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Slum upgrading strategies and their effects on health and socio-economic outcomes

A systematic review

August 2013

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Urban development and health



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Slum upgrading strategies and their effects on health and socio-economic outcomes: a systematic review

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Abstract

Background

Slums are densely populated, neglected parts of cities where housing and living conditions are exceptionally poor. In situ slum upgrading, at its basic level, involves improving the physical environment of the existing area, such as improving and installing basic infrastructure like water, sanitation, solid waste collection, electricity, storm water drainage, access roads and footpaths, and street lighting, as well as home improvements and securing land tenure.

Objectives

To explore the effects of slum upgrading strategies involving physical environment and infrastructure interventions on the health, quality of life and socio-economic wellbeing of urban slum dwellers in low and middle income countries (LMIC).

Where reported, data were collected on the perspectives of slum dwellers regarding their needs, preferences for and satisfaction with interventions received.

Search methods

We searched for published and unpublished studies in 28 bibliographic databases including multidisciplinary (for example Scopus) and specialist databases covering health, social science, urban planning, environment and LMIC topics.

Snowballing techniques included searching websites, journal handsearching, contacting authors and reference list checking. Searches were not restricted by language or publication date.

Selection criteria

We included studies examining the impact of slum upgrading strategies involving physical environment or infrastructure improvements (with or without additional co-interventions) on the health, quality of life and socio-economic wellbeing of LMIC urban slum dwellers. Randomised controlled trials (RCTs), controlled before and after studies (CBAs) and interrupted time series (ITS) were eligible for the main analysis. Controlled studies with only post-intervention data (CPI) and uncontrolled before and after (UBA) studies were included in a separate narrative to examine consistency of results and to supplement evidence gaps in the main analysis.

Data collection and analysis

Two authors independently extracted data and assessed risk of bias for each study. Differences between the included study interventions and outcomes precluded meta-analysis so the results were presented in a narrative summary with illustrative harvest plots. The body of evidence for outcomes within the main analysis was assessed according to GRADE as very low, low, moderate or high quality.

Main results

We identified 10,488 unique records, with 323 screened as full text. Five studies were included for the main analysis: one RCT with a low risk, two CBAs with a moderate risk and two CBAs with a high risk of bias. Three CBAs evaluated multicomponent slum upgrading strategies. Road paving only was evaluated in one RCT and water supply in one CBA. A total of 3453 households or observations were included within the four studies reporting sample sizes.

Most health outcomes in the main studies related to communicable diseases, for which the body of evidence was judged to be low quality. One CBA with a moderate risk of bias found that diarrhoeal incidence was reduced in households which received water connections from a private water company (risk ratio (RR) 0.53; 95% confidence interval (CI) 0.27 to 1.04) and the severity of diarrhoeal episodes (RR 0.48; 95% CI 0.19 to 1.22). There was no effect for duration of diarrhoea. Road paving did not result in changes in parasitic infections or sickness in one RCT. After multicomponent slum upgrading, claims for a waterborne disease as opposed to a non-waterborne disease reduced (RR 0.64; 95% CI 0.27 to 0.98) in one CBA with a high risk of bias but there was no change in sanitation-related mortality in a CBA with a moderate risk of bias.

The majority of socio-economic outcomes reported within the main studies related to financial poverty, for which the body of evidence was of very low quality. Results were mixed amongst the main studies; one RCT and two CBAs reported no effect on the income of slum dwellers following slum upgrading. One further CBA found significant reduction in monthly water expenditure (mean difference (MD) -17.11 pesos; 95% CI -32.6 to -1.62). One RCT also showed mixed results for employment variables, finding no effect on unemployment levels but increased weekly worked hours (MD 4.68; 95% CI -0.46 to 9.82) and lower risk of residents intending to migrate for work (RR 0.78; 95% CI 0.60 to 1.01).

There was no evidence available to assess the impact of slum upgrading on non-communicable diseases or social capital. Maternal and perinatal conditions, infant mortality, nutritional deficiencies, injuries, self-reported quality of life, education and crime were evaluated in one study each.

Nine supporting studies were included that measured varying outcomes (6794 households or observations within eight studies reporting sample sizes). One CPI evaluated cement flooring only while three UBAs and five CPIs evaluated multicomponent slum upgrading strategies. All studies but one had a high risk of bias.

The studies reinforced main study findings for diarrhoea incidence and water-related expenditure. Findings for parasitic infections and financial poverty were inconsistent with the main studies. In addition, supporting studies reported a number of disparate outcomes that were not evaluated in the main studies.

Five supporting studies included some limited information on slum dweller perspectives. They indicated the importance of appropriate siting of facilities, preference for private facilities, delivering synergistic interventions together, and ensuring that infrastructure was fit for purpose and systems were provided for cleaning, maintenance and repair.

Authors' conclusions

A high risk of bias within the included studies, heterogeneity and evidence gaps prevent firm conclusions on the effect of slum upgrading strategies on health and socio-economic wellbeing. The most common health and socio-economic outcomes reported were communicable diseases and indicators of financial poverty. There was a limited but consistent body of evidence to suggest that slum upgrading may reduce the incidence of diarrhoeal diseases and water-related expenditure.

The information available on slum dwellers' perspectives provided some insight to barriers and facilitators for successful implementation and maintenance of interventions.

The availability and use of reliable, comparable outcome measures to determine the effect of slum upgrading on health, quality of life and socio-economic wellbeing would make a useful contribution to new research in this important area. Given the complexity in delivering slum upgrading, evaluations should look to incorporate process and qualitative information alongside quantitative effectiveness data to determine which particular interventions work (or don't work) and for whom.

Plain language summary

The effect of slum upgrading on slum dwellers' health, quality of life and social wellbeing

Low and middle income countries (LMIC) are home to over 90% of the one billion people living in slums. Urban slums describe parts of cities where living conditions are exceptionally poor. The slums lack basic services and often have many people crowded into small living spaces. Slums can provide shelter and proximity to jobs, and communities are often social and supportive. However, poor living conditions and health are closely related, and illnesses such as diarrhoea, malaria, cholera and respiratory diseases are common.

Slum upgrading basically involves improving the physical environment, for example the water supply, sanitation, waste collection, electricity, drainage, road paving and street lighting. Additional strategies may be included to improve access to health, education and social services, increase residents' income and secure legal rights to the land.

We found five main studies with suitable methods for examining the effect of slum upgrading on health, quality of life and social wellbeing (for example poverty). Nine supporting studies were also included, which used methods that could indicate associations between interventions and outcomes but could not assess whether interventions caused the effect. Only one main study had a low risk of bias, with the rest having a mixed or high risk of bias. The majority of supporting studies had a high risk of bias, meaning their methods had several limitations that made the study results unreliable. In addition, the studies measured different interventions and outcomes, making it difficult to compare results.

Overall, there was limited but consistent evidence to suggest that slum upgrading may reduce diarrhoea in slum dwellers and their water-related expenses. There were mixed results for whether slum upgrading reduced parasitic infections, general measures of communicable diseases, financial poverty and unemployment outcomes. There was very little information on other health or social outcomes, or which types of interventions were most beneficial. Some of the studies asked slum dwellers for their views and their experiences of slum upgrading interventions. They suggested a number of reasons why facilities were not used as intended and which may have reduced the benefits.

Future research, with improved study designs and common outcome measures, is needed to determine how best to improve the conditions of existing slums and to offer the most benefit to the health, quality of life and social wellbeing of slum dwellers.

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1. Background

1.1 Description of the issue

Slums are densely populated and neglected parts of cities where housing and living conditions are exceptionally poor. Varying in nature, from central city tenements to spontaneous squatter settlements at the edge of cities, slums are the product of unplanned urbanisation and are responsible for a number of socio-economic and health problems for their residents ([UN HABITAT 2003a](#)). Conditions of living within slums can differ between countries and even between residents within the same country or city. Some settlements may have few employment prospects for residents, whereas others may provide a wealth of formal or informal income-earning opportunities. Rapid population growth, rural-urban migration and the failure of urban governance are considered the key contributory factors for the development of slums ([WHO 2005](#)).

This review focused on slums, and the impact of strategies to upgrade them, in low and middle income countries (LMIC). Home to over 90% of slum dwellers today, a significant proportion of slums and the related socio-economic and health burdens occur in these LMIC regions ([United Nations 2007a](#)). Efforts to improve slum conditions in these resource-constrained settings may also be met with further challenges of extreme poverty, rapid population growth and urbanization.

It is expected that nearly 60% of the world's population will be urban dwellers within two decades. Urban population growth is most rapid in LMICs, where cities gain an average of five million residents every month. Rapid and unplanned growth of urban centres is occurring in the context of unfavourable economic conditions, inadequate urban planning policies and regulatory frameworks unresponsive to the transformation in progress. As a result, the number and size of informal settlements or slums are growing rapidly ([United Nations 2007b](#)).

The United Nations Human Settlements Programme (UN-Habitat), the global agency for promoting socially and environmentally sustainable towns and cities, provides a working definition of slums that focuses on both physical living conditions and legal aspects. According to UN-Habitat, a slum household is defined as a group of individuals living under the same roof in an urban area and who lack one or more of the following:

1. access to improved water (access to sufficient amount of water for family use, at an affordable price, available to household members without being subject to extreme effort);
2. access to improved sanitation (access to an excreta disposal system, either in the form of a private toilet or a public toilet shared with a reasonable number of people);
3. security of tenure (evidence of documentation to prove secure tenure status or de facto or perceived protection from evictions);
4. durability of housing (permanent and adequate structure in non-hazardous location);
5. sufficient living area (not more than three people sharing the same habitable room) ([UN HABITAT 2003a](#)).

In addition, slums may lack other municipal services (storm drainage, street lighting, paved footpaths, emergency access roads, electricity and energy for cooking and heating) and suffer from a paucity of educational, social and health services and institutions (childcare facilities, schools, playgrounds, health clinics) ([UN HABITAT 2003a](#)).

Evidence for the association between key characteristics of slums and ill health ([UN HABITAT 2003a](#)) has been discussed by several authors ([Kyobutungi 2008](#); [Riley 2007](#); [Sclar 2005](#); [Unger 2007](#)). Poor access to safe water and sanitation can often lead to water scarcity or contamination, increased rat density and open sewers. These living conditions among slum dwellers can lead to high risks of communicable diseases such as diarrhoeal diseases, cholera, malaria, dengue and leptospirosis. Poor structural quality of housing (such as damp housing) or homes located in hazardous areas can make slum dwellers susceptible to respiratory illnesses like tuberculosis (TB) or asthma and injuries from land or mud slides, flooding or fire. Overcrowding in slums also provides enhanced opportunity for transmission of diseases such as TB and other respiratory conditions. Furthermore, lack of secure tenure can inhibit residents' access to health care or social services in the neighbourhoods. [Appendix 1](#) provides an overview of the adverse health outcomes associated with slum defining characteristics, reproduced from [Unger 2007](#).

Although the proximate physical environment of slum dwellers is a major factor in the transmission of communicable diseases, it is only one of a number of key influences on health and wellbeing. The major trends shaping urban living conditions are complex. Existing frameworks to describe the determinants of urban health posit that fundamental distal, or 'upstream', factors (such as population size, climate, geography, political orders, economy, religion and culture) underlie and influence health and wellbeing via multiple pathways. These in turn influence an array of interlinking proximate physical and social factors, interceded by the individual's behaviour, knowledge and healthcare seeking behaviour (see [Northridge 2003](#) and [Galea 2005](#)).

1.2 Description of the intervention

Advocated by John Turner in the 1970s, slum upgrading, in its most basic form, involves improvements in the physical environment of the existing area, for example improving or installing basic infrastructure services such as water, sanitation, solid waste collection, electricity, storm water drainage, access roads, footpaths and street lighting. Interventions may also include home improvements and securing land tenure. Over time the concept of upgrading has evolved to include integration of social, economic, organizational and environmental intervention components ([Wekesa 2011](#)). Through partnerships with slum residents, community groups, non-governmental organisations (NGOs), businesses and municipal authorities or local governments, the goal of slum upgrading programs is to provide basic services; strengthen the capacity of governance institutions to support upgrading projects in slums; improve the livelihoods of people living and working in informal settlements; and empower communities to improve their wellbeing ([WHO 2005](#)).

This review examines the impact of slum upgrading programmes on health and social wellbeing. A broad range of slum upgrading approaches and their interlinkages with health and socio-economic outcomes have been depicted in the logic model ([Figure 1](#)). These have been grouped into proximal interventions within the living environment (physical environment, social environment, service access, health promotion and behavioural interventions) and distal strategies that enable structures and systems to implement these proximal environment interventions (policies, laws and regulations, financial investment, community action, or a combination of these factors). The logic model also demonstrates that strategies may be delivered by governments (global, national, state or local), the private sector, civil society, or by a combination of these actors and stakeholders.

The number, breadth and diversity of slum upgrading interventions outlined in the logic model are too broad to be assessed in a single systematic review. This review, therefore, has focused on upgrading interventions involving physical environment and infrastructure improvements, with or without the integration of wider slum upgrading approaches (for example policy, legal, financial, community action, social or service interventions). Where such studies deliver multicomponent strategies, the nature of the full package of interventions were examined.

This review did not set out to examine the issue of preventing future unplanned growth of slums, nor to evaluate the impact of slum clearance or relocating slum dwellers to new housing. While these remain key areas of relevance to the health and wellbeing of the urban poor, and critical issues worthy of investigation, they are outside the scope of this review and will require examination through separate reviews.

1.3 How the intervention might work

1.3.1 Potential effects of slum upgrading

The complex picture of urban health influences suggests that slum upgrading strategies have the potential to effect various interwoven health and socio-economic outcomes. Interventions may directly influence physical and mental health through a reduction in the risks of disease transmission, injuries and stressors; or indirectly through economic development and modification of key socio-economic factors. Interventions may also have varying impact at the individual, household or community level. For example, installing private latrines in homes may improve the health within the household, but if the latrines are not connected to an effective sewerage system in the neighbourhood the community may still be exposed to waste and its associated health risks.

A World Health Organization (WHO) literature review assessing the evidence for associations between slum life, health and health inequity demonstrated that overcrowding has been linked with stress and violence (including intimate partner violence) ([WHO 2005](#)). Thus, in addition to checking the spread of communicable diseases, reduced overcrowding may lead to declines in injuries and mental health problems. The WHO review also points to links between poverty and mental illness, child malnutrition, stunting and wasting plus health risk behaviours (for example drug and tobacco use) ([WHO 2005](#)).

Existing evidence suggests water and sanitation improvements could improve both health and socio-economic wellbeing. Systematic reviews (not limited to slum settings) report reductions in rates of diarrhoeal diseases following improved water supply ([Clasen 2006](#); [Waddington 2009](#)) and excreta disposal ([Clasen 2010](#)). In addition to health gains and reduced health costs, a recent WHO cost-benefit analysis of water and sanitation access at the global level demonstrated clear reductions in days lost with respect to formal and informal employment, school attendance, or other productive activities in the household, as a result of time saved from illness and accessing safe water and sanitation ([Hutton 2004](#)). A further impact evaluation concluded that improvements in water supply enhance household economy as residents are able to reallocate the time saved in collecting water to income-generating activities ([Aiga 2002](#)).

Land titling has often been included within slum upgrading strategies. It is increasingly being considered one of the most effective forms of encouraging economic growth in poor communities. De Moura 2009 suggested that land titling leads to a reduction in child labour force participation; and [Field 2006](#) indicated that securing tenure can lead to significant increases in the value of housing and, in turn, increases banks' willingness to use housing as collateral for loans.

1.3.2 Potential moderators of slum upgrading

The effects of slum upgrading strategies may be moderated by upstream influences on urban slum strategies, such as governance, crime and mafia influence, culture, religion and gender roles. For example, [Field 2006](#) noted that criminal organizations may present significant barriers to project implementation by controlling access to water supplies. Land mafias that acquire, develop and sell slum land in illegal ways for profit may also hinder slum improvement strategies.

Key organisations such as Cities Alliance, a global alliance of cities and their development partners, advocate community participation in the planning and delivery of interventions as being a key aspect of successful slum upgrading. Women's participation is particularly advocated as slum dwelling women are likely to have useful skills honed from running the household and specific needs due to cultural norms that often do not give them the same legal rights or status as a man ([Cities Alliance 2011](#)).

Thus, wider slum upgrading programmes targeting policy, organizational, community engagement, financial, social environment and health and social care access aspects may enhance the impact of slum upgrading strategies on slum dwellers' health and socio-economic wellbeing. The short and long-term effects of the slum upgrading programmes will also be mediated by process variables, such as the uptake and completion of the programme; its reach, longevity or sustainability; and slum dwellers' satisfaction and acceptance of the intervention.

Given the complex nature of the suggested interlinking outcomes and mediators described, it was important that this systematic review adopted a holistic approach to examining the key effects of slum upgrading.

1.4 Why it is important to do this review

Efforts to improve the living conditions of slum dwellers, particularly within LMICs, peaked during the 1980s and was followed by a period of disjointed activities ([UN HABITAT 2003a](#)). Renewed concern, political will and slum upgrading activities were fuelled, however, following the United Nations Millennium Declaration in 2000 which included aims to significantly improve the lives of at least 100 million slum dwellers by the year 2020.

