used and whether child sleeps in room where cooking is done. **Exposure prevalence: 95% of controls used wood for cooking.**	Matched adjustment using CMLR. Matching on villages because 'many of the variables were potentially related'. Adjusted for: Mother's education; ETS (parents); household religion; child sleeps in room with <4 people; vaccination; water from village tap; maternal age; parity; respondent; child eating pattern (alone, with others); decision maker on treatment. **Limited adjustment**	**Adjusted OR for all cause deaths for sleeping in room with cooking vs. not doing so:** 2.78 (1.79, 4.33) **Adjusted OR for death from pneumonia using same exposure measure:** 4.29 (95% CI not provided)	Stars = 3.5/12 Not included in meta-analysis as pneumonia deaths only 25% of total, and no SE or 95% CI available for pneumonia deaths. Potential of long delays in VAs for majority. Staff interviewing cases different from those interviewing controls. Authors recognised and stated 'both groups had extensive and similar experience in field surveys and interview techniques over the last five years in the same district.' Information collected from mother for 92% controls, but for only 62% of controls (adjusted for informant in analysis).

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
de Francisco, 1993[8] Gambia Upper River Division, rural, altitude close to sea level Conducted prior to 1990	**Age < 24 months** Cases: 129 deaths from ALRI. Controls: 270 live controls and 144 dead controls (other cause of death). All selected from community, live controls selected randomly from neighbourhood, dead controls being next on chronological list of deaths, not due to ALRI. Matched by age, sex, ethnic group, season of death, and geographic area.	Deaths ascertained by community surveillance. Cause of death by VA, confirmed by 2 out of 3 physicians working independently. Cause of death in controls determined by same VA procedure. **Deaths: cause determined by verbal autopsy**	Interview of family as soon as possible after the death. Information obtained on location and type of stove, carrying of child while cooking, and parental ETS (details not provided). This information used in analysis separately and combined in a score of indoor air pollution. **Exposure prevalence: not available (assumed to be ≥15%, based on evidence of other studies from rural Gambia)**	Adjustment in matched analysis using CMLR, including factors significant factors in univariate analysis. Factors considered: SES Score (type of house, father's occupation, mother's income, various possessions); maternal education, crowding, parental ETS, weight for age Z-score; vaccination; Vitamin A status and diet; child ever visited welfare clinic. **Good adjustment**	**Adjusted OR (cases vs. live controls), for carrying child on back while cooking vs. not carrying:** **Sometimes carrying:** 1.47 (0.54, 4.02) **Always carrying:** 5.23 (1.72,15.92) Univariate results for IAP score: no relationship. Adjusted OR for dead vs. live control: Sometimes carrying: 0.44 (0.21, 0.91); Always carrying 1.33 (0.62, 2.85)	Stars = 6.5/12 OR for 'always carrying' used in meta-analysis. Community controls should avoid selection bias, as all death ascertained through surveillance. Misclassification of ALRI deaths (e.g., confusion with malaria) is possible. Reliance on carriage of child as exposure measure, which has not been validated by personal exposure measurement. IAP score showed no relationship.
Victora 1994[9] Brazil Urban, Porto Alegre, altitude close to sea level Conducted 1990	**Age 0 to <24 months** Cases: 510 pneumonia patients from outpatient and inpatient departments of largest paediatric hospital in region. 510 controls from same neighbourhood matched for age. Selected if mothers indicated preference for medical consultation if ALRI to reduce selection bias.	Cases were admitted to hospital with a pulmonary infiltrate on chest X-ray (WHO criteria). Children with wheezing or a history of aspiration of a liquid or a foreign body excluded. Controls were age-matched, selected from the same community as cases. **Radiological diagnosis**	Trained field worker interview using standardised questionnaire. Observation of household characteristics. Exposure classified as 'indoor smoke' (any source of smoke in the house, including open-air fires, wood stoves or fireplaces). Also used question about whether the child is usually in kitchen while cooking. **Exposure prevalence: Only 6% controls exposed to 'indoor smoke'**	Analysis of IAP exposure to IAP was univariate as not significant. CMLR used for factors achieving statistical significance. Factors considered included: family income; mother's education; father's education; maternal age; overcrowding; quality of housing; parental smoking; cigarettes smoked; birth weight; breastfeeding; previous pneumonia; previous wheezing; day centre attendance. **Good adjustment (but estimate not available for smoke exposure)**	**Unadjusted OR for 'Indoor smoke' vs. reference (not described)** 1.1 (0.61, 1.98). Reference group not stated. **Unadjusted OR for 'child usually in the kitchen when cooking'** 0.97 (0.75, 1.26)	Stars = 7.5/12 OR for 'indoor smoke' used in meta-analysis. Only 6% of children exposed to indoor smoke. Urban population with relatively good access to health care. Unlikely to be representative of typical settings in developing countries. Proportion of deaths from pneumonia outside hospital is 25%.
Azizi 1995[10] Malaysia	**Age 1 to 60 months** Cases: 271 hospital	Diagnoses of pneumonia (143), bronchiolitis (92), LTB (32) and empyema (4). Radiologically	Interviewed by research staff unaware of aims of study. Enquired about cooking fuel,	The following variables were examined using unmatched UMLR:	**Unadjusted OR for all respiratory diagnoses for wood fuel vs.**	Stars = 7.5/12 Generally well-conducted case