The 2010 Millennium Development Goals progress report showed that whilst these efforts were considerable, slum improvements failed to keep pace with the growing ranks of the urban poor ([United Nations 2010](#)). More recently there have been signs of progress, the share of slum dwellers in urban areas declined from 39% in 2000 to 33% in 2012, but major inequalities remain ([United Nations 2012](#)).

To ensure that valuable resources are invested in the most effective and efficient ways and are tailored to appropriate settings, it is important that slum upgrading strategies be based on the best available evidence. Evidence on the effectiveness of strategies to reduce the ill effects of urban slums has, to date, not been examined in a systematic review. Whilst several systematic reviews have evaluated the impact of water and sanitation interventions on health outcomes ([Clasen 2006](#); [Clasen 2010](#); [Waddington 2009](#)), these have not focused on the complex setting of slums and do not cover the range of slum upgrading interventions that exist beyond water and sanitation. Furthermore, they are restricted to targeted health outcomes (for example diarrhoea incidence).

Scoping searches by the author team found that the evidence base for slum upgrading is widely dispersed across different disciplines and grey literature sources. Moreover, single studies may not be adequate to capture the broad spectra of relevant health and social outcomes, or diverse slum upgradation approaches. A comprehensive review of slum upgrading programmes can collate all relevant research and provide a broader picture on effectiveness across different settings, interventions and outcomes whilst considering the reliability and validity of the results and measures. Systematically reviewing this literature can provide a documented account of reliable evidence and research gaps, and serve as an important investment in global knowledge to guide urban planning and sectoral reforms.

This review examined slum upgrading strategies involving physical environmental or infrastructure changes with or without additional wider upgrading approaches (for example policy, legal, financial, community action, social or service interventions). Within such strategies, the authors sought to identify key intervention components that may result in the greatest improvements in the health and socio-economic wellbeing of slum dwellers and highlight any potential adverse effects.

2. Objectives

The main objectives of this systematic review were:

- to examine the effectiveness of slum upgrading strategies involving physical environment and infrastructure interventions for improving the health and quality of life of slum dwellers.
- Secondary research objectives were:
- to examine the effectiveness of slum upgrading strategies involving physical environment and infrastructure interventions for improving the socio-economic wellbeing of slum dwellers;
- to identify slum dwellers' perceived needs, preferences for slum upgrading and satisfaction with the interventions they receive;
- to identify potential adverse impacts slum upgrading may have on slum dwellers' health and wellbeing;
- to define and identify programme characteristics and components which increase the health and wellbeing of slum dwellers;
- to identify external contexts that may boost or hinder intervention effects.

3. Methods

3.1 Criteria for considering studies for this review

3.1.1 Types of studies

Slum upgrading programmes have been evaluated using a wide variety of approaches and designs. Whilst prone to less bias, randomised controlled trials (RCTs) are difficult to design and implement due to ethical, resource and practical implications. Common methodologies often include longitudinal impact studies using experimental or quasi-experimental designs, and evaluations often utilise qualitative data collection ([Field 2006](#)). Further, appropriate controls may be difficult to identify due to the varying characteristics between and within slums, and evaluations are often commissioned during or after the implementation phase ([Vaessen 2010](#)). To overcome these challenges, the following study designs were considered for the synthesis of the main findings:

- RCTs including, cluster RCTs;
- quasi-RCTs, cluster quasi-RCTs;
- controlled before and after studies (CBAs), cluster CBAs;
- interrupted time series (ITS).

In these studies, control groups could include slums or areas within slums which did not receive an intervention, or received a different intervention, for example an alternative slum upgrading strategy or a relocation or clearance programme.

In addition, the following study designs were included as supporting studies:

- uncontrolled before and after studies (UBAs);
- non-randomised, controlled studies with only post-intervention outcome data (CPIs).

Supporting studies can indicate associations between interventions and outcomes but not whether interventions caused the effect. They were included as supplemental information, and described in a separate narrative to the main study findings, to explore consistency with the main study findings or summarise the limited 'best available evidence' where main studies did not evaluate a relevant outcome. Whilst these study designs are prone to a higher level of bias, in the absence of studies with greater internal validity they can provide an evidence map of rich data on the settings and contexts, intervention characteristics, processes and indicative findings. A similar approach has been employed in a previously conducted review of specialist outreach clinics in primary care and rural hospital settings that is published in *The Cochrane Library* ([Gruen 2004](#)).

Qualitative data regarding slum dwellers' needs, preferences and satisfaction with slum upgrading strategies were also included if conducted in parallel with a quantitative study described above. Stand-alone qualitative research studies not linked to quantitative or mixed methods studies were excluded. Non-comparative case reports or cross-sectional studies were also excluded.

3.1.2 Types of participants

Populations living in urban or peri-urban slums in LMICs (as defined by the [World Bank](#)) were eligible. The population was not restricted by age, gender, social hierarchy (for example caste, class) or any other criterion. Slums were identified on the basis of at least one of the following

two criteria.

A. The authors described the setting using the term 'slum', an alternative synonym(s), or named a slum community (please see [Table 1](#) for further information). If the authors referred to slum upgrading within the publication but did not specifically identify the settings as slums, they were contacted for further clarification.

B. Sufficient detail was provided to determine that the setting is an urban area within an LMIC and that the households lack two of or more of the following five indicators used by UN-HABITAT to identify slum households ([United Nations 2010](#)):

- access to improved water;
- access to improved sanitation;
- security of tenure;
- durability of housing; sufficient living area.

Further details outlining the criteria for classifying the elements as improved are provided in [Appendix 2](#). UN-Habitat requires just one criterion to be met in order for a household to be identified as a slum household. However, a more conservative approach was taken for this review because in many urban cities living area may be insufficient for both middle classes and slum populations ([UN HABITAT 2003b](#)). Urban refugee camps or settlements clearly meeting at least two of the UN-Habitat criteria for slums were considered to be eligible settings.

3.1.3 Types of interventions

The review examined slum upgrading programmes involving at least one or more physical environment or infrastructure change to the slum environment in situ; with or without the inclusion of policy, financial, legal, behavioural, educational, social environment, or health and social service interventions.

Examples of potential physical environment interventions include the following.

- Water and sanitation: improved access to sanitation (e.g. private latrines), access to adequate water quality and quantity for drinking and other needs (e.g. piped water into dwelling), drainage and flood protection.
- Energy infrastructure e.g. gas or electricity supply, improved cook stoves.
- Transportation infrastructure e.g. building road networks, emergency access roads, public transportation, paved sidewalks and footpaths, installing street lighting.
- Mitigation of environmental hazards (flood, landslide and waste) via ground stabilisation, water drainage, sewerage systems, waste disposal and collection.
- Waste management e.g. kerbsidewaste collection.
- Housing improvements e.g. improved flooring.

Where packages of interventions were provided (for example multicomponent physical environment strategies or a combination of physical and wider slum improvement programmes), the full nature of the included components was recorded. No minimum duration was required for a slum upgrading intervention. The following interventions were not eligible:

- behavioural, educational, social or health service interventions without accompanying physical environment or infrastructure change in slums;

- interventions to prevent slum formation;
- slum clearance or relocation to housing outside of the slum neighbourhood.

3.1.4 Types of outcome measures

The review examined a range of primary and secondary outcomes of interest. Studies were included in the review if they reported either a health, quality of life or socio-economic outcome as described below.

Primary outcomes

Health and quality of life

The primary outcomes for this review are shown below. They may be measured objectively or subjectively (self-reported).

- Mortality and morbidity related to:
 - communicable diseases;
 - non-communicable diseases;
 - Injuries.
- Quality of life (QoL): example measures could include validated instruments such as health-related quality of life or self reports of subjective wellbeing such as life satisfaction or happiness).

Secondary outcomes

Socio-economic wellbeing

As slum upgrading projects frequently comprise a combination of physical, social, economic, organizational and environmental interventions, they also have the potential to impact a broad range of socio-economic outcomes. These factors are intrinsically linked with urban health (see [How the intervention might work](#)). Therefore, studies were included in the review if they reported at least one of the following socio-economic outcomes.

- Financial poverty:
 - household income;
 - household assets;
 - time or proportion of income spent on water or fuel collection;
 - households above or below poverty threshold.
- Employment and occupation.
- Crime and violence.
- Education.
- Social capital: example measures could include membership of formal or informal clubs, societies; contact with social groups including families, religious groups, friends; presence and reliance on networks of support; shared norms and values within a community; trust in neighbours, family members, government and community members such as politicians and police; and civic participation and shared decision making.

Slum dwellers' views and preferences

Where reported, data regarding slum dweller perspectives and experiences were collected

from eligible effectiveness studies examining the outcomes described above. The following information was sought:

- slum dwellers' diagnoses of their own needs and preferences for interventions and improvements to their living environment;
- slum dwellers' perceptions and views regarding the delivery, acceptability and impact of the intervention received;
- adverse effects reported by slum dwellers e.g. whether families felt their cultural patterns were impaired as a result of upgrading interventions or upgraded homes were no longer affordable.

3.2 Search methods for identification of studies

A comprehensive search for both published and unpublished research studies was performed across a broad range of information sources to reflect the cross-disciplinary nature of the topic. Articles from all languages were considered and no restrictions were made regarding publication dates. An initial literature search was performed between May 2011 and July 2011, followed by an update search between April 2012 and May 2012.

3.2.1. Electronic searches

Databases

A comprehensive search strategy for the database SCOPUS was developed that combined two concept groups of search terms: setting (slums) and interventions (upgrading). Studies were sifted manually for study designs and outcomes once the search was completed. The SCOPUS strategy was then adapted to the other databases listed below using database-specific subject headings, where available.

Health and Biomedical

- MEDLINE and MEDLINE in Process (1947 to April 2012), via Ovid)
- EMBASE (1947 to April 2012, via Ovid)
- British Nursing Index (1994 to May 2012, via ProQuest)
- Cochrane Public Health Group Specialized Register (inception to April 2012)
- Cochrane Central Register of Controlled Trials (CENTRAL) (inception to May 2012)
- CINAHL (via EBSCOhost) (1981 to May 2012)
- PsycINFO (1806 to April 2012)
- Science Citation Index (1899 to April 2012, via ISI Web of Knowledge)

Multidisciplinary

- Scopus (1960 to May 2012)

Social Science

- ASSIA (1987 to April 2012)
- Sociological Abstracts (1963 to May 2012)
- Social Science Citation Index (1956 to April 2012, via ISI Web of Knowledge)

Architecture, Urban Planning, Environment

- Avery (1930s to May 2012)
- EI Compendex (inception to May 2012 via Engineering village)
- Georef (1666 to May 2011)
- Greenfile (inception to May 2012 via EBSCO)
- Planex (inception to May 2012 via UKMFA)
- ICONDA (1976 to April 2012 via Ovid)
- REPIDISCA (1982 to April 2012)

LMIC-relevant

- ELDIS (inception to May 2012)
- IndMed (1985 to May 2012)
- MedCarib (inception to April 2012)
- Global Health Library (inception to May 2012). Search all sources to cover:
 - Regional Indexes, AIM (AFRO), LILACS (AMRO/PAHO), IMEMR (EMRO), IMSEAR (SEARO), WPRIM (WPRO), WHOLIS (KMS), SciELO

Grey literature, Unpublished Research

- HMIC (1979 to April 2012 via Ovid)
- Current Controlled trials (unpublished studies) (inception to May 2012)
- 3ie impact database (inception to May 2012)
- IDEAS (inception to April 2012)
- JOLIS (inception to April 2012)

During the update search, the sensitivity of the original search strategy was slightly increased by including additional search terms relating to improved cookstoves, mitigation of environmental hazards and home flooring. These extra search terms were incorporated in databases that allowed complex search strategies (SCOPUS, MEDLINE, EMBASE, HMIC, ICONDA and Psycinfo) and rerun for the entire search period. Remaining update searches covered January 2011 to April, May 2012. Georef was not available for the update search.

The final SCOPUS search strategy is shown in [Appendix 3](#) and all search strategies used in the original and updated search are presented in [Appendix 4](#).

Websites

- The following websites were searched for grey literature:
- Asian Development Bank;
- Care International;
- Centers for Disease Control and Prevention; Cities Alliance;
- Comic Relief;
- International Council for Research and Innovation in Building and Construction (CIBD);
- J-PAL;
- Office of Evaluation and Oversight (OVE) of the Inter-American Development Bank;
- Oxfam;
- Red Cross;
- Slum Dwellers International;
- The Society for the Promotion of Area Resource Centres (SPARC);

- UK Department for International Development (DFID);
- UN-HABITAT;
- US Agency for International Development (USAID), including its Environmental Health Project (EHP); Water Aid;
- World Bank;
- World Health Organization.

OVE was not included in the original literature search but was searched for publications of any date during the update literature search.

3.2.2. Searching other resources

The journal titles of all included articles were handsearched for the previous five years with the exception of Social Science and Medicine, which was searched for just the last six months due to the large volume of issues published by the journal.

Additionally, reference lists from included studies were scanned for further relevant articles, and individual experts and organisations were contacted to obtain relevant published, unpublished or ongoing studies.

3.3 Data collection and analysis

3.3.1 Selection of studies

Search results were downloaded and screened using reference management software. Initially one review author sifted the titles and abstracts to exclude duplicate records and clearly ineligible articles (that is studies in high income countries, not slum settings, or purely descriptive articles). If there was any uncertainty as to whether records were potentially relevant they were retained for further screening.

The remaining titles and abstracts were then sifted by two independent review authors. Where available, full texts of all remaining potentially relevant or unclear papers were obtained and reviewed against the inclusion criteria using a checklist, by two independent review authors working in duplicate. Disagreements were resolved by discussion and, where required, a third review author.

3.3.2 Data extraction and management

Data were extracted by two review authors, independently in duplicate, using a data extraction form adapted from the Cochrane Public Health Group 'Guide for Developing a Cochrane Protocol' ([CPHG 2011](#)). Any disagreements in data extraction were resolved by discussion, and using a third review author if required.

If key data were missing from reports, attempts were made to contact the investigators to obtain the information. Where multiple reports of the same study were published, the most recent paper formed the primary reference and data were maximally extracted to cover all relevant outcomes and methods reported across the studies.

Data extraction also recorded information on a range of important characteristics to reflect the array of distal and proximal influences on slum health and socio-economic wellbeing as well as factors such as the fidelity of intervention delivery. Where possible, details were collected regarding: the population, setting (including origin of slum, defining characteristics, whether

squatter settlement or legal but dilapidated, and whether conditions were improving or worsening), interventions, process variables, outputs (for example fidelity and sustainability of intervention), and barriers and facilitators to implementation.

3.3.3 Assessment of risk of bias in included studies

Two independent review authors assessed the quality of included studies in duplicate using checklists based on the 'Graphical Appraisal Tool for Epidemiological studies' (GATE) ([Jackson 2006](#)) and adapted by the National Institute for Health and Clinical Excellence (NICE) for public health interventions ([NICE 2009](#)). Disagreements between review authors were agreed on by discussion and a third review author if required.

These checklists were used to inform risk of bias (RoB) tables based on the Cochrane Effective Practice and Organisation of Care Group (EPOC) RoB tool. The tables were completed to summarise the internal validity of all included studies. An additional domain (taken from the NICE tool) was added to capture details of any measures that non-randomised studies applied to minimise selection bias. Studies were reported as having high, unclear, or low risk of bias in each of the domains shown below.

1. Random sequence generation (selection bias).
2. Allocation concealment (selection bias).
3. Selection of exposure (and comparison groups) for non-randomised studies (selection bias).
4. Baseline outcome measurements similar (selection bias).
5. Baseline characteristic measurements similar (selection bias).
6. Incomplete outcome data (attrition bias).
7. Knowledge of interventions adequately prevented (performance and detection bias).
8. Study adequately protected against contamination (performance bias).
9. Selective outcome reporting (reporting bias).
10. Other bias.

Questions answered with 'not reported' or 'not applicable' in the NICE checklist were completed as 'unclear bias' or 'high risk of bias' in the EPOC RoB tables, respectively. Where EPOC RoB domains were not applicable to a particular study design (mainly CPI and UBA studies) a description was added in the notes section of the RoB tool to indicate this.

Completion of the NICE checklists and EPOC RoB tables provided summary scores for a study's internal validity. Grades ranged from '++' (good internal validity, low risk of bias), '+' (mixed or unclear risk of bias), to '-' (poor internal validity, high risk of bias). If any of the EPOC RoB domains applicable to a particular study were reported as having a high risk of bias, the study was graded as '-', that is an overall high risk of bias. The NICE checklists also resulted in summary scores for external validity, that is the extent to which the findings for the study participants are generalisable to the population they were chosen from ([NICE 2009](#)). Scores were either '++' (good), '+' (mixed or unclear), or '-' (poor). Appropriate NICE checklists were also completed for qualitative components of included studies using the same grading system for internal validity ([NICE 2009](#)).

Risk of bias is discussed in the section [Risk of bias in included studies](#) while RoB tables are

presented in [Characteristics of included studies](#) and results of NICE checklists in [Additional tables](#).

3.3.4 Measures of treatment effect

Continuous outcomes (mean differences (MDs)) were reported as found in the primary research. Where appropriate and feasible, dichotomous outcomes were presented as relative risk ratios (RRs) with their associated CIs. For regression based studies, RRs were estimated according to methods outlined in the Campbell International Development Group guidelines ([CIDG 2011](#)). Standard errors were estimated based on reported t statistics (following [Keef 2004](#)).