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
Kuala Lumpur, urban, altitude sea level. Conducted 1989-90	inpatients with lower respiratory illness. Controls: 322 inpatients with non-respiratory illness, matched for age.	confirmed pneumonia, within 24 hours of admission. Confirmation based on presence of consolidation. **Radiological diagnosis of pneumonia (but not analysed separately)**	including fire wood, kerosene and other (presume compared with cleaner fuels). Prevalence of wood use 6.8%; of kerosene use 14.6%. Use of mosquito coils also recorded, as potential source of IAP. **Exposure prevalence: only 7% controls used wood**	Age; sex; ethnicity; type of home; crowding; parents education; ETS (father); sleeps with 3 others; birth weight; breast fed; previous diagnosis of allergy; family history of asthma; coughing siblings. **Adequate adjustment (but estimate not available for smoke exposure)**	**kerosene and other fuel (presumed cleaner fuel):** Wood: 1.20 (0.65, 2.21) Kerosene: 0.92 (0.58, 1.46) Adjusted estimates for fuel type were non-significant and are not presented.	control study, with suitable controls and effort to avoid recall bias. Exposure not well described, however. Unclear what wood fuel use was compared with (fuel and stove type). Prevalence of wood use only 6.8%
Fonseca 1996[11] Brazil Urban Forteleza, altitude sea level Conducted 1989-90	**Age < 24 months** Cases: 650 recruited from main paediatric hospital, over 12 months, all days of the week represented. Controls: 650 selected from same neighbour-hoods as cases, stratum matched for age (0-5 months; 6-11 months; 12-23 months). Only children whose mothers said they would attend a government service were included.	Cases were drawn from children with ALRI attending hospital out patients, with radiologically confirmed pneumonia. CXRs examined by paediatric radiologist. Children with wheeze, foreign body aspiration, congenital heart disease, congenital malformation, cerebral palsy, cystic fibrosis, or AIDS, were excluded. Controls excluded if respiratory rate raised, measles, or pertussis in prior 10 days. **Radiological diagnosis**	Interview questionnaire to mother or usual caretaker, in clinic (cases) or home (controls). Asked about "indoor smoke arising from poor cooking facilities or lighting". No further information available on types of fuel, stove, the relative proportion of poor cooking vs. lighting facilities, or of behavioural factors affecting child exposure. **Exposure prevalence: 10% of controls exposed**	Matched analysis, using CMLR. The following factors were examined and/or included in analysis: SES (income <twice minimum wage; no piped water); complete vaccination; parents' education; ETS; breast feeding; nutrition Z-scores; low birth weight; multiple birth; crowding; >7 prior pregnancies; day care attendance; prior wheezing; prior hospitalisation for pneumonia; industrial smoke. **Good adjustment**	**Adjusted OR for 'indoor smoke' exposure vs. no exposure:** 1.14 (0.71, 1.81)	Stars = 8/12 A very well conducted case-control study, considerable effort to avoid bias. However, exposure poorly described, and it is questionable whether the exposure described in this urban community is relevant to the majority of settings where biomass fuel use is common. Very low prevalence of exposure of 9.6%
O'Dempsey 1996[12] Gambia Upper River Division, rural, altitude close to sea level Conducted 1989-1991	**Age < 60 months** Cases: 80 out of 103 (70 definite, 33 possible) cases of pneumococcal disease, recruited from under-5 clinics and hospital OPD. Controls: 159 community controls selected within one	Aim was identification of pneumococcal disease. Trained nurses screened for possible pneumonia, meningitis or septicaemia, at outpatient clinics. If met specified criteria including raised respiratory rate (see paper for further detail), transported to Medical Research Council centre for physician diagnosis, CXR, blood culture, urine sample (for antigen test)	Interview questionnaire for all cases and controls within one week of identification of the case. Exposure assessed by question on whether mother carries child while cooking. Although cases recruited prospectively (described in title as 'prospective' study),	Matched analysis using CMLR used for adjustment. Factors examined: SES (father's occupation, whether mother has income, value of possessions); parents' education; ETS; child's weight slope; Vitamin A status; breast feeding (almost universal in study group); vaccination; total	**Adjusted OR for pneumococcal disease (all diagnoses, 79% of which were pneumonia) using carriage on back while cooking as exposure measure:** 2.55 (0.98, 6.65)	Stars =8/12 Community controls for severe illness should minimise selection bias. Proportion of all pneumococcal infections presenting to clinic that were detected is unknown, but may be incomplete. Reliance on carriage of child as