3.3.5 Unit of analysis issues

Clustered studies

Studies that allocated interventions to communities (clusters) but did not account for the community effect during analysis were to be reported and reanalysed, inflating the standard error to account for the correlated nature of the data. Where this was not feasible, only the point estimate was reported (without the P value or CI).

Multiple time-points per outcome

Outcomes were extracted for multiple timepoints where reported by the included studies.

3.3.6 Dealing with missing data

Investigators were contacted when study designs or outcomes were unclear or had not been reported.

3.3.7 Data synthesis

Meta-analysis was only considered for studies eligible for the main analysis of findings (that is RCTs, CCTs, CBAs and ITS). However, diversity of interventions and outcomes prohibited any pooling of studies. Therefore, a narrative synthesis was performed separately for both main and supporting study findings.

Drawing on methods described by [Ogilvie 2008](#), harvest plots were developed to visually convey findings, appropriateness of the study design, confidence in the estimate of effect and risk of bias of the included studies. Studies are represented by bars plotted onto a grid, marked with the first three letters of the primary author's surname and placed according to the direction of effect. Outcome measures varied considerably between studies, thus study results were grouped into broad outcome categories. For example, diarrhoea, parasitic infections and dengue fever were all plotted within the communicable diseases group. Where possible, one bar was used for each study within one outcome group. In some cases, the same study measured two or more individual outcomes that fitted under the same broad outcome heading. Where the direction and statistical significance of the effects were the same, one bar was used for all outcome indicators. Where a study's results differed for each indicator, separate bars were used to illustrate the uncertainty.

The height of the bar reflects the appropriateness of the study design in relation to its ability to eliminate selection bias and detect whether the intervention has a causal effect on the outcome of interest (highest represents most appropriate). RCTs are considered the gold standard study design to eliminate selection bias as known and unknown differences in

intervention and control groups can be evenly distributed. Therefore, the highest bar is used for RCTs.

Study designs that allow a causal effect to be plausibly interpreted are marked by the second highest bar. This is assigned to CBA or ITS designs as well as controlled post-intervention only studies (CPI) that statistically aimed to eliminate selection bias by a combination of analytical methods (for example propensity score matching, adjusting for confounders). UBAs and all other CPI study designs were assigned the lowest height bar, as a causal effect of the intervention rather than some other factor cannot be confidently interpreted. See [Summary of main results](#).

All outcomes were represented in summary of findings tables by organising them into broad categories (see [Summary of findings table 1](#); [Summary of results table 2](#)). Health and QoL outcomes were grouped into the following broad categories: communicable diseases; maternal and perinatal diseases and infant mortality; nutritional deficiencies; non-communicable diseases; injuries; general health measures; and QoL. Socio-economic outcomes were grouped into financial poverty; employment; education; crime and violence; and social capital. The GRADE approach (Grading of Recommendations Assessment, Development and Evaluation) ([Guyatt 2008](#)) was used to assess the quality of the body of evidence from all main studies within each broad outcome category. According to GRADE, the body of evidence for each outcome group was judged as either:

- high quality, further research is very unlikely to change our confidence in the estimate of effect;
- moderate quality, further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate;
- low quality, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; or
- very low quality, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

For each broad outcome, the corresponding results of supporting studies were also briefly described as supplementary information.

Qualitative data were extracted in duplicate within the same data extraction forms described above. Perspectives were sought for three key topics: slum dweller living conditions in unimproved areas and their perceived needs; views regarding intervention effects (whether beneficial or adverse) and factors thought to enhance or mediate impact; acceptability of the intervention including perceived barriers and facilitators of their use and implementation. Due to a lack of available studies including slum dwellers' perspectives, paucity of richness in the data and the dissimilar nature of the information available, a narrative description of the findings within each paper was presented in accordance with [Noyes 2011](#) and [NICE 2009](#). One review author organised individual study findings into broad descriptive themes which were listed in a summary table and accompanied by a brief description of the study finding associated with each theme (see [Table 2](#)). A second review author reviewed the narrative description of studies and checked that themes in the summary table were appropriate. The table highlighted that, on the whole, themes were disparate, precluding further thematic analysis across studies.

3.3.8 *Subgroup analysis and investigation of heterogeneity*

Given the paucity of available main studies and the high degree of study heterogeneity, it was not possible to conduct planned subgroup analyses regarding: the composition of the intervention (singular versus multiple component); and use of community engagement in the design, delivery, or maintenance of interventions (engagement versus non-engagement).

Instead, harvest plots were developed to visually explore potential trends in studies with these characteristics.

4. Results

4.1 Description of studies

4.1.1 Results of the search

The combined literature search, completed in May 2012, yielded 10,488 unique titles and abstracts. After initial screening to remove clearly irrelevant records, 1160 abstracts were screened by two independent review authors; 323 were considered potentially eligible and assessed in full text by two independent review authors. On completion of the selection process 21 publications reporting five main studies and nine supporting studies were included. See [Figure 2](#) for a flow diagram of the selection processes.

4.1.2 Included studies

Please see: [Characteristics of included studies](#).

Main studies are those eligible for the main synthesis of findings (RCTs, ITS, CBA). Five main studies were identified for inclusion: one cluster-RCT ([Gonzalez-Navarro 2010](#)) and four cluster-CBAs ([Butala 2010](#); [Galiani 2007](#); [Soares 2005](#); [Taylor 1987](#)) using difference in difference analyses and adjustment for confounders. [Taylor 1987](#) was the only study not to use robust standard errors to account for the effect of clustering or to provide sufficient information to allow reanalysis. A graphical overview of the intervention components and outcomes examined by the main studies is provided in [Figure 3](#). A total of 3453 households or observations were included in the four studies that reported a sample size, while the number of observations within studies varied depending on the outcome measured. One further study did not report a clear sample size ([Taylor 1987](#)).

In brief, three CBAs compared the impact of broad slum upgrading strategies, involving physical upgrading and wider living environment strategies, to no intervention ([Butala 2010](#); [Soares 2005](#); [Taylor 1987](#)). Outcomes differed between studies.

[Butala 2010](#) examined effects on waterborne illnesses, whereas [Taylor 1987](#) examined effect on mean household income and [Soares 2005](#) measured mortality (infant, homicide and sanitation-related), income and illiteracy. Two further studies evaluated the impact of single physical interventions: one RCT ([Gonzalez-Navarro 2010](#)) evaluated the impact of road paving on parasite or fungus infections, sickness and quality of life; and one CBA examined the effect of water supply on diarrhoea and water expenditure ([Galiani 2007](#)). Due to the lack of similar interventions and common outcomes between the studies, a meta-analysis was not possible.

Supporting studies are UBAs and CPIs that cannot determine causality and are reported only as supplemental information to explore consistency with the main study findings or summarise the limited 'best available evidence' where the main studies do not evaluate a relevant outcome. Nine supporting studies were included: six CPI studies ([Aiga 2002](#); [Cattaneo 2009](#); [De Leon 1986](#); [Moitra 1987](#); [Morales 2004](#); [Parikh in press](#)) and three UBA studies ([Abelson 1996](#); [Joshi 2002](#); [Milone 1993](#)). A total of 6794 households or observations were included in the four studies reporting sample sizes, while the number of observations within studies varied depending on the outcome measured. One further study did not report the sample size ([Moitra 1987](#)). Except for three ([Aiga 2002](#); [De Leon 1986](#); [Joshi 2002](#)), the majority of studies were clustered yet four studies did not adjust for the clustering effect ([Abelson 1996](#); [Milone 1993](#); [Moitra 1987](#); [Morales 2004](#)). [Cattaneo 2009](#) selected controls using propensity score matching and adjusted for confounders whilst two studies controlled for potential confounders

([Aiga 2002](#); [Moraes 2004](#)). A graphical overview of the intervention components and outcomes examined by the supporting studies is provided in [Figure 4](#).

One study evaluated a single physical upgrading intervention entitled Piso Firme. This project replaced dirt floors with cement floors in slum households ([Cattaneo 2009](#)). The remaining studies examined multiple physical environment interventions with additional health or social components ([Abelson 1996](#); [De Leon 1986](#); [Joshi 2002](#); [Moitra 1987](#)) and four studies assessed multicomponent physical upgrading only ([Aiga 2002](#); [Cattaneo 2009](#); [Milone 1993](#); [Moraes 2004](#)).

Outcomes differed considerably between studies, focusing mostly on measures of communicable diseases and financial poverty.

Actors and how communities were chosen to receive the intervention

The majority of studies were 'natural experiments' whereby researchers did not manipulate allocation or delivery of the intervention, and comparison groups were frequently established post hoc. One RCT was able to incorporate randomisation into a government road paving intervention, offering an objective system of assigning the intervention where budgetary constraints prevented treatment of all the communities identified as in need ([Gonzalez-Navarro 2010](#)).

Included studies reported an array of actors who contributed to intervention delivery. Amongst the main studies two projects were state-led government programmes, road paving ([Gonzalez-Navarro 2010](#)) and Favela-Barrio, which also received funding from the Inter-American Development Bank (IADB) ([Soares 2005](#)). The majority of interventions described in the supporting studies were government-led, such as the Piso Firme cement flooring project ([Cattaneo 2009](#)) and Barrio-Escopa ([De Leon 1986](#)). Global agencies commonly provided financial assistance, including the World Bank ([Aiga 2002](#)), Asian Development Bank ([Milone 1993](#)), UK government overseas departments ([Abelson 1996](#)) and the United Nations ([De Leon 1986](#)).

Partnerships between different combinations of government, civil society, private industry, NGOs and charitable trusts were also described in both the main and supporting studies ([Butala 2010](#); [Galiani 2007](#); [Joshi 2002](#); [Parikh in press](#)).

Intervention duration

The time needed to implement interventions was not reported in the majority of studies. Where information was provided, descriptions were usually limited to time periods in which programmes were rolled out across slums, without clearly stating how long the interventions took to complete within each slum.

Community engagement

Three main studies ([Butala 2010](#); [Galiani 2007](#); [Taylor 1987](#)) and three supporting studies ([Aiga 2002](#); [Joshi 2002](#); [Parikh in press](#)) reported community involvement, either in the form of slum residents paying for the intervention delivery or the fees for the resulting infrastructure such as water supply (see [Figure 3](#) and [Figure 4](#)).

Only one main study described slum residents being involved in the selection of slum upgrading projects ([Soares 2005](#)). However, one project involved varying levels of community engagement between neighbourhoods, with marginal consultation in planning and some involvement during implementation. Some slums residents were consulted about the location of roads and walkways, and to a lesser degree regarding the location of water standpipes and

sanitary facilities ([Taylor 1987](#)). [Galiani 2007](#) reported greater involvement with the community – whereby slum neighbourhoods requested the private water service and provided the labour for implementing the intervention, in addition to paying the water company fees for the services provided thereafter.

Community consultation was also included in the interventions of three supporting studies ([Abelson 1996](#); [Joshi 2002](#); [Moitra 1987](#)). Slum dwellers provided labour for interventions in one main study intervention ([Galiani 2007](#)) and two supporting studies ([Cattaneo 2009](#); [De Leon 1986](#)).

[Joshi 2002](#) also described significant community involvement in the delivery of the interventions, including consultation on needs, establishment of community based organisations to monitor delivery of the interventions and contributions to the costs of the programme via a community management organisation (CMO). Community management was also present in a further study of multicomponent slum upgrading ([Abelson 1996](#)).

[Joshi 2002](#) was the only study that specifically stated that gender dimensions were considered in the planning of the intervention. The Integrated Slum Development (ISD) Programme was required to proactively impact on women. Therefore, tailoring and embroidery courses were provided in addition to a women's CMO which sustained ISD in the slum and gave them technical and managerial skills and credibility within slums as leaders.

4.1.3 Excluded studies

A common reason for excluding publications was ineligible study design. Many papers were descriptive overviews or discussion papers of slum upgrading, or non-comparative cross-sectional reports and stand-alone qualitative studies. Furthermore, a large number of papers did not address a relevant topic, that is the study setting(s) was not

identifiable as a slum neighbourhood or the intervention was not a slum upgrading strategy involving physical environment and infrastructure interventions.

4.2 Risk of bias in included studies

Please see [Table 3](#) and [Table 4](#) for a summary of the NICE validity assessments. A more detailed description is provided in RoB tables within the [Characteristics of included studies](#) section. Risk of bias ranged from low to high for the main studies. One RCT ([Gonzalez-Navarro 2010](#)) was assigned a low risk of bias (++) , two CBAs ([Galiani 2007](#); [Soares 2005](#)) were judged to be have mixed or unclear bias (+) and two CBAs were considered to have a high risk of bias (-) ([Butala 2010](#); [Taylor 1987](#)).

Only one supporting study was judged to have a mixed or unclear risk of bias ([Cattaneo 2009](#)), the remaining eight studies were all judged to have a high risk of bias ([Abelson 1996](#); [Aiga 2002](#); [De Leon 1986](#); [Joshi 2002](#); [Milone 1993](#); [Moitra 1987](#); [Morales 2004](#); [Parikh in press](#)).

4.2.1. Allocation (selection bias)

To establish whether an intervention is responsible for the effect on outcomes of interest, the results need to be compared to the 'counterfactual', that is the outcomes that would have been observed had the intervention participants not received the intervention. Because the counterfactual cannot be directly observed, outcomes in intervention groups are compared to reference control groups with similar characteristics so that the only difference between groups is the intervention itself.

Selection bias, whereby systematic differences are present between the participants in the comparison groups, is an important threat to internal validity of studies. As a result, observed differences in the outcomes may be explained by pre-existing differences between the groups rather than the intervention itself ([NICE 2009](#)). Reducing the risk of selection bias in evaluations of slum upgrading can be challenging, as identifying suitable control groups is particularly difficult due to the high degree of variability between and within slum settings. While concealed random allocation within an RCT design is considered the most reliable approach to eliminating selection bias, most of the included studies represented real-life projects where the intervention itself had been carried out as part of the country's existing program for upgradation. Thus randomisation to either intervention or control was not always feasible.

It should be acknowledged that in any non-randomised study, even when experimental and control groups appear comparable at baseline, there is still a risk of bias due to residual confounding as all methods to control for confounding are imperfect ([Higgins 2011](#)). However, studies can use a range of statistical techniques to minimise selection bias and establish plausible counterfactuals. These can include analyses to adjust for unobserved differences between comparison groups such as difference in differences (DiD), instrumental variables and regression discontinuity designs, or adjusting for observed differences such as matching control and intervention individuals or groups according to similar characteristics, adjusting for potential confounders in multiple regression analyses, and propensity score matching ([Craig 2012](#)). Combining analytical methods for addressing observed and unobserved variables can strengthen causal inference ([Craig 2012](#)).

Within the five main studies, one RCT was identified as having a low risk of selection bias due to its random allocation and use of DiD analysis ([Gonzalez-Navarro 2010](#)). Three CBAs ([Butala 2010](#); [Galiani 2007](#); [Soares 2005](#)) were graded as having a mixed risk of selection bias, as they were not randomised but employed a DiD approach to minimise selection bias and adjusted for potential confounders. In addition, [Soares 2005](#) utilised propensity score matching. One further CBA was graded as having a high risk of selection bias as it did not report analytical techniques to address observed or unobserved characteristics, and the authors noted significant differences between key variables measured. The author reported difficulties in identifying comparable control slums as the only unimproved 'control sites' were those considered by the city's planners to be unsuitable for permanent residential use due to their hazardous location ([Taylor 1987](#)).

Just one of the six controlled supporting studies used propensity score matching in addition to adjusted multivariate regression and was graded as having a mixed risk of selection bias ([Cattaneo 2009](#)). The remaining five CPI studies were graded as having a high risk of selection bias due to the lack of matching analyses or ability to compare baseline measures to check the comparability of comparison groups. This included two studies that described attempts to identify similar communities and controlled for potential confounders ([Aiga 2002](#); [Moraes 2004](#)) and three studies that did not discuss comparability between groups ([De Leon 1986](#); [Moitra 1987](#); [Parikh in press](#)).

4.2.2. Blinding (performance bias and detection bias)

Detection bias

The process of blinding is a technique used to minimise risks that the participants, investigators and outcome assessors' knowledge of the intervention could cause systematic differences in the way in which outcomes are assessed, collected or analysed ([Higgins 2011](#)).

This is relevant to all included controlled studies from both the main analysis of results and the supporting studies. Given the nature of the interventions to the physical living environment, it would not be possible to blind the slum residents from the upgrading taking place. Generally, it was difficult to blind slum dwellers or field workers from the interventions that took place. Just two studies described methods to minimise detection bias. One RCT ensured participants were not informed of the study objectives during household interviews with field workers as a way to minimise bias ([Gonzalez-Navarro 2010](#)). One supporting study blinded microscopists examining stool samples to the intervention status of the community from whom the samples had been collected ([Moraes 2004](#)).

Performance bias

Performance bias occurs if there are systematic differences between study groups in their exposure to factors other than the interventions of interest ([Higgins 2002](#)). For example, in healthcare studies if patients are aware they are receiving the study placebo they may use other forms of care. Blinding is the main approach to minimising risk of performance bias but this was generally not possible to achieve.