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
	week of case selection, from the same neighbourhood. Matched on age, within three months for <2 year olds, or within 6 months for older children.	lumbar puncture (where indicated), lung aspiration where lobar consolidation showed on CXR. All cases required clinical and laboratory evidence of pneumococcal infection. **Physician and laboratory diagnosis of pneumococcal disease**	exposure assessment was retrospective. **Exposure prevalence: 44% of controls exposed**	number sharing same room; recent illness; and significant illness in last six months. **Good adjustment**		exposure measure, which has not been validated by personal exposure measurement. Notable that OR for ETS comparable with that for IAP exposure, at 2.99 (1.10, 8.15).
Wesley 1996[13] South Africa Peri-urban Durban, altitude close to sea level Conducted 1988-91	**Age 3 to 36 months** Cases: 48 children with pneumonia admitted to King Edward VIII hospital, Durban. Controls: AURI attending same hospital, with respiratory rate <50/minute, and no wheeze or crackles on auscultation. Presume also: excluded children weighing < 2,500 gm at birth; overt protein calorie malnutrition. Matched on age and time period of illness.	Physician-diagnosed cases of pneumonia. Unclear whether inpatient or outpatient, but investigations would suggest inpatient for cases. Excluded children weighing <2,500 gm at birth and overt protein calorie malnutrition. CXR (all cases) scored for severity: 1-4 points for pneumonic shadows; 1 point for outer third involvement; 1 point for segmental collapse; 1 point for breakdown or effusion. State method had 'previously been successful in grading pneumonia severity' CFT for respiratory virus antibodies (range of viruses including RSV). **Radiological diagnosis**	Interview at home visit, after the case occurred. Obtained information on fuel type used for cooking and heating. Fuel types wood, coal or (presume as not stated) cleaner fuels. **Exposure prevalence: 14% of control homes used wood or coal fires.**	Adjustment for confounding not carried out. Information collected on parental smoking; day care attendance; crowding; weight for age; number of family contacts with respiratory infections. **Not adjusted**	**Unadjusted (unmatched) OR for exposure to wood or coal fires vs. (not stated) presumed cleaner fuels:** 1.35 (0.40, 4.71) Insufficient numbers for any meaningful analysis of RSV disease risk.	Stars = 4/12 Very poor characterisation of exposure, with no information on the frequency and intensity of use of the wood/coal stoves, whether these had chimneys, etc. Also, there is no information on the 'unexposed' group. Controls are hospital AURI cases. The analytic approach used looked at factors that may increase risk of lower ARI, compared to those with upper ARI (if IAP increased risk of both similarly, the result would be no association). In addition, children attending hospital with AURI are unlikely to be representative of the case population, so this may lead to bias. **Control selection bias possible**
Broor 2001[14] India New Delhi, mixed urban and rural,	**Age < 50 months** Cases: 201 hospital cases of severe ALRI. Controls: 311 healthy	Severe ALRI, defined as ill children with cough or fever less than 2 weeks duration, and presence of lower chest in-drawing with raised respiratory rates (defined using the WHO	Information obtained by interview on type of cooking fuel used in the home, either LPG or 'other than LPG' (implies this is mainly biomass, but no data on types	Stepwise MLR used to adjust for confounding where univariate p<0.2 , with the following variables examined: SES (type of house material);	**Adjusted OR for severe pneumonia, for 'exposure to fuel other than LPG' vs. LPG:** 2.51 (1.51, 4.16)	Stars = 5.5/12 Selection of well children attending hospital immunisation clinic for comparison with severe pneumonia inpatients may result in