It is important, however, that any concurrent interventions outside the programme being studied are recorded to ensure that the intervention and control groups are similar except for the intervention being studied. One supporting CPI study noted the presence of other social programs in the communities but controlled for these confounders within its multivariate analyses ([Cattaneo 2009](#)).

4.2.3. Incomplete outcome data (attrition bias)

Most of the eight studies with baseline and follow-up measures did not report attrition of participants from the study or whether an intention-to-treat analysis was performed. This is particularly pertinent for determining whether systematic differences between comparison groups occurred due to withdrawals or attrition from the study.

One RCT analysed data only for households that were interviewed at both baseline and follow-up (and not those who moved out of or into the area in the study period) and it was determined that attrition in the panel was random ([Gonzalez-Navarro 2010](#)). One CBA ([Galiani 2007](#)) redefined and transferred observations from the control group to the treatment group based on the knowledge that the intervention programme (water expansion) had reached one of the control communities during the study period and some participants gained access to the water service prior to the follow-up data collection.

4.2.4. Selective reporting (reporting bias)

Selective reporting was difficult to judge in most studies due to the lack of published protocols. There were, however, concerns regarding one CBA ([Taylor 1987](#)) and three supporting studies ([Milone 1993](#); [Moitra 1987](#); [Parikh in press](#)), which scored poorly in this area due to the lack of reporting of raw data or numerical values for results that were described narratively or graphically.

4.2.5. Other potential sources of bias

Length of follow-up

Whilst studies generally reported the timing of the baseline and follow-up surveys, they lacked sufficient detail on the length of follow-up after intervention delivery. Thus it was difficult to judge whether or not a sufficient follow-up period was utilised in order for the impact of

interventions to be fully recognised. Although relatively short follow-up periods may detect changes in communicable diseases, the length of follow-up is especially pertinent to non-communicable diseases, mortality and socio-economic outcomes, which could take a longer time for effects to take place. Of the main studies, it was possible to determine that [Galiani 2007](#) had follow-up periods of between five to 10 months after intervention completion, which may have been sufficient to detect an impact on diarrhoeal diseases and water-related expenses. [Taylor 1987](#) had a longer follow-up period of between two and four years, which would be appropriate for detecting income changes. The follow-up

period in [Gonzalez-Navarro 2010](#) varied depending on the intervention site, ranging from 0 months to 17 months (seven sites were completed in 2007, five sites in 2008, and five sites just before follow-up measures were recorded). Follow-up after intervention completion was unclear in the two remaining main studies ([Butala 2010](#); [Soares 2005](#)). Only three of the supporting studies described follow-up outcome measures of between two and four years after intervention completion ([Cattaneo 2009](#); [De Leon 1986](#); [Joshi 2002](#)). The remaining studies did not clearly report the follow-up period following the intervention delivery ([Abelson 1996](#); [Aiga 2002](#); [Milone 1993](#); [Moitra 1987](#); [Moraes 2004](#); [Parikh in press](#)).

Fidelity of the intervention

The fidelity of the interventions delivered was also poorly reported. There was scarce information concerning whether interventions were delivered as intended, reached the target populations, or the equity of that reach. Therefore it was not possible to assess the impact of the intervention in the context of how successfully it was implemented.

Of the main studies, three did not report information on fidelity ([Butala 2010](#); [Galiani 2007](#); [Taylor 1987](#)). Data was analysed in the road paving project for 17 out of the intended 28 communities that the project reached, with no further information provided on the fidelity or maintenance of the treated communities ([Gonzalez-Navarro 2010](#)). The multicomponent slum upgrading programme evaluated by [Soares 2005](#) was found to significantly increase access to sewerage, water and rubbish collection, though it was not reported whether this achieved full access to all participants surveyed.

Three supporting studies did not consider the degree to which the intervention or its components were delivered as intended (the fidelity of the intervention) ([Moitra 1987](#); [Moraes 2004](#); [Parikh in press](#)). Factors such as uptake of the services, the successful implementation of the intervention, and maintenance and sustainability of the intervention components were not explored, or whether fidelity differed within or between comparison groups. [Moitra 1987](#) did report some information regarding sustainability, stating infrastructure improvements were not maintained. Results showed a positive association with the intervention and employment, but not for health (those reporting being 'well') or education outcomes. It is possible that the poor maintenance of the intervention may explain the lack of improved outcomes. Results from the study should, however, be viewed cautiously due to the high risk of bias, with lack of causality and lack of accounting for clustering.

Some supporting studies provided limited information on the fidelity of at least some of the component interventions within their packages of slum upgrading strategies. [Aiga 2002](#) did not formally evaluate fidelity but described residents in the intervention enjoying water nearly 24 hrs per day. The study did not discuss the fidelity of the additional interventions delivered as part of the zonal improvement programme (ZIP), which may also have been factors responsible for the outcomes observed. [Milone 1993](#) revealed qualitatively that a number of the components delivered within the multicomponent physical upgrading programme were not

successfully installed, maintained or used. This included drains either not being delivered or being inappropriately installed or not working, or poor siting of facilities resulting in lack of use. It was noted that the study did not report that the community were consulted and engaged in the planning of the interventions, and this may be a contributory factor to the poor implementation and maintenance. The study by [Joshi 2002](#), however, had several levels of community engagement (consulted at design stage) and the CMO helped oversee implementation and collected extensive data on the uptake of the various components of the Integrated Slum networking programme, which demonstrated reasonably successful uptake and delivery of services with 95% of slum dwellers receiving a regular water supply and 100% provided with a toilet and electricity connection. [Abelson 1996](#) described successful implementation of secure land tenure and waste disposal practice following multiple slum upgrading, however access to tap water and private latrines was not achieved and communal latrines were not properly maintained. It is possible that the poor maintenance of the intervention may explain the lack of improved health outcomes (sickness or chronic illness). Results from the study should be viewed cautiously, however, due to the high risk of bias, with lack of causality and lack of accounting for clustering. One supporting study of a single slum upgrading intervention (Piso Firme project to provide cement flooring) succeeded in prompting households to install cement floors for almost all their household floor space ([Cattaneo 2009](#)).

Consideration of all intervention components

Two supporting studies emphasised one aspect of a slum upgrading strategy being implemented without detailed consideration of co-interventions. [Aiga 2002](#) studied the impact of improvement of water supply on diarrhoea and household economy. However, closer examination of the article revealed that water improvements were taking place in the context of a multicomponent ZIP including water connections, private toilets, electric power supplies to every housing unit, paved roadways and secure tenure. Similarly, [Moraes 2004](#) aimed to examine the impact of drains or drains and sewerage but it was apparent that paved paths and tenure were also provided as part of the intervention.

Clustered studies

Individuals within a particular group tend to be more similar to each other than to members of other groups ([Higgins 2011](#)). Failure to adjust for this can result in overestimating the precision of effect estimates. Four main studies allocated the intervention to slum communities (that is clusters) rather than individual slum dwellers and used appropriate analyses ([Butala 2010](#); [Galiani 2007](#); [Gonzalez-Navarro 2010](#); [Soares 2005](#)). One further main study ([Taylor 1987](#)) was also clustered but did not adjust for clustering.

Six of the nine supporting studies were clustered and analysed results by individuals, yet only one study adjusted for clustering effect in its analysis of results ([Cattaneo 2009](#)) whilst the remaining five did not ([Abelson 1996](#); [De Leon 1986](#); [Milone 1993](#); [Moitra 1987](#); [Moraes 2004](#)).

Reliability of outcome measures

The reliability of outcome measures used across studies varied. Most studies relied on self-reporting by participants, which is subject to recall and reporting bias.

Recall of up to two weeks is considered a generally reliable period in reporting disease morbidity before significant bias sets in ([Waddington 2009](#)) though recent research indicates that shorter recall periods of three days in children and four days in adults would be likely to

yield more accurate data ([Feiken 2010](#)). Two of the main studies used recall periods of four weeks or more for self-reported outcomes ([Galiani 2007](#); [Gonzalez-Navarro 2010](#)) and two did not report the length of recall ([Soares 2005](#); [Taylor 1987](#)). Several supporting studies also used recall periods that were unclear, or greater than four weeks ([De Leon 1986](#); [Joshi 2002](#); [Milone 1993](#); [Moitra 1987](#); [Parikh in press](#)). Among the studies reviewed, the most reliable outcome measures were utilised in the supporting studies [Cattaneo 2009](#) and [Moraes 2004](#). Both collected stool samples to measure the prevalence of intestinal parasites. A two-week calendar designed for use by illiterate adults and bearing a photo of each child aged < 5 years was used to avoid recall bias. In addition, [Moraes 2004](#), described rigorous methods to assess self-reported diarrhoea, by measuring episodes every two weeks over the period of a year, using diarrhoea calendars and quality checking data obtained. The presence of geohelminth infections was confirmed using microbiological assessment of collected stool samples.

[Butala 2010](#), a CBA, was the only study that used health insurance claims to measure health, expressed as a ratio of waterborne compared to non-waterborne diseases. This outcome measure was considered unreliable because assumptions about the changes in the proportion of waterborne illnesses relies on no significant change in non-waterborne illnesses. The criteria used by researchers to code illness claims were not reported, and findings may not be representative of the most disadvantaged slum residents, who may not be able to afford health insurance.

Sample sizes

Only one study reported a power calculation to identify the required sample size for detecting significant effects ([Aiga 2002](#)).

Conflicts of interest

Two studies posed potential conflicts of interest from the authors being associated with the deliverer or designers of the intervention. Dr Parikh examined the 'Slum Networking Programme', an intervention created and designed by the author's father. [Joshi 2002](#) evaluated the Integrated Slum Development programme, founded and implemented by an organisation the author is a director for (SAATH). Staff from SAATH were also responsible for the data collection during the household interventions.

4.3 Effects of interventions

4.3.1 Main review findings

One cluster RCT ([Gonzalez-Navarro 2010](#)) and four cluster CBAs ([Butala 2010](#); [Galiani 2007](#); [Soares 2005](#); [Taylor 1987](#)) were identified. Three studies compared the impact of broad slum upgrading strategies involving physical upgrading plus wider living environment interventions to no intervention (control) ([Butala 2010](#); [Soares 2005](#); [Taylor 1987](#)). Two further studies evaluated single physical upgrading interventions: road paving ([Gonzalez-Navarro 2010](#)) and water supply ([Galiani 2007](#)).

Multicomponent upgrading programmes compared to no intervention

Primary outcomes – health and quality of life

See [Table 5](#).

Communicable diseases

One clustered CBA, using difference in difference (DiD) analysis, examined the change over time in the probability of making a claim for a waterborne disease as opposed to a non-waterborne disease. Waterborne illnesses were identified from health insurance claims, which were coded according to whether the diagnosis of illness reflected a disease that was waterborne or not. Both a broad model (whereby mosquito-borne illnesses were coded as waterborne) and a conservative model (mosquito-borne considered non-waterborne) were tested. The estimated relative risk ratio (RR) indicated that the slum upgrading intervention resulted in a significant decrease in waterborne illness claims as opposed to non-waterborne illness claims for both the broad model (RR 0.62; 95% CI 0.61 to 0.64; P = 0.04) and conservative model (RR 0.64; 95% CI 0.41 to

0.98; P = 0.04) ([Butala 2010](#)).

One clustered CBA, using DiD analysis, examined the impact of phase one of a multicomponent upgrading project (Favela- Bairro project) on mortality rates within slum neighbourhoods. After controlling for baseline infrastructure facilities (water, sanitation, garbage), household income and average years schooling; DiD estimates showed that the proportion of treated households over time did not decrease the proportion of deaths caused by diseases related to lack of sanitation (DiD β - 0.007; 95% CI -0.02 to -0.01) ([Soares 2005](#)).

Infant mortality and Injuries

Multicomponent slum upgrading did not reduce the proportion of infant deaths (DiD β 0.03; 95% CI -0.02 to 0.07) or homicides (DiD β -0.01; 95% CI -0.04 to 0.03) in intervention areas compared to control areas ([Soares 2005](#)).

Secondary outcomes - socio-economic

See Table 6.

Financial poverty

No statistically significant impact was found for Favela-Bairro on head of household income (DiD β -0.105; 95% CI -0.31 to 0.31) ([Soares 2005](#)). A second CBA with a high risk of bias also observed no significant differences in mean total household income at three-year follow-up. The study did not report whether clustering or potential inflation increases over the study period were accounted for ([Taylor 1987](#)).

Education

Multicomponent slum upgrading was not shown to effect the illiteracy rate of the head of the household (DiD β 0.007; 95% CI

-0.03 to 0.06) ([Soares 2005](#)).

Crime

Multicomponent slum upgrading did not lead to a reduction in homicides (DiD β -0.01; 95% CI -0.04 to 0.03) in intervention areas compared to control areas ([Soares 2005](#)).

Privatised water service only compared to no intervention

Primary outcomes – health and quality of life

Communicable diseases - diarrhoea

[Galiani 2007](#) reported limited evidence (at the 10% significance level) that the incidence of diarrhoea and severity of infections was lower in intervention slums following improved water supply by a private water company. The relative risk (RR) was calculated as 0.53 (95% CI 0.26 to 1.04; P = 0.07) for 2-week diarrhoeal episodes and 0.48 (95% CI 0.19 to 1.22; P = 0.12) for severity of the infection, comparing intervention to control. There was no significant difference in duration of diarrhoea episodes between intervention and control following improved water supply mean difference (MD -0.12 days; 95% CI -2.8 to 0.43; P = 0.16) ([Galiani 2007](#)).

Secondary outcomes - socio-economic

Financial poverty - annual water-related expenditure

[Galiani 2007](#) reported that after controlling for changes in household income, there was evidence that monthly water related expenditure was reduced in the intervention group compared to the control group, MD of -19.72 pesos (95% CI -35.4 to - 4.04; P = 0.01), which persisted after including costs associated with the intervention (MD -17.11 pesos: 95% CI - 32.6 to - 1.62; P = 0.03).

Road paving only compared to no intervention

One cluster RCT looked at the impact of paving street projects (a neighbouring set of unpaved urban blocks connecting to the city's pavement grid). As only 17 of the 28 planned street paving projects were completed in time for the follow-up survey, instrumental variable regression results are presented below ([Gonzalez-Navarro 2010](#)).

Primary outcomes – health and quality of life

Communicable diseases

Health outcomes were unchanged by the street paving intervention; this was observed for both the proportion of intervention residents reporting sickness (defined as vomiting, diarrhoea, bronchitis, stomach pain, flu, fever or coughing) within the last month compared to residents in unpaved streets (RR 0.98; 95% CI 0.85 to 1.14; P = 0.83); and participants reporting parasites or fungus infections in the last year (RR 1.06; 95% CI 0.70 to 1.61; P = 0.79) ([Gonzalez-Navarro 2010](#)).

Quality of life

Following road paving, residents' satisfaction with living in their city did not differ between intervention and control groups (MD 0.01; 95% CI -0.10 to 0.12; P = 0.92). At baseline, satisfaction was relatively high in both groups (rated as 3 on a 4-point scale, whereby 3 is satisfied and 4 is very satisfied) ([Gonzalez-Navarro 2010](#)).

Secondary outcomes – socio-economic

Financial poverty

Street paving did not result in a statistically significant change in the log monthly labour income (MD 0.05; 95% CI -0.13 to 0.23; P = 0.67) ([Gonzalez-Navarro 2010](#)).

Employment

Unemployment was unchanged by the road paving intervention (RR 1.05; 95% CI 0.39 to 2.83; P = 0.92). Household heads in paved streets were more likely to use a motor transport to travel to work than household heads in unpaved streets (RR 1.43; 95% CI 1.13 to 1.83; P < 0.001) and there was also limited evidence at the 10% level of improved labour market expectations (intervention households were less likely to have plans to migrate for work reasons than those in unpaved streets (RR 0.78; 95% CI 0.60 to 1.01; P = 0.06) and an increase in weekly worked hours (MD = 4.68; 95% CI -0.46 to 9.82; P = 0.07) ([Gonzalez-Navarro 2010](#)).

Education

Paving streets did not result in changes in education variables for children aged 5 to 17: estimated RRs for school enrolment and absenteeism in the last month were 1.03 (95% CI 0.96 to 1.12; P = 0.38) and 1.49 (95% CI 0.75 to 2.93; P = 0.25) respectively ([Gonzalez-Navarro 2010](#)).

Crime and violence

Crime outcomes were not affected by road paving. There was no strong evidence that burglary or vehicles stolen in the past 12 months were more likely following the intervention (RR 1.83; 95% CI 0.84 to 4.02; P = 0.13 and RR 1.07; 95% CI 0.25 to 4.57; P = 0.92, respectively). Furthermore household members from paved streets were not more likely to feel safe walking the street at night than household members on unpaved streets (RR 1.08; 95% CI 0.88 to 1.32; P = 0.48) ([Gonzalez-Navarro 2010](#)).