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
altitude 250 metres Conducted 1995-97	children attending immunisation clinic.	cut-offs). **Physician diagnosis presumed, but chest wall indrawing and fast breathing also required**	of non-LPG fuel used). **Exposure prevalence: exposure to fuel 'other than LPG' in controls 21%**	parents' education; ETS; nutritional status; breast feeding history; vaccination; family history of respiratory infection in last 2 weeks. **Adequate adjustment**		bias. **Control selection bias possible** Exposure measure poorly described.
Mahalanabis 2002[15] Calcutta, India Urban and peri-urban, close to sea level Conducted 1997-98	**Age 2-35 months** Cases: 127 inpatients at Calcutta Children's Hospital. Any selection procedure used was not described. Controls: 135 attendees at immunisation clinic at the same hospital, weakly matched by age strata (2-11 months, 12-35 months).	Physician diagnosis of pneumonia and bronchiolitis. For pneumonia, used criteria (WHO) of tachypnoea (fast breathing) with or without lower chest 'constriction' and /or stridor. Admitting medical officer was 'supported by the paediatrician', and raised respiratory rate checked. Not clear if physician's diagnosis was criterion for pneumonia. Diagnosis for bronchiolitis less clear, assume based on clinical diagnosis. **Physician diagnosis (assumed)**	Details of data collection not given. Information obtained on solid fuel use (coal, wood cow dung), compared to other fuels (details not given). 29% of controls use some combination of solid fuels. No direct pollution or exposure measurement. **Exposure prevalence: 29% used solid fuels**	Unmatched UMLR used to adjust for: SES (has TV, fan, cement floor and wall, income>median); ETS (both parents); nutritional status (weight for age, mid arm circumference); breast fed; animals at home; history of asthma in child. **Good adjustment**	**Adjusted OR for risk of pneumonia and bronchiolitis combined (no separate analysis), with use of solid fuel vs. (presumed) non-use of solid fuel:** 3.97 (2.00, 7.88)	Stars = 5.3/12 As controls selected from immunization clinic in same hospital, there may be bias due to higher SES and hence less solid fuel use. No further information or discussion in paper. 65% male cases, but 50% male controls. **Control selection bias possible** Proportions of pneumonia and bronchiolitis not stated, and no separate analysis.
Kumar 2004[16] India Lucknow, urban and rural, altitude 150 metres Conducted 2001 to 2002	**Age 2 months to <60 months** Cases: 50 children admitted with severe pneumonia Controls: 50 children attending outdoor paediatric clinic for immunization. Matched for sex, age (within 6 months) and weight for height Z-score.	Primary goal of study was to investigate Zinc levels in severe pneumonia cases. As these were hospital inpatients, assume physician made diagnosis. However, the cases are described as 'satisfying the WHO criteria for severe pneumonia'. Children with diarrhoea, allergic disease or asthma excluded. **Physician diagnosis**	Method of data collection not described. Obtained information on fuel used in home, these being LPG or "biomass fuels other than LPG" (described as including coal, wood, dung and kerosene). Note 'coal' is sometimes used to describe charcoal in India, but this is not clear in the paper. **Exposure prevalence: 36% of control homes used 'biomass fuels other than LPG'**	Used CMLR in matched analysis to adjust for confounding. Variables examined: SES (Family type, separate cooking space); mother's education; urban/rural residence/ ETS (father); vaccination; blood zinc levels **Adequate adjustment**	**Adjusted OR for biomass fuels (coal, wood, dung and kerosene) vs. LPG:** 3.87 (1.15, 12.43)	Stars = 4/12 Selection of controls from immunization clinic for comparison with severe inpatient pneumonia cases may have resulted in bias**.** **Control selection bias possible** Adjustment missing some potential confounding variables (crowding, breast feeding).
Wayse 2004[17]	**Age < 60 months**	Main aim is investigation of role of sub-clinical Vitamin D	Questionnaire to obtain information on cooking fuels	Adjustment for confounding carried out with UMLR. The	**Adjusted OR for severe ALRI with biomass vs.**	Stars = 5.5/12

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
India Indapur, mainly urban, possibly mixed, altitude 500 metres Conducted 2002	Cases: 80 children admitted to hospital or seen in OPD with severe ALRI. Controls: 70 children living in same area as cases, attending immunization clinic. Not matched.	deficiency in severe ALRI. Definition of severe ALRI was presence of lower chest wall indrawing with raised respiratory rate (using WHO cut-offs). **Physician diagnosis presumed, but chest wall indrawing and fast breathing also required**	used in the home (biomass, LPG). **Exposure prevalence: 43% of controls used biomass**	following variables were examined: Housing; parental education; ETS; height for age; weight for age; breast feeding; vaccination; introduction of liquids and solids; exposure to sunlight before crawling. **Good adjustment**	**LPG:** 1.39 (0.57, 3.22) [presented in paper as adjusted OR for LPG vs. biomass: 0.72 (0.31. 1.65)]	Use of raised respiratory rate with chest wall indrawing in definition of severe ALRI. Controls from immunization clinic compared with severe, admitted ALRI cases. **Control selection bias possible** Very simple exposure classification, that is, no information on whether exclusive or partial use of LPG.
Case-control studies of solid fuel (wood) smoke exposure carried out in communities in developed countries (North America)						
Morris 1990[18] Navajo & Hopi communities, Arizona. Presumed mainly rural, altitude 1500 metres Conducted January to February 1988	**Age 2 weeks to <24 months** Cases: 58 presenting to Tuba City outpatient department (OPD) and Emergency Room with pneumonia or bronchiolitis. Not stated whether all eligible presenting cases recruited. Controls: 58 matched on age (within 0.5 months) and sex.	Cases: Physician diagnosis of pneumonia (evidence of infiltrate on chest X-ray required), or bronchiolitis. Excluded children with history (from records) of asthma, prematurity, ventilator dependency, congenital heart disease. Controls: Presenting to same OPD, but for well child care: no infectious disease, and no history of LRTI. Excluded children with history (from records) of asthma, prematurity, ventilator dependency, congenital heart disease. **Radiological diagnosis**	Information collected by structured interview, at the time of presentation, with the adult caregiver (usually parent or grandparent). Asked about 'primary source of energy for heating and cooking'. **Exposure prevalence: 57% of controls used a wood stove for heating**	Examination in univariate analysis and adjustment as required using CMLR in matched analysis for: SES (crowding, running water, and dirt floor); ETS (although smoking in only 9% homes); humidification; recent respiratory illness exposure; pets in home; family history of asthma. **Adequate adjustment**	**Adjusted OR for combined outcome of pneumonia and bronchiolitis, for use of wood burning stove vs. no use:** 4.85 (1.69, 12.91)	Stars = 5/12 Some concern about bias from control selection, which is discussed by authors. Suggest that controls probably representative of case population as most children (90%) born at Tuba City hospital complete immunizations, but it is not shown that this applies to the study controls. **Control selection bias possible** Care seeking for cases is also not described. No differentiation in outcome between pneumonia and bronchiolitis.
Robin 1996[19] Navajo community, Fort Defiance, Arizona	**Age 1-24 months** Cases: 45 ALRI cases ascertained from inpatient records at Fort Defiance Hospital and	Cases: physician diagnosed lower respiratory illness, bronchiolitis or pneumonia. Chest X-ray requirement not stated. All cases admitted during the period October 1992	Interview with parents or carers at home. Asked about type of cooking and heating fuels, which included wood, coal, gas and electricity.	Adjustment made for each confounder separately, and report that had little effect (<20% of OR). Factors examined were:	**Unadjusted OR for pneumonia and bronchiolitis, for use of wood alone for heating vs. clean fuel:**	Stars = 7.5/12 Small numbers. Limited consideration of confounding factors, and not adjusted in multivariate regression.

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 12]
Presumed mainly rural, altitude 2000 metres Conducted 1992-93	Indian Health Service Facility. Controls: 45 matched on age (within 30 days) and sex. Outpatients from same hospital, without ARI, over same period. Cardio-respiratory conditions and previous ALRI cases excluded.	to April 1993. **Physician diagnosis**	PM_{10} levels measured in all study homes, for 15 hrs from 5 pm to 8 am, 2 weeks to several months after illness: Use gas/electricity (n=33); median 22.2 µg/m^3 Cook and heat with wood; median 85.6 µg/m^3 **Exposure prevalence: 51% of control used wood for heating (not necessarily only wood)**	SES (number of children in house, hot/cold water, electricity, type of home), difficulty with transport to clinic, ETS. **Limited adjustment**	1.4 (0.6, 3.3) OR (not adjusted) of ALRI among children living in houses with a PM10>=65 µg/m^3 relative to those in houses with PM10 <65 µg/m^3 was 7.0 (95% CI 0.9 to 56.9).	Levels of PM_{10} are low relative to developing country studies, but demonstrated to be higher in wood using homes.