4.3.2 Supporting information studies

Studies in this section are included as supporting studies only as their design lacks the ability to deduce causal effects of the intervention. Nine studies examined the impact of varying physical environment and infrastructure upgrading strategies within CPIs ([Aiga 2002](#); [Cattaneo 2009](#); [De Leon 1986](#); [Moitra 1987](#); [Moraes 2004](#); [Parikh in press](#)) or UBAs ([Abelson 1996](#); [Joshi 2002](#); [Milone 1993](#)). Six studies were clustered ([Abelson 1996](#); [Cattaneo 2009](#); [Milone 1993](#); [Moitra 1987](#); [Moraes 2004](#); [Parikh in press](#),). One CPI employed analytical methods of matching and regression adjustment to minimise selection bias and tentatively allow plausible causal inference ([Cattaneo 2009](#)).

One study evaluated a single physical upgrading intervention examining the effect of providing cement flooring via the Piso Firme project ([Cattaneo 2009](#)). Eight studies examined multicomponent slum upgrading programmes consisting of physical upgrading interventions only ([Aiga 2002](#), [Moraes 2004](#), [Milone 1993](#); [Parikh in press](#)) or physical upgrading with additional co-interventions at the living environment level ([Abelson 1996](#); [Joshi 2002](#); [Moitra 1987](#)).

Consistency of supporting studies with findings of main studies

Some health, quality of life and socio-economic outcomes were examined in both main and supporting studies. The degree to which the supporting studies reinforced the findings of main studies was variable, though findings for reduced diarrhoea incidence and reductions in water supply expenditure were consistent. Details for each shared outcome are given below.

Health and quality of life outcomes assessed in both main and supporting studies

Diarrhoeal and parasitic infections were the most common communicable diseases evaluated by main studies. These outcomes were also measured in supporting studies. See [Table 7](#) for individual supporting study results.

Communicable diseases - diarrhoea

One main study, a CBA with a mixed risk of bias, showed that slum upgrading reduced diarrhoea incidence ([Galiani 2007](#)). Supporting studies provided additional evidence to strengthen this finding, demonstrating associations between multicomponent slum upgrading ([Aiga 2002](#); [Milone 1993](#); [Moraes 2004](#)) or single interventions (cement flooring - [Cattaneo 2009](#)) and less diarrhoea. Lower diarrhoeal incidence among children under five years was associated with the presence of the multicomponent slum upgrading (RR 0.29; 95% CI 0.20-0.42; $P < 0.0001$) in one CPI ([Aiga 2002](#)). Two further studies (one CPI, one UBA) also showed associations between multicomponent upgrading and reduced diarrhoeal incidence, but the precision and statistical significance of effect estimates could not be determined as the analysis did not account for clustering ([Moraes 2004](#)) or provide sufficient information ([Milone 1993](#)).

One further CPI found that a single intervention (cement floors via the Piso Firme programme) was associated with lower diarrhoea incidence in the previous month, comparing intervention children to controls (estimated RR 0.87; 95% CI 0.77 to 0.98; $P = 0.05$).

One main study found that water supply did not improve either the severity or duration of diarrhoea ([Galiani 2007](#)). These outcomes were not examined by supporting studies.

Results should be interpreted carefully as the study designs identify associations between interventions and observed outcomes but not whether the intervention caused the results.

Communicable diseases - intestinal infections

One RCT reported that slum upgrading (road paving) did not reduce the incidence of parasitic infections ([Gonzalez-Navarro 2010](#)). Two supporting studies ([Cattaneo 2009](#), [Moraes 2004](#)) added some uncertainty regarding the effect of slum upgrading on parasitic infections, finding associations between multicomponent interventions and lower incidence of infection. One CPI with a moderate risk of bias found that a single intervention (cement flooring as part of the Piso Firme project) was associated with a 19.2% reduction in the presence of parasites present in a child's stool sample, when compared to control children (RR 0.84; 95% CI 0.71 to 1.0; $P = 0.05$). Results should be interpreted carefully as the study designs identify associations between interventions and observed outcomes but not whether the intervention caused the results.

A further CPI study with a high risk of bias, examined the effect of multi-component slum upgrading (involving either provision of drains or drains and sewerage) on three species of intestinal infections (*Ascaris*, *Trichuris* and *Hookworm*) ([Moraes 2004](#)). Both interventions were associated with lower incidence of the three species when compared to the control group, with the lowest risk observed in the drain and sewers group. The precision and statistical significance of the effect estimates could not be determined as the study did not account for clustering. There was no difference between the study groups regarding the intensity of infection (eggs per gram stool) in those with *Ascaris*. *Trichuris* had a significantly higher intensity in the control than in the intervention groups, and contrary to expectation *Hookworm* intensity was highest in the drains and sewerage intervention group ([Moraes](#)

2004). Intensity of infection was not evaluated in main studies.

Quality of life

Only one main study evaluated outcomes related to quality of life, finding that satisfaction with living in the city was unchanged by a road paving intervention ([Gonzalez-Navarro 2010](#)). One further CPI with a moderate risk of bias, showed inconsistent results with this finding. Offering cement flooring as part of the Piso Firme programme was associated with an 18.7% increase in the proportion of mothers satisfied with their quality of life, compared to control mothers (RR 1.19; 95% CI 1.11 to 1.27; $P < 0.001$) ([Cattaneo 2009](#)).

Socio-economic outcomes assessed in both main and supporting studies

Income, water expenditure, unemployment, literacy and school participation were examined in both main studies and supporting studies. See [Table 8](#) for the individual supporting study results.

Financial poverty

Main studies found consistent results for reductions in water-related expenditure ([Galiani 2007](#)) but lack of an effect on household income from either road paving ([Gonzalez-Navarro 2010](#)) or multicomponent interventions ([Soares 2005](#); [Taylor 1987](#)).

The results of one CPI reinforced main study findings that water expenses are reduced following multicomponent slum upgrading ([Aiga 2002](#)). Mean water expenditure and mean proportion of income spent on water was lower in the intervention group who received improved water supply as part of multicomponent slum upgrading, than the control group (109 peso/household/months in the intervention slum compared to 234 peso/household/month in control slum, $P < 0.01$; and 2.8% in the intervention slum compared to 10.1% in the control slum, $P < 0.05$, respectively) ([Aiga 2002](#)).

The results of the majority of supporting studies however, did not agree with main study findings related to household income, adding some uncertainty to the findings. One CPI with a moderate risk of bias, found no significant association between provision of cement floors (Piso Firme) and improved household income per capita. In contrast, five studies (three CPIs and two UBAs) found that multicomponent physical slum upgrading was associated with improved income ([Abelson 1996](#); [Aiga 2002](#); [Joshi 2002](#); [Morales 2004](#); [Parikh in press](#)).

Employment

There was limited evidence from the main analysis for the effect of slum upgrading on employment. Only one main study evaluated employment outcomes, finding that road paving did not improve levels of unemployment, with limited evidence of increased labour expectations and weekly worked hours ([Gonzalez-Navarro 2010](#)). Supporting studies contributed to the uncertainty, finding inconsistent results across studies. One UBA with a high risk of bias found that adult employment rates did not change following a multicomponent upgrading intervention in comparison to baseline (RR of 1.01) ([Abelson 1996](#)). A further CPI with a high risk of bias showed an association between lower levels of unemployment and multicomponent slum upgrading when compared to the control group. The relative risk of 0.53 was estimated from frequency percentages, but insufficient information was available to determine the precision or statistical significance of the effect estimate ([Moitra 1987](#)).

Education

Only two main studies considered education, finding no effect of slum upgrading on different education outcomes: literacy of head of household ([Soares 2005](#)), school enrolment ([Gonzalez-Navarro 2010](#)) and school absenteeism ([Gonzalez-Navarro 2010](#)).

Supporting studies added uncertainty to the findings, either disagreeing with main studies or displaying inconsistent results across studies. Results for literacy were mixed amongst supporting studies. Literacy levels were slightly higher in groups receiving multi-component slum upgrading versus no intervention, in one UBA ([Abelson 1996](#)) and two CPIs ([Moitra 1987](#); [Parikh in press](#)) with a high degree of bias. The precision and significance of two studies could not be determined because they did not account for clustering ([Abelson 1996](#)) or did not report numerical results ([Parikh in press](#)). Multicomponent slum upgrading was not associated with changes in literacy in one UBA ([Joshi 2002](#)). There was also no change in literacy between intervention and control groups in the slums situated in South Africa, unlike the improvements observed in the study slums situated in India ([Parikh in press](#)).

[Gonzalez-Navarro 2010](#) found no effect of slum upgrading (road paving) on children's school participation. However, two UBA supporting studies disagreed; reporting that multicomponent slum upgrading was associated with an increase in school-going children when compared to baseline (RR 1.34; 95% CI 1.07 to 1.60; P = 0.01) ([Joshi 2002](#)) and in the proportion of children going to pre-school (RR of 1.94) ([Abelson 1996](#)). In addition, one CPI study examined education differences in slums with varying community sanitation interventions. Mean schooling of household head was greater in both the sewerage and drainage group (MD of 1.4) and drainage only group (MD of 1.6) compared to the control group ([Morales 2004](#)). As clustering was not accounted for precision of these results are not presented. Results should also be interpreted carefully, as the study designs identify associations between interventions and observed outcomes but not whether the intervention caused the results.

Relevant outcomes only assessed in supporting studies

Several relevant outcomes were evaluated in supporting studies that were not examined by main studies. Whilst it is not possible to determine causal effects within these supporting studies, the findings summarised below represent the best available evidence for the specified outcomes. Results of individual studies are presented in [Table 7](#) (health outcomes) and [Table 8](#) (socio-economic outcomes).

Health outcomes only assessed in supporting studies

Communicable diseases - skin diseases and dengue fever

Two supporting studies examined skin diseases ([Cattaneo 2009](#); [Milone 1993](#)). One UBA study with a high degree of bias found a lower relative risk of having a skin disease 'seldom or often' when outcomes, immediately after the delivery of multicomponent slum upgrading or at final follow-up one year later, were compared to baseline (RR 0.77 and 0.38 respectively) ([Milone 1993](#)). However, there was not sufficient information available to determine the precision and statistical significance of the effect estimate. [Cattaneo 2009](#) found no difference in skin diseases between intervention and slum sites. [Milone 1993](#) did not find any change in dengue fever, which was only measured at cycle II (once the intervention had been delivered) and at final follow-up a year later.

Maternal and perinatal outcomes

Infant mortality was the only maternal and perinatal outcome examined in the main analysis ([Gonzalez-Navarro 2010](#)). One UBA study also evaluated perinatal outcomes but was unable to reinforce main analysis findings as the study reported different measures. The study observed that following multicomponent slum upgrading there was no difference in the probability of delivery problems amongst births (RR of 0.98) but there were fewer post-natal consultations (RR of 0.32) ([Abelson 1996](#)). The precision and significance of the effect

estimates could not be determined as the study did not adjust for clustering.

Non-communicable diseases - mental health

Mental health outcomes were only evaluated in supporting studies. One CPI found that offering cement flooring (Piso Firme project) was associated with fewer symptoms of maternal depression (CES-D scale MD -2.37; 95% CI -3.46 to -1.28; $P < 0.001$) and stress (perceived stress scale MD -1.74; 95% CI -2.50 to -0.98; $P < 0.001$) ([Cattaneo 2009](#)).

Nutritional deficiencies

While nutritional deficiencies were not examined in the main studies, two supporting studies measured different indicators ([Abelson 1996](#); [Cattaneo 2009](#)). One UBA study with a high risk of bias found no difference in the proportion of households that were undercaloried following a multicomponent slum upgrading (estimated RR of 0.96) but found a small decrease in the proportion of children who were underweight (RR of 0.68) ([Abelson 1996](#)). Clustering was not accounted for therefore the precision of the effect could not be determined.

One CPI with a moderate risk of bias found limited evidence that lower incidence of anaemia in children under six years old was associated with the offering cement floors (Piso Firme project) (RR 0.81; 95% CI 0.70 to 0.92; $P < 0.001$), but not for height-for-age and weight-for-height z scores (MDs of 0.00 and -0.01, respectively) ([Cattaneo 2009](#)).

Cognitive development

Cognitive development was not examined in main studies but was evaluated in one CPI study of cement floor provision. The intervention was associated with significantly higher MacArthur Communicative Development Test scores (MD 5.57; 95% CI

2.35 to 8.80; $P = 0.01$) and Picture Peabody Vocabulary Test percentile scores (MD 3.08; 95% CI 0.31 to 5.85; $P = 0.03$) ([Cattaneo 2009](#)).

General health measures

Supporting studies examined a range of outcomes relating to general ill-health, with inconsistent results. Two CPIs observed fewer reports of ill-health ([Moitra 1987](#); [Parikh in press](#)) in intervention groups compared to controls, one CPI found no difference ([Cattaneo 2009](#)) and one study found that the proportion of reported 'persons sick' increased (from 1.5% to 4.5%) or those 'chronically ill' from 1.4% to 3.2% ([Abelson 1996](#)). Results should be viewed cautiously. The precision and significance of the effect estimate could not be determined in three studies, either because clustering was not accounted for ([Abelson 1996](#)) or numerical results and sample sizes were not reported ([Moitra 1987](#); [Parikh in press](#)). [Abelson 1996](#) reasoned that the increase in ill-health over time may be due to improved health reporting. [Cattaneo 2009](#) did not expect differences in child respiratory diseases or 'other diseases' between beneficiaries of cement flooring and non-beneficiaries. The analysis was performed as a robustness check to explore the possibility that other public programmes in the study area were falsifying the results of the study.

Socio-economic outcomes only assessed in supporting studies

Financial poverty - households living below the poverty threshold

Income or water-related expenditure, or both, were evaluated in main and supporting studies. In addition, two supporting studies with a high risk of bias measured changes in households living under the poverty threshold. [Aiga 2002](#), a CPI study, found that households in the slum receiving multicomponent upgrading were less likely than controls to be living under the

poverty threshold (RR 0.47; 95% CI 0.37 to 0.59; $P < 0.001$ based on income levels). [Milone 1993](#) also observed that the risk of households living below the poverty threshold (set at the 40th percentile expenditure level) was lower following slum upgrading compared to before (RR of 0.74, precision and statistical significance could not be determined from the information reported). Results should be interpreted carefully, as the study designs identify associations between interventions and observed outcomes but are not able to examine causality.

Employment - occupation type

Employment rates were evaluated by both main ([Gonzalez-Navarro 2010](#)) and supporting studies ([Abelson 1996](#); [Moitra 1987](#)). However, occupation type was only evaluated in one UBA study with a high risk of bias ([Joshi 2002](#)). The study found the proportion of workers engaged in casual and unskilled occupations decreased following multi-component slum upgrading (RR 0.5; 95% CI 0.28 to 0.88; $P = 0.02$). Other occupation types such as skilled workers, vendors, government or private, were unchanged ([Joshi 2002](#)).

Social capital

Social capital was not examined in the main studies. One CPI study with a high risk of bias measured an indicator of social capital ([De Leon 1986](#)) during its evaluation of a multicomponent physical upgrading programme. The study found the proportion of residents agreeing that there had been an improvement in resident social interaction and citizen participation was higher in slums receiving the intervention than no intervention (RR 1.14; 95% CI 1 to 1.31; $P = 0.05$). Results should also be interpreted carefully, as the study designs identify associations between interventions and observed outcomes but not whether the intervention caused the results.

4.3.3 Slum dweller perspectives

Three of the included supporting studies qualitatively examined slum dwellers' views and experiences ([Aiga 2002](#); [Milone 1993](#); [Parikh in press](#)). Qualitative studies were assessed in duplicate using NICE/GATE checklists. Methods were poorly reported, therefore the qualitative aspect of the studies were judged as 'not reported, unable to assess validity'. Two further supporting studies collected slum dwellers perspectives quantitatively ([De Leon 1986](#); [Joshi 2002](#)).

As summarised in [Table 2](#), themes varied considerably between studies and there were just five themes common to more than one study.

- Water, drainage and sanitation infrastructure were perceived as the most important needs for slum communities, in preference to health, education and employment ([Joshi 2002](#); [Parikh in press](#)).
- Water and sanitation was considered to improve health, health behaviour and quality of life ([Joshi 2002](#); [Parikh in press](#)). Infrastructure was believed to free time which could be used for productive activities (such as income generating opportunities or school) ([Aiga 2002](#); [Milone 1993](#); [Parikh in press](#)).
- Water supply was perceived to reduce financial burden ([Aiga 2002](#); [Parikh in press](#)). Footpaths were viewed as increasing safety ([De Leon 1986](#); [Milone 1993](#)).

Further details of the views and opinions of slum dwellers reported within the included studies is described below.

Qualitative findings of slum dweller perspectives Aiga 2002

[Aiga 2002](#) captured views regarding the delivery of water supply as part of a multicomponent programme and described living conditions in unimproved control slums or intervention slums prior to receipt of the programme.

Conditions of slums without upgrading and residents diagnosis of their own needs

In the control group, waiting and filling time for collecting water from the three public water faucets was very long, particularly during the morning. Upgraded-slum residents reported that water collection at public water faucets used to be one of the major problems prior to intervention, highlighting constraints on income generating activities. Most households collected water from three public water faucets. Water delivery services were utilised by 39% of households used at a price four times as expensive as the unit price of water itself, to overcome long water collection waiting times ([Aiga 2002](#)).

Poor availability of water in the control slum constrained water consumption and finances, due to the expense of acquiring water and depriving residents of job opportunities. Focus group discussion revealed that households who could not afford water delivery services nominated one household member to forgo employment and just be in charge of water collection. A total of 68.6% of the 122 household members in charge of water collection expressed their willingness to work for additional income when water supply is improved ([Aiga 2002](#)).

Factors perceived to mediate or enhance impacts of the intervention on the outcomes of interest

All participants in the intervention focus group discussions unanimously agreed that the financial burden of water had been reduced by the improvement of water supply ([Aiga 2002](#)).

Milone 1993

[Milone 1993](#) captured perspectives of residents who received multicomponent slum upgrading programme, and residents from unimproved control slums.

Acceptability of the intervention components

Cemented footpaths and roads were highly appreciated, more than drains or other components. Residents deemed drains to be very essential. Toilets were judged as the second most important component by kampung residents. Some communities wanted paths and roads widened so that more and larger vehicles could enter. Some residents believed that footpaths “made the kampung more beautiful and neater” ([Milone 1993](#)).

There was a consistent theme that residents preferred private facilities. The authors reported that the public bath, laundry and latrine facilities were introduced too late in the project. During that time, there had been increasing opportunities for kampung residents to obtain low interest SIP loans or aid from other programs to install a slab toilet in their own yard or home. There was also declining use of public taps during the study period because increasingly kampung residents with higher incomes began installing piped water in homes or in household yards ([Milone 1993](#)).

Barriers and facilitators to use or implementation of intervention

Siting of facilities was an important factor in whether or not services were used. Several examples were described of facilities not being located where they were needed most, or in areas that were impractical or inconsiderate of gender and social class sensitivities. For example, bath, laundry and latrine facilities could be on the other side of a swamp which

flooded during the rainy season; or water taps situated too far away for a woman or girl to carry water home, requiring them to pay male vendors. Some shared facilities were housed in an affluent family's yard, since only the more affluent had large enough and titled land to denote a portion. Poorer residents were often ashamed to use the public facilities as it denoted poverty ([Milone 1993](#)).

Solid waste disposal boxes were unsuccessful because the cities did not have the capacity to collect rubbish on a regular basis. This was partly because a subproject had not yet been implemented ([Milone 1993](#)).

Residents deemed drains to be an essential part of the intervention, yet numerous problems with the installed drains were reported. This included complaints that drains were not deep enough, connected to discharge pipes from kitchens and baths, or were found on only one side of the path instead of both. In some sites, drains could not function optimally because they were not yet connected to the larger diameter city drains. Furthermore, some reported drains along some streets were installed higher than the level of the floor of the house, thus when it rained houses were flooded ([Milone 1993](#)).

Strategies for maintaining the taps or keeping the drains and public latrines clean were not established. Thus a majority of residents objected to having the public baths, laundry and latrine facilities nearby due to the bad odour. The private water company (PAM) complained that not enough fees were collected to cover the water they dispersed, so several public taps were closed down. User groups had not held together because members could not pay PAM fees on a sustained basis ([Milone 1993](#)).

Latrines were only used by the absolute poor when they were sited in a secluded public area. In kampungs where drains were kept clean it was due to effective leadership of the kepala Rukka Warga (community), kepala Rukka Tetanga (neighbourhoods within), and policy setting by the Lurah (leadership of the overall village). Community self-investment also appeared to enhance the implementation of interventions, such as residents making improvements to new footpaths in front or alongside their property ([Milone 1993](#)).

Factors perceived to mediate or enhance impacts of the intervention on the outcomes of interest

Residents said footpaths and roads improved access to the rest of the city, and made efficient and quicker transport possible. This improved and quickened access to market, schools and work all year round. Otherwise during the rainy season, unpaved muddy, and often flooded kampung paths were difficult to manoeuvre. In some instances this component facilitated the establishment of small sidewalk enterprises ([Milone 1993](#)).

Paved paths were perceived to increase security, as residents invested in electric lighting along footpath edges at their own expense. In some kampungs paths were valued as safe pedestrian thoroughfares, to the extent that residents constructed barriers to prevent vehicle entry. Flag holders in several kampungs were constructed along the paths for national celebrations and greater efforts were put into constructing kampung gates, reflecting heightened community identity ([Milone 1993](#)).

Parikh in-press

[Parikh in press](#) collected opinions from both control slums and communities receiving SNP intervention, in the main study and in a subsample of 20 residents.

Diagnosis of own needs

Slum dwellers gave top priority to investments in water and sanitation infrastructure, in preference to housing health, education and employment ([Parikh in press](#)).

Factors perceived to mediate or enhance impacts of the intervention on the outcomes of interest

Many women in Sanjaynagar said that no longer having to carry buckets of water had reduced their back problems, and indicated improvements in quality of life and gender dimensions. They stated that bathing everyday made their bodies feel “furt” (energetic) and that girls who previously had to spend time disposing waste water because the boys would not do this work, could now wake up late and sleep more ([Parikh in press](#)).

Respondents perceived water and sanitation as a factor influencing income due to freed time, fewer days lost to illness and less medical expenses. The effect on education was highlighted: “Children go to school now. Previously there was no time to send children to school. If women go out of their houses to fetch water who will get the children ready to go to school?” ([Parikh in press](#)). Discussions revealed that the provision of physical infrastructure was reported as the most important reason for making investments in upgrading of their shelter, followed by better social standing and security of tenure. ([Parikh in press](#)).

In the subsample study, intervention residents reported that owning a TV, as a result of electricity provision and increased income, had improved communication with the outside world: “Ignorance is now reducing and TV shows like Discovery channel shows us things that we have never dreamt or seen before.” ([Parikh in press](#)).

Quantitative findings of slum dweller perspectives De Leon 1986

Conditions of slums without upgrading and residents diagnosis of their own needs

Tenure was valued with 21% of the control (no intervention) group stating that certificate of lot ownership should be given to improve slum improvement project activities ([De Leon 1986](#)).

Factors perceived to mediate or enhance impacts of the intervention on the outcomes of interest

Prior to a multicomponent slum upgrading programme, 90% of slum residents felt that the government was not concerned about residents' housing problems. Yet after the slum upgrading project, 80.4% of intervention residents in comparison to 60% of control residents were satisfied that the housing upgrading aspect of the programme was proof of the government's concern. In addition, roads were perceived to improve safety, with residents expressing preferences for straight pathways to facilitate neighbourhood vigilance ([De Leon 1986](#)).

Joshi 2002

[Joshi 2002](#) captured views of slum residents included in a UBA study of a broad slum upgrading strategy including physical environment upgrading and other interventions within the living environment.

Residents diagnosis of own needs

Prior to the intervention, the majority of residents listed water and drainage facilities (85.54%) as their first priorities of housing needs, above health and education. Following water and drainage facilities most residents listed education facilities (27/62, 43.55%) and health facilities (30.65%) as their next priority ([Joshi 2002](#)).

Factors perceived to mediate or enhance impacts of the intervention on the outcomes of interest

On average, women saved almost two hours every day due to regular household water supply. The majority of men, women and boys stated that the main benefit of the regular water supply was the time saved; girls equally listed hygiene and time saved, whereas elders listed hygiene improvements as the main benefit ([Joshi 2002](#)).

4.3.4 Potential adverse effects

Adverse health or socio-economic outcomes were observed in three supporting studies that suffered from a high risk of bias and were not designed to infer causal effects. One UBA study observed increases in general health measures following a multicomponent slum upgrading strategy with wider health and social co-interventions. The proportion of persons sick increased from 1.5% to 4.5% (estimated RR of 3.0) and persons chronically ill from 1.4% to 3.2%. The authors reason this may be due to improved health reporting ([Abelson 1996](#)). An increase in the intensity of hookworm infections was observed in the fullest community sanitation neighbourhoods (drainage and sewers) than in drainage only or control groups ([Moraes 2004](#)). Out of a wide range of education outcomes, [Joshi 2002](#) observed a small increase in female illiteracy (RR 1.34; 95% CI 0.99 to 1.80; P = 0.05).

Residential mobility of slum residents is a potential adverse effect of slum upgrading if rent and housing costs become unaffordable, or home owners move out to capitalise on the ability to charge higher rent. There were mixed reports of out-migration and its causes amongst five included studies. Three main studies found that moving out of the community was not associated with presence of the intervention ([Gonzalez-Navarro 2010](#); [Taylor 1987](#)) or changes in housing values ([Soares 2005](#)).

Two supporting studies narratively discussed residential mobility. [Moitra 1987](#) observed that rent increased in improved bustees, and there was a gradual change in occupancy pattern with self-employed workers replaced by higher earning white collar workers. [Abelson 1996](#) however indicated that outmovers were residents who took advantage of increased wealth rather than those pushed out by high rents.

5. Discussion

5.1 Summary of main results

What are the effects of slum upgrading strategies involving physical environment and infrastructure interventions on the health and quality of life of slum dwellers?

See [Summary of findings table 1](#) and [Figure 5](#).

The majority of available health-related evidence examined the effect of slum upgrading on different measures of communicable diseases.

According to GRADE, the quality of the body of research for effects on communicable diseases was low, with the majority of evidence coming from CBA studies, and one RCT with unreliable health outcome measures. The outcome measures and corresponding results varied across studies (see [Data synthesis](#) for a description of GRADE and summary of findings tables).

There is limited but consistent evidence to suggest that slum upgrading interventions improve diarrhoeal incidence. One main study with a mixed risk of bias found evidence that diarrhoeal incidence decreased in households which received water connections from a private water company in comparison to control households (RR 0.53; 95% CI 0.26 to 1.04; P = 0.07) ([Galiani 2007](#)). Four supporting studies with high risk of bias reinforced this result, reporting that lower diarrhoea incidence was associated with receiving a single cement flooring intervention ([Cattaneo 2009](#)) or multicomponent slum upgrading ([Aiga 2002](#); [Milone 1993](#); [Moraes 2004](#)). [Galiani 2007](#) also found limited evidence for a reduction in severity of diarrhoeal episodes (RR 0.48; 95% CI 0.19 to 1.22; P = 0.12) and no effect on duration of diarrhoea.

There were mixed and inconclusive results for parasitic infections. One RCT with a low risk of bias but unreliable recall period, found no improvement in the likelihood of slum dwellers reporting a parasite or fungus infection in the past year following road paving ([Gonzalez-Navarro 2010](#)). Two supporting studies with a mixed or high risk of bias disagreed with this finding. When compared to controls, a lower incidence of parasitic infections was observed in single cement floor intervention groups ([Cattaneo 2009](#)) or multicomponent slum upgrading ([Moraes 2004](#)).

The available evidence for other communicable diseases is insufficient. Results for broader indicators of communicable diseases were inconsistent. There was no effect on mortality caused by lack of sanitation, but this was only evaluated in one CBA study with a mixed risk of bias ([Soares 2005](#)). There was limited evidence of reductions in waterborne illnesses from one CBA study with a high risk of bias. ([Butala 2010](#)) Skin diseases were examined in two supporting studies with inconsistent results ([Cattaneo 2009](#); [Milone 1993](#)) and dengue fever in one supporting study ([Milone 1993](#)).

There is also insufficient evidence available to assess the impact of slum upgrading on other types of health outcomes. The limited evidence identified is described below.

The body of evidence for maternal and peri-natal conditions was sparse and considered to be low quality according to GRADE. [Soares 2005](#), a CBA with mixed risk of bias, reported no effect of slum upgrading (multicomponent) on infant mortality. One UBA with a high risk of bias was unable to reinforce these findings as it examined different perinatal outcomes ([Abelson 1996](#)).

No main studies were identified that examined nutritional deficiencies or non-communicable diseases such as mental health. Two supporting studies with a moderate and a high risk of bias, found inconsistent results for different indicators of nutritional deficiencies (anaemia, height-for-age and weight-for-height z scores, children underweight, and under-caloried households) ([Abelson 1996](#); [Cattaneo 2009](#)). Similarly, only one supporting study with a moderate risk of bias examined mental health effects ([Cattaneo 2009](#)). The study observed fewer symptoms of depression (CES-D scale MD -2.37; 95% CI -3.46 to -1.28; P < 0.001) and stress (perceived stress scale MD -1.74; 95% CI -2.50 to -0.98; P < 0.001) in intervention households provided with cement floors.

There was no effect of road paving on homicides according to one CBA with a mixed risk of bias ([Soares 2005](#)). However, the quality of the body of evidence available for injuries was graded as very low, because of the serious limitations in the applicability of the outcome and intervention to wider types of injuries and slum upgrading approaches.

Whilst no effect of slum upgrading was identified for residents satisfaction with living in the city in one RCT with a low risk of bias ([Gonzalez-Navarro 2010](#)), the quality of the body of evidence available for injuries was graded as low, because of the 'very serious' limitations in the applicability of the intervention (road paving) and outcome measure to wider slum upgrading interventions and quality of life.

What are the effects of slum upgrading strategies involving physical environment and infrastructure interventions on the socio-economic wellbeing of slum dwellers?

See [Summary of findings table 2](#) and [Figure 6](#).

The majority of available socioeconomic evidence examined the effect of slum upgrading on financial poverty.

Apart from beneficial effects on water-related expenditure observed in one main study, three main studies reported that financial poverty (indicated by household income) was unchanged by slum upgrading. In contrast, supporting studies generally found associations between slum upgrading and improvements in financial poverty. Results for financial poverty should be viewed cautiously, as the quality of the body of evidence according to GRADE was judged to be very low. This was because the CBA evidence was downgraded due to the wide confidence intervals indicating a lack of precision in effect estimates (see [Data synthesis](#) for a description of GRADE and summary of findings tables).

One CBA with a moderate risk of bias reported improved private water supply significantly reduced monthly water expenditure (including costs associated with the intervention) (MD -17.11 pesos; 95% CI -32.6 to -1.62; P = 0.03) ([Galiani 2007](#)). This was reinforced by one supporting study that observed an multicomponent slum upgrading was associated with reduced water expenditure ([Aiga 2002](#)). Three main studies (1 RCT with a low risk of bias, 1 CBA with a mixed risk of bias and 1 CBA with a high risk of bias) reported no effect on slum dwellers' income following slum upgrading ([Gonzalez-Navarro 2010](#); [Soares 2005](#); [Taylor 1987](#)). Six further supporting studies with a high risk of bias, added some uncertainty by consistently disagreeing with this finding. They reported slum upgrading was associated with improvements in income per capita ([Aiga 2002](#); [Moraes 2004](#)), household monthly income ([Abelson 1996](#)), lower proportions of households below poverty thresholds or earning very low incomes ([Aiga 2002](#); [Joshi 2002](#); [Milone 1993](#)), disposable income ([Parikh in press](#)).

There was insufficient evidence available to assess the impact of slum upgrading on other socioeconomic outcomes. The limited evidence identified is described below.

One RCT with a low risk of bias found no effect of slum upgrading on unemployment, but did report limited evidence that fewer residents intended to migrate for work (RR 0.78; 95% CI 0.60 to 1.01; P = 0.06) and weekly worked hours increased (MD 4.68; 95% CI -0.46 to 9.82; P = 0.07) ([Gonzalez-Navarro 2010](#)). The quality of the body of evidence was graded as low, because of the serious limitations in the applicability of the intervention (road paving) compared to broader slum upgrading strategies and the wide confidence intervals observed for the estimate of effect. Three further supporting studies with a high risk of bias reported mixed results; observing either lower or similar unemployment levels between interventions and control groups ([Abelson 1996](#); [Moitra 1987](#)) and a decrease in the proportion of workers engaged in casual or unskilled occupations ([Joshi 2002](#)).

The quality of the body of evidence for crime and violence was graded as low because of the serious limitations in the applicability of the intervention to broader slum upgrading strategies and the wide confidence intervals observed for the estimate of effect. [Gonzalez-Navarro 2010](#), an RCT with a low risk of bias, found no evidence for an effect of slum upgrading (road paving) on the proportion of residents feeling safe walking the street at night or the proportions of households reporting burglaries or vehicles stolen. No supporting information studies examined these outcomes.

The quality of the body of evidence for the effect of slum upgrading on education outcomes was judged to be low according to GRADE. Two main studies found no effect of slum upgrading on different education outcomes. One RCT with a low risk of bias reported no effect of road paving on the proportion of children enrolled in school or school absenteeism ([Gonzalez-Navarro 2010](#)) and one CBA found no effect of multicomponent slum upgrading on illiteracy rate of head of slum households ([Soares 2005](#)). The results across five supporting studies were inconsistent, adding uncertainty to the findings. ([Abelson 1996](#); [Joshi 2002](#); [Moitra 1987](#); [Moraes 2004](#); [Parikh in press](#)).

No main studies were identified that examined the effect of slum upgrading on social capital. This was evaluated in just one supporting study with a high risk of bias, which found limited evidence of an association between slum upgrading and improvements in perceived resident social interaction and citizen participation ([De Leon 1986](#)).

What are potential adverse impacts slum upgrading may have on slum dwellers health and wellbeing?