A.3 Cohort studies

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 13]
Pandey 1989[20] Nepal Kathmandu Valley, rural, Altitude 1200 – 2000 metres Conducted 1984-85	**Age < 24 months** 780 (study I) Feb – July 1984. 455 (study II) Nov 1984 – Jan 1985. All residents from two contiguous village "panchayats".	Fortnightly home visits: ARI grades from I to IV (Goroka severity grading). Grade III included chest indrawing or fast breathing or stridor; IV includes heart failure, cyanosis or shock, breathlessness. **Trained field workers using Goroka pneumonia grades, with health assistant supervision**	Asked mothers for average hours per day the child was near the fireplace. In study 1, same team personnel asked about exposure & ARI, so possible bias. Hence in study II used separate personnel. **Exposure prevalence (more than 2 hours per day): Study I: 55%; Study II 24%**	Authors state that, since homes were 'homogeneous,' adjustment for confounding was not carried out. **No adjustment**	**Unadjusted OR for Grades III and IV, for exposure ≥2 hours vs. less than 2 hours** Study I: 2.2 (1.6, 3.0) Study II: 40.6 (9.79, 168.8) (Both estimates used in meta-analysis, as these are separate groups of children)	Stars = 4/13. Exposure-response relationship reported but assessment of exposure not validated. Lack of adjustment for any confounding factors. Very high OR for Study II, but of the two, it is the second that might be expected to have less bias. **The (outlying) estimate from study II removed in sensitivity analysis.**
Campbell 1989[21] Gambia Rural Basse Conducted 1987-88	**Age < 24 months** 280 children (youngest in family).	Weekly surveillance - mother's history of "difficulty with breathing" over subsequent 3 month period. **Parental recall. Weekly recall by mother of "fast or difficult breathing"**	Reported carriage of child on the mother's back whilst cooking. **Exposure prevalence: not stated (37% carried on mother's back whilst cooking in Armstrong 1991)**	Adjustment made for: birth interval; parental ETS; crowding; socioeconomic score; nutritional indicators; vaccination status; number of health centre visits; ethnic group and maternal education. **Good adjustment**	**Adjusted OR for reported fast or difficult breathing, for carriage of child on mother's back whilst cooking** 2.8 (1.3, 6.1)	Stars = 3/13. Father's ETS only other significant factor. Authors are cautious about interpretation, ability to deal with confounding, and to establish causation (in observational studies) where exposure and incidence high.
Armstrong 1991[22] Gambia Rural Upper River Division Not stated when conducted	Age < 60 months 587 children 7 villages, 10- 15km from Medical Research Council field station in Basse.	Weekly home visits by trained field worker looking for ALRI signs. Subsequently assessed by physician examination and CXR (independently assessed by 2 clinical investigators). Clinical and CXR signs required for case definition. **Radiological (with clinical) diagnosis**	Reported carriage of child on mother's back whilst cooking. **Exposure prevalence: 37% 'carried on mother's back whilst cooking'**	Adjustment made for: parental ETS; crowding;- socioeconomic index; number of siblings; sharing bedroom; vitamin A intake; number of wives; number of clinic visits; village ethnicity; birth order; weight for age (NCHS standard). **Good adjustment**	**Adjusted OR for X-ray confirmed ALRI, for carriage of child on mother's back whilst cooking** Approach (i) - All episodes males: 0.5 (0.2, 1.2) females: 1.9 (1.0, 3.9) Approach (ii) - 1st episode males: 0.5 (0.2, 1.3) females: 6.0 (1.1, 34.2)	Stars = 7.7/13. Boy/girl difference in OR could be due to greater exposure. Reporting of carriage on back whilst cooking stated quite a distinct behaviour so should define the two groups fairly clearly with low level of misclassification. However, as with other studies using this measure, validation of exposure differential not demonstrated.

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 13]
Jin 1993[23] China Urban Shanghai Conducted 1983	**Age < 19 months** 1007 children. Retrospective cohort of children born in last quarter of 1983.	Health cards were used during a survey to verify parental recall of any hospital attendance since birth. Health card contained information on diagnosis by doctor as wheezing or non-wheezing bronchitis or pneumonia. **Physician diagnosis of wheezing or non-wheezing bronchitis or pneumonia based on health cards**	Reported use of coal or gas as fuel for cooking. **Exposure prevalence: 34% used coal for cooking**	Adjustment made for: parental ETS; sex of child; whether breast fed; birth weight; maternal age at birth; parental education. **Limited adjustment**	Adjusted RR for diagnosed ALRI (inc. bronchitis) based on health cards, for use of coal for cooking vs. gas: 0.7 (no confidence interval given) **Unadjusted RR for diagnosed ALRI (inc. bronchitis) based on health cards, for use of coal for cooking vs. gas:** 0.6 (0.6-1.0)	Stars = 5.5/13. Quality and completeness of health cards is not known; bronchitis is also included in the outcome definition for analysis. This study was primarily concerned with risk of passive smoking and not use of biomass.
Ezzati 2001[24;25] Central Kenya Mapla Ranch, Rural, Altitude 2000 metres Conducted 1997-99	**Age < 60 months** 93 children from 55 randomly selected rural households.	Fortnightly home visits by trained nurses initially, later in study visited each week. Stated that staff were trained using 'WHO protocols for clinical diagnosis of ARI', but further details of symptoms and signs assessed not given. **Field worker assessed WHO pneumonia, with health cards**	Microenvironment real time measurement of PM_{10} for 14-15 hrs, combined with information collected on time spent by the child at each micro-environment. Daily 24-hr exposure: M: 1.4(1.1) $\mu g/m^3$; F:1.3(1.2) $\mu g/m^3$ **Exposure prevalence: 46 (49%) of children in 1000 $\mu g/m^3$ and above exposure groups, but only 5 (5.3%) children in highest (>3,500 $\mu g/m^3$)**	Adjustment made for: age; sex; number of people in house; village type. **Limited adjustment**	**Adjusted ORs for fieldworker WHO pneumonia, for stated exposure levels compared to reference of <200$\mu g/m^3$** 200-500 $\mu g/m^3$: 1.48 (0.83, 2.63) 500-1,000 $\mu g/m^3$: 1.40 (0.74, 2.67) 1,000-2,000 $\mu g/m^3$: 2.33 (1.23, 4.38) 2,000-3,500 $\mu g/m^3$: 1.93 (0.99, 3.78) >3500 $\mu g/m^3$: 2.93 (1.34,6.39)	Stars = 7.5/13. Exposure group 1,000-2,000 $\mu g/m^3$ used for meta-analysis as middle value among non-reference categories, with sufficient numbers (pooling of groups not available). Analysis of outcome uses all weeks with ALRI, not new episodes. Main confounding variables like ETS, vaccination status, breastfeeding, SES were not adjusted.

A.4 Intervention studies

Study	Subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues [max stars = 14]
Smith (in preparation)[26-28] RESPIRE (main results papers unpublished) Guatemala, San Marcos rural highlands, altitude 2,200 to 3,000 metres Conducted 2002 - 2004	**Age <19 months** 518 children recruited aged <4 months or in utero, followed until aged <19 months or completion of study in December 2004. Indigenous (Mam) Indian community. Households randomised to intervention (plancha chimney wood stove) or continue use of traditional 3-stone wood fire.	Weekly home visit by field workers trained in WHO pneumonia recognition, interviewed mother and examined child. Children with possible ALRI referred to study physician working in local community centre (to maintain blindness from intervention status), carried out clinical examination, including pulse oximetry. Cases of pneumonia tested (direct antigen test) for RSV (90% tested) and referred for CXR (79% X-rayed). Analysis carried out on new episodes (separated by at least one week without lower respiratory signs). **Physician diagnosis (radiological diagnosis and RSV status available)**	Comparison of intervention chimney stove. Personal exposure measured using 48-hour CO as proxy for wood smoke in all children, repeated 3 monthly, showed 52% (95% CI: 56, 47)% reduction. Kitchen pollution measured using 48-hour and real time CO (and PM – awaited) in random sub-sample, repeated 3 monthly, showed >80% reduction. **Exposure prevalence: 50% intervention homes**	**Randomisation effective (adjustment not required)** Use of intention to treat analysis using GEE for comparison of plancha vs. open fire. Exposure-response analysis adjusted using GEE for: Age; season; sex; SES; kerosene lamps; wood-fired sauna; asset index; floor; roof; mother's age; crowding; altitude; occupation; water source; maternal/paternal education.	**A. Intention to treat analysis** (Results presented as plancha vs. control). **Fieldworker defined:** All: 0.91 (0.73, 1.13) Severe (chest indrawing and/or unable to feed): 0.54 (0.31, 0.96) **Physician defined:** All pneumonia: 0.85 (0.63, 1.14) Severe (hypoxaemic): 0.74 (0.50, 1.09) Pneumonia on X-ray: 0.85 (0.50, 1.43) **B. Adjusted RR for 50% exposure reduction:** **Fieldworker defined:** All: 0.93 (0.75, 1.08) Severe (chest indrawing and/or unable to feed): 0.59 (0.37, 0.96) **Physician defined:** All pneumonia: 0.74 (0.58, 0.95) Severe (hypoxaemic): 0.67 (0.50, 0.90)	Stars = 11.5/14 Provisional analyses awaiting full publication. Evidence of modest bias in case ascertainment (higher compliance with referral and investigations in plancha group), but this is in direction of biasing risk estimate towards no effect. Incomplete RSV and Chest X-ray data.

Appendix Table B: Studies providing information on risk of Respiratory Syncytial Virus (RSV) illness