There is no strong evidence to suggest slum upgrading has adverse impacts on slum dwellers health and socioeconomic wellbeing. No main studies reported any adverse effects. However the harvest plots ([Figure 5](#)) highlight two supporting studies indicated adverse results for two health outcomes; intensity of hookworm eggs per gram stool ([Moraes 2004](#)) and increased proportion of 'ill-health' ([Abelson 1996](#)). These observations should be viewed cautiously as the study designs are not able to infer causality. One UBA study observed small increases in general ill-health measures following a multicomponent slum upgrading yet this may be as a result of increased reporting of illnesses following improved access to health services ([Abelson 1996](#)). Furthermore, the study did not account for clustering so it is unclear whether the finding was statistically significant. Reasons for the observed increase in the intensity of hookworm infections was not discussed by [Moraes 2004](#), however the results should be viewed cautiously as there were no increases in intensity of *Ascaris* or *Trichuris*, and the prevalence of all three infections were lower in slums receiving the interventions.

One potential unintended consequence, residential mobility, is a particular policy concern of slum upgrading. Former residents may rent or sell their properties, to capitalize on the increased security and home value, particularly if land titling is included as part of the upgrading strategy. Relocating may also become the only option, if slum residents are unable to afford their new financial responsibilities such as taxes, maintenance and legal expenses and tenants may face increases in rent charges ([Cadavid 2010](#)). This poses several implications, namely that the intervention no longer targets the most disadvantaged populations it was intended to reach. Out-migration also has significant potential to affect community cohesion as long-term residents move away to affordable shelter and new residents who can afford the cost of living, move in. This may create further complications if upgrading interventions rely on community participation or cohesive community organisations to be responsible for the maintenance of the interventions provided ([Kellet 1992](#)).

There was only limited evidence available that explored residential mobility and affordability of upgraded slums. Three main studies found that moving out of the community was not associated with presence of the intervention ([Gonzalez-Navarro 2010](#), [Taylor 1987](#)) or changes in housing values ([Soares 2005](#)). Two supporting studies narratively discussed residential mobility. [Moitra 1987](#) observed that rent increased in improved bustees, and there was a gradual change in occupancy pattern with self-employed workers replaced by higher earning white collar workers. [Abelson 1996](#) however indicated that outmovers were residents who took advantaged of increased wealth rather than those pushed out by high rents.

Further research outside of the scope of this review specifically examined whether slum rehabilitation (in situ clearance and rebuilding of slums) results in residential mobility. The author found that on average 10% of original slum occupants moved away. The reason for mobility was found to be due to upgrading slums not being matched to the needs of the resident, and the high cost of living ([Cadavid 2010](#)). Outmigration rates reported in two included studies were 16.8% ([Joshi 2002](#)) and 21.5% ([Gonzalez-Navarro 2010](#)).

What are slum dwellers perceived needs, preferences for slum upgrading and satisfaction with the interventions they receive?

Views regarding slum dwellers needs, preferences and satisfaction with interventions were not captured within main studies, but were discussed in four supporting studies. Due to the lack of available methodological information, it was not possible to assess the reliability of the perspectives reported. Water, sanitation and drainage improvements were rated as higher priorities for residents above health and education services ([Joshi 2002](#); [Milone 1993](#); [Parikh in press](#)). The needs of the residents and the values attributed to them changed as water and sanitation improved. Once implemented, water and sanitation was perceived to improve health, health behaviour and quality of life, and income. Residents mentioned less days lost to illness, fewer back problems from carrying water, increases in feeling energetic and saving time from water collection that was directed to income generating opportunities ([Aiga 2002](#); [Parikh in press](#)). Tenure was valued in one study, with 21% of control participants stating that certificate of lot ownership should be given to improve slum upgrading project activities ([De Leon 1986](#)).

In the limited information available on the nature of services, private facilities appeared to be preferred by residents to communal facilities for water, bathing and toilets. Siting public facilities away from areas of most need, impractical locations, or in ways that social class and gender dimensions were described as barriers to the use of services ([Milone 1993](#)).

Cemented footpaths and roads were highly appreciated, where residents thought these led to improved access to market, schools and work, and increased safety ([Milone 1993](#)) and were viewed as increasing safety ([Abelson 1996](#)).

[Milone 1993](#) also reported resident dissatisfaction with a number of intervention components due to their location, incomplete service design (for example solid waste disposal boxes were provided but no system for collecting them) and lack of maintenance of drains or public latrines.

What programme characteristics and components increase health and wellbeing of slum dwellers?

Conclusions on whether particular characteristics and components have less or more impact on the health and wellbeing of slum dwellers, or operate synergistically, could not be drawn from the available main studies due to study heterogeneity and the lack of information regarding integrity and follow-up. For these reasons it was not appropriate to perform subgroup meta- analyses intended at the protocol stage. Instead harvest plots were developed to visually compare results between single and multicomponent interventions and those with and without community involvement. No trends were observed according to the type of intervention (these harvest plots are available from the review authors).

Views and opinions of slum dwellers collected in only five supporting studies ([Aiga 2002](#); [De Leon 1986](#); [Joshi 2002](#); [Milone 1993](#); [Parikh in press](#)) offer potential reasons for why slum upgrading strategies may improve health and wellbeing. Slum dwellers discussed water, sanitation and roads or footpaths in particular.

Slum dwellers described how improved water and sanitation benefited their hygiene ([Joshi 2002](#)), quality of life (residents in [Parikh in press](#) stated girls who previously had to spend time disposing waste water could now wake up late and sleep more) and health ([Parikh in press](#)). Access to safe water and sanitation was described as freeing time ([Aiga 2002](#); [Joshi 2002](#); [Parikh in press](#)) for example from collecting water ([Aiga 2002](#)) and as a result of fewer days lost to illness ([Parikh in press](#)). The additional time allowed for productive activities such as school ([Parikh in press](#)) or income generating opportunities ([Aiga 2002](#)). Slum dwellers described less costs for medical expenses as a result of less illness ([Parikh in press](#)), and the financial burden of accessing water was reduced by improvement of water supply ([Aiga 2002](#)). Participants even stated that payment for services may actively encourage slum residents to work for income in order to pay fees.

Improvements to roads and footpaths were valued by residents in two studies ([De Leon 1986](#); [Milone 1993](#)). [Milone 1993](#) described how this increased access to the rest of the city, and made efficient and quicker transport possible to market, schools and to work all year round. In some instances road or pavements facilitated the establishment of small sidewalk enterprises. Residents often said that paved paths increased security, as residents at their own expense strung up electric lighting along the footpath edges ([Milone 1993](#)) and slum dwellers in one study expressed preferences for straight pathways to facilitate neighbourhood vigilance ([De Leon 1986](#)).

Considering slum upgrading strategies in general, slum dwellers views suggested that provision of physical infrastructure demonstrated that the government was concerned about their housing problems ([De Leon 1986](#)) and was also reported as the most important reason for residents making investments in upgrading of their shelter.

What external contexts may boost or hinder intervention effects?

The logic model in [Figure 1](#) demonstrates the strategies that take place upstream of interventions to directly change the living conditions of slums.

There is insufficient evidence available to form conclusions on what external contexts may boost or hinder intervention effects. The identified studies were highly heterogeneous and lacked detailed information regarding external contexts.

Limited information was available in the eligible studies on the policy and planning environment that the implemented slum upgrading interventions were operating within. Two of the four main studies were government-led (mostly municipal) projects demonstrating political commitment to slum upgrading ([Gonzalez-Navarro 2010](#); [Soares 2005](#)). This was also present in all nine supporting studies ([Abelson 1996](#); [Aiga 2002](#); [Cattaneo 2009](#); [De Leon 1986](#); [Milone 1993](#); [Moitra 1987](#); [Morales 2004](#); [Parikh in press](#)). However, supportive public policies such as use of local labour for public works to create job opportunities or policies to improve delivery strategies through training and capacity building or increasing urban planning manpower were not reported in either main or supporting studies.

Due to the limitations of the available evidence described above, it was not possible to draw conclusions on whether particular intervention actors boost or hinder programme delivery and outcomes. There was also insufficient evidence available to assess whether community participation or different funding models boosted intervention effects. For these reasons it was not possible to perform intended subgroup meta-analyses to explore the impact engagement with the community has on the intervention effectiveness. However harvest plots (available from the authors) were developed to visually compare results of interventions involving some level of community intervention to those that do not. The plots show the lack of consistent outcomes across the studies and consequently does not demonstrate any trends in results according to type of intervention. Engagement of the community is widely recommended by development experts in intervention programs to ensure that the needs of slum residents are met, and assist with the fidelity and sustainability of the intervention. Within the included studies, most community participation was in the form of residents paying for at least part of the services they received or providing labour. Just one main study ([Soares 2005](#)) and three supporting studies described how communities were consulted during intervention design, or were responsible for managing delivery and maintenance of interventions, or both ([Abelson 1996](#); [De Leon 1986](#); [Joshi 2002](#)).

It is generally acknowledged that some of the underlying structures affecting both the living environment and upstream interventions include religious, political, and economic structures and institutions. These have not been described sufficiently in any of the included studies. However, [Galiani 2007](#) demonstrate how economic and political environments can, relatively quickly, impact on slum upgrading interventions even after the actual program delivery has ended. The authors describe that Argentina suffered a macro-economic crisis in the years that followed the private water expansion of services in shantytowns. Conflict between the government and water privatisation services followed as the government blocked previously agreed tariff increases, and private companies reacted by interrupting their investments. Eventually the water concession was cancelled, and water provision contracts were transferred to a newly created public company.

5.2 Overall completeness and applicability of evidence

Completeness of the evidence

Outcomes examined in the papers

The harvest plots provide a visual presentation of the interventions and outcomes covered by main and supporting studies (see [Figure 5](#) and [Figure 6](#)). The most commonly examined health outcome was communicable diseases, namely diarrhoeal diseases. There was insufficient evidence available to assess the impact of slum upgrading on other communicable diseases such as parasitic infections, and other maternal or perinatal conditions, nutritional deficiencies and other non-communicable diseases. There was also insufficient evidence to assess the impact of slum upgrading on slum residents quality of life.

Similarly, among socioeconomic outcomes, indicators of financial poverty were most commonly investigated across studies. Various indicators were used including mean income per capita, proportion of residents under the poverty threshold, and water-related expenditures. There was insufficient available to assess the impact of slum upgrading on education, employment, crime and violence and social capital.

As described in the background section [How the intervention might work](#), slum upgrading has the potential to not only directly influence health outcomes by reducing routes of disease transmission, but also to impact upon a broader range of social determinants of health and wellbeing. Given the complexity of designing and delivering slum upgrading interventions, it is important that impact evaluations take a holistic approach to the array of important policy-relevant outcomes that may be affected, in order to demonstrate that the investment, time and resources required, are outweighed by their effect on improving the lives of slum dwellers, and their integration into society.

Intervention components of the included studies

Across all included studies, three groups of slum upgrading interventions incorporating improvements to the physical environment and infrastructure, were found.

1. Single-component physical environment and infrastructure intervention within slums were investigated in two of the five main studies regarding improved water supply ([Galiani 2007](#)) and road paving ([Gonzalez-Navarro 2010](#)). One further supporting study evaluated cement floors ([Cattaneo 2009](#)).
2. Broad slum upgrading strategies involving multicomponent physical environment and infrastructure interventions plus other interventions within the living environment (such as health and social service provision or health behaviour, education) were investigated in two of the five main studies ([Butala 2010](#); [Taylor 1987](#)) and four supporting studies ([Abelson 1996](#); [De Leon 1986](#); [Joshi 2002](#); [Moitra 1987](#)).
3. Multicomponent physical environment and infrastructure interventions without other living environment interventions were evaluated in one main study ([Soares 2005](#)) and four supporting studies ([Aiga 2002](#); [Milone 1993](#); [Morales 2004](#); [Parikh in press](#)).

The combination of intervention components differed across studies, even when the programmes shared the same name (please see [Figure 3](#) for characteristics of main studies and [Figure 4](#) for supporting studies). The lack of available main studies with a low risk of bias and the heterogeneous nature of the interventions, settings and outcomes did not permit any conclusions on which components may have been most beneficial.

Water, sanitation, drainage and road infrastructure were common features of slum upgrading strategies in both main and supporting studies.

Within the five main studies waste management, energy improvements and improved housing interventions were poorly covered, though self-improvements to homes were observed in two main studies of multicomponent slum upgrading ([Gonzalez-Navarro 2010](#); [Taylor 1987](#)) Regarding co-interventions, micro-credit loans were included within the programme of one main study ([Butala 2010](#)). Health education co-components were included in the slum upgrading programmes of two main studies ([Butala 2010](#); [Taylor 1987](#)) and secure tenure in one study ([Butala 2010](#)). Social environment interventions such as crime reduction interventions were not examined by any main studies.

A similar pattern of slum upgrading interventions were observed in the nine supporting studies. Considering physical upgrading; waste management, energy improvements and improved housing interventions were poorly covered, though self-improvements to homes were observed in four studies ([Abelson 1996](#); [Joshi 2002](#); [Moitra 1987](#); [Parikh in press](#)). Regarding wider co-interventions, provision of health clinics or schools were evaluated in three supporting studies ([Abelson 1996](#); [Joshi 2002](#); [Moitra 1987](#)), and health education component in one study ([De Leon 1986](#)). Slum upgrading interventions included secure tenure or time-bound guarantees from threat of eviction were described in over half of the supporting studies ([Abelson 1996](#); [Aiga 2002](#); [De Leon 1986](#); [Joshi 2002](#); [Moraes 2004](#); [Parikh in press](#)). The inclusion of income generation projects or microcredit loans were investigated in four supporting studies ([Abelson 1996](#); [De Leon 1986](#); [Joshi 2002](#); [Moitra 1987](#)). Health and social service components were described in three supporting studies ([Abelson 1996](#); [De Leon 1986](#); [Moitra 1987](#)) but, as with the main studies, social environment interventions such as crime reduction interventions were include in supporting study programmes.

A range of terminologies were used to describe the implemented projects, including slum upgrading ([Butala 2010](#)), slum improvement ([Abelson 1996](#); [Moitra 1987](#)), Kampung Improvement Programme (KIP – [Milone 1993](#); [Taylor 1987](#)), Zonal Improvement Programme (ZIP, [Aiga 2002](#)), Barrio Escopa pilot project ([De Leon 1986](#)), Small Town Urban Development Project (STUDP - [Milone 1993](#)), and Favela-Bairro ([Soares 2005](#)). Two projects employed Slum Networking Programmes (SNP), [Parikh in press](#) evaluated just SNP in five communities, whereas [Joshi 2002](#) delivered a wider 'Integrated Slum Development' Programme, with SNP forming the physical upgrading element.

External contexts

Limited information was available in the eligible studies on the policy and planning environment that the implemented slum upgrading interventions were operating within. Interventions in two of the five main studies were government-led (mostly municipal) projects demonstrating political commitment to slum upgrading ([Gonzalez-Navarro 2010](#); [Soares 2005](#)) and all nine supporting studies ([Abelson 1996](#); [Aiga 2002](#); [Cattaneo 2009](#); [De Leon 1986](#); [Milone 1993](#); [Moitra 1987](#); [Moraes 2004](#); [Parikh in press](#)). Supportive public policies such as use of local labour for public works to create job opportunities or policies to improve delivery strategies through training and capacity building or increasing urban planning manpower were not reported in either main or supporting studies.

Just one main study ([Soares 2005](#)) and three supporting studies included interventions reported to involve community engagement, either by consultation during intervention design, or through delivery or maintenance of interventions ([Abelson 1996](#) [De Leon 1986](#) [Joshi 2002](#)).

Information regarding underlying contexts such as religious, political, and economic structures was not described sufficiently in any of the included studies.

Were the interventions sustained?

Firm conclusions on the sustainability of completed interventions are not possible, due to the lack of available information. Only one main study ([Butala 2010](#)), a CBA, described anecdotal evidence suggesting that a majority of ancillary health interventions did not persist after construction of the basic infrastructure as per the slum upgrading programme.

The remaining information was reported in four supporting studies. [Milone 1993](#) did not quantitatively examine sustainability but described the lack of maintenance of the multi-component physical upgrading, for example drains were not kept clear, water taps were not maintained so that if they broke they were not fixed, and water fees were not always paid so taps were turned off. [Joshi 2002](#) reported that building capacities and sustaining motivation of co-coordinators and local workers had proved challenging. Key facilitators for maintaining these partnerships included structures to facilitate collaborative initiatives, proactive integration of partners differing aims, acceptance of different working styles, recognition of efforts put in by all partners, sustainable processes that enhance partnership and meeting partners objectives. [Moitra 1987](#) discussed that earlier improvements were nullified because of lack of adequate arrangements for operation and maintenance. The author believed that this was due to the government becoming the owner of the areas through land rights acquisition, which meant that maintenance fell on an organisation ill-equipped to handle it. The author proposed that residents should take responsibility for day to day maintenance (such as clearing drains) but that there's no formal system of community participation in the urban areas. [De Leon 1986](#) described how almost all lot boundaries established within an upgrading programme kept their original positions, pathways were well maintained. However pocket parks were reduced in size by 20% at follow-up.

There was some evidence in the included studies that the slum upgrading programmes also resulted in self-initiated improvements by the slum community. Two main studies ([Gonzalez-Navarro 2010](#); [Taylor 1987](#)) and four supporting studies ([Abelson 1996](#); [Joshi 2002](#); [Moitra 1987](#); [Parikh in press](#)) reported that slum dwellers made improvements to their homes, and one supporting studies reported community enhancement of footpaths ([Milone 1993](#)).

Were the outcomes sustained?