Study	Design, subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues
Weber 1999[29] Western Gambia Urban and rural, close to sea level Conducted 1993-95	Case control. Age under 5 years. 277 cases of severe (hospitalised) RSV +ve illness , admitted to 3 hospitals. Subjects lived within 40 km of hospitals, which take almost all admissions for RSV. 364 matched controls recruited in two periods: (i) 1993, 142 controls, randomly selected from Gambian HiB trial, not admitted with RSV. Matched on health centre and age within one week. (ii) 1994, 222 controls not admitted for ARI, matched on village or suburb and age.	Cases were those children admitted with a physician diagnosis of acute lower respiratory tract infection, and confirmation of RSV infection. RSV status carried out by immune-fluorescent microscopy on nasopharyngeal aspirate, within MRC Gambia laboratory.	Interview asking about frequency of cooking, carriage of child on back while cooking (including when sick), and location of cooking. No direct pollution or exposure measurement.	In addition to matching, CMLR used to adjust for: SES (father's occupation, nationality, mother's ethnic group, toilet type, electricity in home); parents' education; key food items; breast feeding; water source; siblings alive; co-wives; place of delivery; number of children 3-5 yrs and 2 -<3 yrs; animals in compound. Father's smoking non-significant so not in model.	Adjusted OR for cooking more than once daily 0.31 (0.14, 0.70)	Stars: 5/12 Case definition (severe) relies on clinical decision to admit, but RSV status specific. If all (or great majority) of severe RSV cases admitted, then community controls appropriate and should avoid bias. Authors, in discussion of findings for SES (lower SES protective), do consider whether higher SES households are more likely to seek care and be admitted.
Al-Sonboli 2006[30] Yemen Altitude 2,200 metres Conducted 2002-03	Case control. Age <2 years. 266 RSV positive severe ARI cases and 34 RSV positive non-severe controls. 66 HMPV positive severe ARI cases and 20 HMPV[1] positive non-severe controls. No matching. Recruited at Al Sabeen Hospital, Sana'a.	All cases and controls recruited from ARI cases attending hospital outpatient department and emergency room (8 am to 1 am) and from ward for overnight admissions. RSV and HMPV status assessed by PCR. Pulse oximetry carried out on all subjects, severe hypoxaemia being defined as SaO_2 <88%. For analysis, cases were those with severe hypoxaemia.	Interview at time of assessment in hospital (details of data collection sparse). Asked about fuel for cooking, and categorised by whether used gas or other fuel (implies that this would usually be wood and/or dung). No direct pollution or exposure measurement.	Backward stepwise MLR used to adjust for variables associated with p<0.2. Assessment included: Source of water; ETS; height for age score; exclusive breastfeeding; incomplete vaccinations; preterm birth; recurrent wheeze, asthma, eczema; family member with ARI, asthma, eczema, allergies; animals indoors; larger animals.	Adjusted OR for severe hypoxaemic RSV ARI: 10.3 (2.2, 48.0) Adjusted OR for severe hypoxaemic HMPV ARI: 13.1 (2.2, 78.0)	Stars: 5.3/12 Clearly defined outcome, specific to RSV and HMPV. Potential for control selection bias. Only 7% of controls 'exposed'. Very small control groups. Exposure poorly defined.

[1] HMPV: Human meta-pneumovirus

Study	Design, subjects and setting	Outcome Definition	Exposure assessment	Adjustment for confounding	OR (95% CI)	Quality assessment and issues
Jeena 2003[31] Durban, South Africa Close to sea level 96% urban	Case control. Age 3 to <24 months, with 91% < 12 months old. 114 cases of clinically diagnosed bronchiolitis. Of these, 23 were admitted and used as cases in analysis, while outpatient (OPD) children with bronchiolitis were used as controls. Recruited in OPD at King Edward VIII hospital, 8 am to 4pm weekdays.	Bronchiolitis "defined in accordance with international diagnostic criteria" [see paper for referencing]. Pulse oximetry conducted. Naso-pharyngeal aspirate for RSV monoclonal immuno-fluorescence. Other respiratory viruses tested. RSV +ve had blood taken for cytotoxic T-cell assay. Children with asthma, chronic neurological deficits, severe malnutrition, respiratory failure were excluded.	Asked at interview about "exposure to products of fuel combustion during cooking". Prevalence of exposure in controls = 26.8%, but text suggests mainly kerosene (not clearly described).	Adjusted in multivariate analysis for: Age, atopy, crowding, previous wheezing.	Unadjusted OR from paper: 2.43 (p = 0.05) [Calculated: OR=2.42 (0.84, 6.83), p=0.061] Adjusted OR not provided, but reported to be non-significant.	Stars = 3/12 Small study with only 23 cases. Relies on admission as criterion on severity. Possible control selection bias. Poorly defined exposure assessment, and text implies kerosene is main fuel used in the 'exposed' group.
Smith et al[26;27] RESPIRE trial Guatemala, San Marcos. Rural, altitude 2,200 to 3,000 metres Conducted 2002 – 2004	Randomised control trial See Appendix Table A.4 518 children aged < 19 months	See Appendix Table A.4 80 (33.9%) of physician diagnosed pneumonia cases with RSV test result were positive. Hypoxaemia defined as SaO2 <87%, based on mean – SD for well children in study sample.	See Appendix Table A.4 Intervention vs. control, plus direct pollution and exposure measurement.	Randomisation effective for intention to treat analysis.	**A. Intention to treat analysis** For plancha vs. control: All RSV +ve pneumonia: 0.95 (0.60, 1.50) All RSV –ve pneumonia: 0.91 (0.64, 1.30) Severe (hypoxaemic) RSV +ve: 1.05 (0.60, 1.84) Severe (hypoxaemic) RSV -ve: 0.61 (0.36, 1.04)	[See Appendix Table A4]

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