While the majority of main studies followed up outcomes a number of years after baseline measures, two studies did not clarify when the slum upgrading intervention was completed, making it difficult to judge the length of follow-up post- intervention delivery ([Butala 2010](#); [Soares 2005](#)). Information in three of the five main studies showed that, [Galiani 2007](#) and [Gonzalez-Navarro 2010](#) measured outcomes over a relatively short period (between five to 10 months and between 19 and 1 month, respectively), whereas [Taylor 1987](#) measured outcomes between three and five years after the intervention (the exact follow-up period is not clearly reported).

It is not possible to detect whether the impact of the interventions had diminished or been maintained during the follow-up period, as short and long-term measures were not common across these studies. Three supporting studies reported relatively long follow-up periods between two to four years after the intervention ([Cattaneo 2009](#); [De Leon 1986](#); [Joshi 2002](#)) but again did not measure outcomes at more than one timepoint within the studies, or measure the same outcomes across these studies.

Did sustained intervention relate to sustained outcome?

There is insufficient information provided on the sustainability of interventions or outcomes to evaluate whether sustained intervention related to sustained outcomes.

Applicability of the evidence to other slum communities

As previously discussed, the study intervention components and outcomes are heterogeneous, preventing conclusion on which specific intervention had the noted effects or whether there was synergy between components. However the diversity in the population settings and intervention strategies does increase the likelihood that the evidence can be generalized to wider slum settings.

Main studies were conducted in Asian countries including India ([Butala 2010](#)) and Indonesia ([Taylor 1987](#)), and Latin America including Argentina ([Galiani 2007](#)), Mexico ([Gonzalez-Navarro 2010](#)) and Brazil ([Soares 2005](#)). A predominant number of support studies examined interventions in slums in Asian countries. Four of these were situated in India ([Abelson 1996](#); [Joshi 2002](#); [Moitra 1987](#); [Parikh in press](#)), two in the Philippines ([Aiga 2002](#); [De Leon 1986](#)) and one in Indonesia ([Milone 1993](#)). Two further supporting studies were conducted in Latin America, including Mexico ([Cattaneo 2009](#)) and Brazil ([Moraes 2004](#)). The evidence base inadequately represented Africa and the Caribbean nations with only one study from Cape Town ([Parikh in press](#)) and none from the Caribbean.

Existing slum conditions prior to or without intervention showed most slum settings lacked secure tenure, water and sanitation services. Studies did not consistently report conditions with respect to drainage facilities, housing materials, overcrowding, roads and energy infrastructure and waste management conditions. Correspondence was required with the authors of two studies authors to ascertain whether the setting could be considered as slums ([Cattaneo 2009](#); [Gonzalez-Navarro 2010](#)).

The majority of studies included squatter communities without secure tenure, though often slums had been in existence for several years. Two studies included participants that were in recognised residential areas, and mostly owned their homes or property title ([Cattaneo 2009](#); [Gonzalez-Navarro 2010](#)). [Taylor 1987](#) additionally reported that the proportion of households with secure land tenure at baseline was low in control slums (24%), and higher in reference and intervention groups (32% and 48% respectively). The percentage owning house tenure was considerably higher in all three groups, ranging from 60 to 72%. Two studies did not provide information on the tenure of the communities ([Galiani 2007](#); [Parikh in press](#)).

[Parikh in press](#) did not describe the setting conditions of the included slums prior to the intervention. Of the remaining studies, water and sanitation provision was poor in all studies, except for [Moraes 2004](#) which reported that many houses had some form of water supply. Only two studies reported information on housing durability, with [Gonzalez-Navarro 2010](#) finding the majority had cement walls and floors, whereas conditions were poor in the included slum settings of [Taylor 1987](#), with only 23% to 36% of households within the study groups having homes built of permanent material. Energy infrastructure was generally not described, though two studies reported good access to electricity ([Cattaneo 2009](#); [Moraes 2004](#)). Drainage facilities, overcrowding, and road infrastructure was also poorly reported amongst the studies.

Thus whilst further detail would have been desired about the history and conditions of the included slums, the included settings could be applicable to urban slums in LMIC countries,

and particularly relevant to slum communities in Asia. Of the main studies, one RCT was considered to have high external validity ([Gonzalez-Navarro 2010](#)), and three CBAs mixed generalisability ([Butala 2010](#); [Galiani 2007](#); [Soares 2005](#)). It should be noted however that [Gonzalez-Navarro 2010](#) evaluated a single intervention, road paving, thus the results may have limited applicability to broader multicomponent slum upgrading interventions. [Taylor 1987](#) was judged to have poor or unclear external validity as it did not report how the neighbourhoods chosen for the study were chosen, or whether the participants included were representative of the neighbourhoods included.

Supporting studies were judged to have either high ([Moraes 2004](#); [Joshi 2002](#)) to moderate ([Abelson 1996](#); [Aiga 2002](#); [Cattaneo 2009](#); [De Leon 1986](#); [Milone 1993](#); [Moitra 1987](#); [Parikh in press](#)) external validity. Studies generally described the source area well, though were less successful in describing whether the study area was representative of the source area, or how selected participants in the study area represented the eligible slum population of interest.

5.3 Quality of the evidence

Risk of bias tables are presented in [Characteristics of included studies](#). The internal validity of included studies according to the NICE/GATE checklist are also presented in [Table 3](#) and [Table 4](#).

Within the main studies, one RCT was considered to have a low risk of bias ([Gonzalez-Navarro 2010](#)). Four CBAs were also included, two of which were judged to have a mixed or unclear risk of bias ([Galiani 2007](#); [Soares 2005](#)) and two had a high risk of bias ([Butala 2010](#); [Taylor 1987](#)).

A significant challenge with the evaluation of slum upgrading projects is the identification of comparable control groups, which was compounded by the failure in most studies to incorporate evaluation processes during the initial stages of project design. Therefore researchers often had to examine the effect of intervention once regions had already been upgraded, and identify control groups post hoc. To reduce the risk of selection bias such limitations were likely to introduce, the majority of main studies utilised difference in difference analyses ([Butala 2010](#); [Galiani 2007](#); [Gonzalez-Navarro 2010](#); [Soares 2005](#)), propensity score matching ([Soares 2005](#)) and multivariate analyses that controlled for confounders ([Galiani 2007](#); [Gonzalez-Navarro 2010](#); [Soares 2005](#)).

With the exception of [Cattaneo 2009](#) all supporting studies were judged to have a high risk of bias. The studies were mostly CPI designs that lacked baseline data ([Aiga 2002](#); [Cattaneo 2009](#); [De Leon 1986](#); [Moitra 1987](#); [Moraes 2004](#); [Parikh in press](#)) and were highly susceptible to selection bias. Propensity score matching was utilised by [Cattaneo 2009](#) and effect estimates were controlled for potential confounders in three studies ([Aiga 2002](#); [Cattaneo 2009](#); [Moraes 2004](#)) to try to minimise such bias.

The majority of studies were clustered. Whilst most main studies used appropriate statistical analyses to account for this, the majority of supporting studies did not and risked wrongly detecting statistically significant effect estimates by underestimating standard errors.

In general, both main and supporting studies suffered from potential detection bias (as blinding was not possible), reliance on existing data sources that tended to use unreliable outcome measures based on self-reporting over recall periods longer than two weeks, and poor reporting of intervention fidelity and power of the sample size.

5.4 Potential biases in the review process

This review may suffer from certain biases in the review process, encountered during identification of relevant studies.

Firstly, the topic crosses multiple disciplines such as health, urban planning and architecture, environmental, and the social sciences. The review authors hence felt it necessary to search both large multidisciplinary (for example SCOPUS) and topic-specific bibliographic databases to attempt to capture potentially specialised literature (such as Planex, Georef, and Sociological Abstracts). Scoping searches during review protocol development, had revealed a lack of clear and standard terminology within the topic, due to the range of disciplines and countries covered in this review. This is reflected in the list of terms used to describe slum settings in [Table 1](#) together with the programme names identified in the included studies to describe the intervention (for example Slum Networking Programme, Kampung Improvement Programme, Zonal Improvement Programme, Integrated Slum Development, and Water Expansion). The review search strategy utilised a broad structure, combining just two search concepts for setting and intervention terms, to minimise the risk of missing eligible study designs or outcomes in the search. Within these concepts, an extensive list of terms and synonyms were utilised, employing truncation and adjacency operators to cast a wide net across the literature. Several bibliographic databases only allowed a limited number of terms to be searched, presenting the risk that relevant studies could have been missed.

A second challenge in identifying relevant research was the large amount of potentially relevant literature, only available as grey or unpublished literature, and therefore not indexed in the bibliographic databases described above. Again, steps were taken to address this by searching grey literature databases such as HMIC, IDEAS and 3ie impact evaluation database, a wide range of key organisation websites, reference list checking and suggestions from experts. Five of the 14 included studies were identified through these snowballing techniques.

A third obstacle faced in the review process, was the difficulty in obtaining potentially relevant studies. The full text of 27 potentially relevant abstracts could not be retrieved, despite using the library resources available to the team or requests to the British Library. It is likely that these records would not meet the inclusion criteria, yet as most provided very limited information in the abstract, or did not provide an abstract it was not possible to confidently exclude them from the literature review. Based on the information available, it is likely that just five records would have potential relevance, however only two of these records reported an abstract, and no records suggested that they met all study review criteria.

5.5 Agreements and disagreements with other studies or reviews

To our knowledge, there is no existing systematic review that has been conducted on the topic of the health or socioeconomic impacts of multicomponent slum upgrading strategies.

There are several reviews (not limited to slum settings) that support our review findings that interventions including water and sanitation improvements could increase both health and socio-economic wellbeing. The reports reveal reductions in diarrhoeal diseases following improved water supply ([Clasen 2006](#); [Waddington 2009](#)) and excreta disposal ([Clasen 2010](#)). In addition to health gains and reduced health costs, a recent World Health Organization (WHO) cost-benefit analysis of water and sanitation access at the global level, demonstrated clear reductions in days lost with respect to formal or informal employment, school

attendance, or other productive activities in the household, as a result of time saved from illness and time saved accessing safe water and sanitation ([Hutton 2004](#)).

Slum Networking Programmes (SNP) were described in two of the included studies ([Joshi 2002](#); [Parikh in press](#)). Within these low quality studies, moderate improvements in health, household income, education and occupation were observed, and the authors reached conclusions generally favouring the interventions. A discussion paper presenting results from a cross-sectional survey conducted in slums receiving SNP in Indore and newspaper archive material from these regions, presents a less positive picture ([Verma 2000](#)). The survey revealed that poor implementation of SNP features, only 34% had toilet connections and only 16% had private water supply. Streets were often waterlogged and there was virtually no evidence of soft landscaping. The author commented on a number of failed assumptions that were made within the SNP concept, such as believing all slum households could and would connect toilets to underground drainage once provided, to ensure all community sewage finds its way into piped sewerage. The contrasting outlook of SNP between the included intervention studies and this cross-sectional survey highlight the importance of incorporating sufficient process evaluations as part of the impact evaluation, in order to assess whether slum residents are satisfied with the intervention received, identify barriers and facilitators, and assess whether the outcomes reported represent that maximal result that could be achieved if the intervention was delivered in the way it was intended.

Due to the heterogeneity of the included interventions and outcome measures, it was not possible to reach clear conclusions regarding which aspects of slum upgrading strategies were responsible for the observed effects. However, studies of sole land titling interventions suggest that tenure security results in significant improvements on residential investment in housing ([Field 2005](#)), hours of employment ([Field 2007](#)) and reduction in the household demand for child labour ([De Moura 2009](#); [Field 2007](#)). Whilst the evidence suggests that secure tenure could be an important aspect to include in slum upgrading strategies, the local context of the area receiving the intervention should be considered. [Taylor 1987](#) described that tenure security was not considered for inclusion by the Government implementing the slum upgrading programme, as it realised that the tenure regularisation process in Indonesia would be very time-consuming. Instead they intended to implement land tenure at a later stage, believing that due the existing complexities in land tenure the system would be stable enough to discourage eviction.

6. Authors' conclusions

6.1 Implications for practice

Within the limited evidence base available, results suggest that the incidence of diarrhoea is reduced following slum upgrading. There were mixed results for whether slum upgrading improved occurrence of parasitic infections, or broader indicators of communicable diseases. There was insufficient evidence available to make firm conclusions on the impact of slum upgrading on other health outcomes (including non-communicable and injuries) or quality of life outcomes. Regarding socio-economic outcomes, the included studies demonstrated mixed effects of slum upgrading on measures of financial poverty and employment outcomes. There was also insufficient evidence available to assess the impact of upgrading on education, social capital, crime and violence.

The heterogeneity of interventions and outcomes prevent conclusions on which interventions, or combination of components is linked to the greatest improvements in health or socioeconomic wellbeing. Within the included studies, water supply, sanitation, drainage, roads and paved footpaths were the most commonly delivered strategies.

Limited qualitative and views based quantitative data within the studies suggest that slum communities value infrastructure upgrading (namely water and sanitation interventions) as top priorities for slum improvement; above health, education or financial interventions. Once the physical living environment had been improved residents valued health and education facilities.

Information provided in several studies also suggested that slum dwellers are keen to contribute to the improvement of their living conditions. It was observed that slum residents were willing to pay for the services they receive, and contribute to the design, planning, and delivery of the intervention. Furthermore, several studies also observed residents making investments to their homes and community outside of the intervention delivered. A consistent theme amongst the studies was the desire for slum households to work for income and belief in education, if time was freed by improved conditions. These factors may present opportunities to build upon for improving the cost recovery of slum upgrading.

Information available on the fidelity and sustainability of interventions was scarce within the included studies. The available qualitative data however indicated the importance of appropriate siting of facilities, preference for private facilities, timing delivery of synergistic interventions together and ensuring infrastructure is fit for purpose and systems are provided for cleaning, maintenance and repair. Engaging with communities during the design and implementation may help to ensure interventions are utilised and maintained as intended by addressing gender, cultural and social stigma.

A common limitation of the included studies was the lack of involvement of independent researchers at the start of the intervention. As a consequence, studies were faced with difficulties in accurate collection of outcomes, confounders and details regarding intervention processes and fidelity. This was often addressed by measuring only post-intervention data for comparison groups or making use of existing health insurance claim data and household surveys, or both. Whilst these provided pragmatic solutions, study validity was limited by the quality of the available data. It is essential that rigorous process and impact evaluations are routinely incorporated during the planning and commissioning of slum upgrading programmes, to enable further refinement of interventions that build upon lessons learned.

6.2 Implications for research

A number of evidence gaps were identified by the systematic review. In particular, there is a lack of research for the effect of physical slum upgrading on non-communicable diseases, maternal and perinatal conditions, injuries, quality of life, employment, education, social capital and crime. With regards to the interventions examined, further research is required on the impact of energy infrastructure, waste management and improvements to homes in slum communities. Additional studies are needed to examine whether the combination of physical upgrading and other interventions designed to improve health/social services, health education and behaviour, or the social environment, have a greater impact on the outcomes of interest.

Rigorous studies with a low risk of bias are required to draw firm conclusions on the impact of slum upgrading strategies. The potential for studies to reduce bias is greatest when evaluations are planned at the same time as the design and delivery of the intervention and independent researchers are involved in intervention allocation and data collection. This is demonstrated by the one RCT ([Gonzalez-Navarro 2010](#)) included in the review and a further RCT of in situ slum upgrading currently in progress ([Cooper 2007](#)). However, it is acknowledged that large-scale multicomponent slum upgrading interventions can be difficult to manipulate experimentally and RCTs would often be impractical or unethical. As is the case with the majority of included studies, many interventions are evaluated under 'natural experiment' conditions. Whether RCTs or other types of impact evaluations are performed, the following study features are recommended in order to strengthen the evidence base on slum upgrading:

Comparison groups

Wherever possible, a control group should be utilised to help demonstrate that changes in the slums are brought about by the effect of the intervention. Choice of control group should be carefully considered to ensure comparison groups are as similar as possible. In particular it is important to understand whether the reasons why the control group has not received the intervention, is reflective of important differences in the setting characteristics.

Outcomes

The existing evidence base would be strengthened by using objective measures where possible to accurately assess outcomes (for example collecting stool samples to examine intestinal infections). If self-reported outcomes are collected, they should use a reliable recall period (up to two weeks). Measures of financial poverty such as household income should consider and adjust for changes in inflation over time.

Measuring outcomes at several time points would allow assessment of secular trends and conclusions to be drawn on whether short term effects of interventions are sustained, continue to improve or worsen over time.

Studies that allocate interventions by clusters but analyse outcomes by individuals should ensure appropriate analyses are used to allow for clustering effect, or report the intracluster coefficient and effective sample size to enable reanalysis of data.

Reporting standards

It is important that studies clearly define the population and setting of interest to maximise the likelihood that studies are identified during the literature search, and enable reviewers to examine heterogeneity between studies and assess 'what works for whom'. Full details of the

intervention should also be provided (see process evaluations below).

To assist the synthesis of primary research in systematic reviews, studies should report sufficient detail to allow estimation of effect sizes and assessment of internal validity. This should include the number of participants or clusters within comparison groups, power calculations indicating how large a sample size is required to detect expected effects, and measures of variance for effect estimates (such as standard deviations, standard errors and confidence intervals).

Addressing selection bias

Given the heterogeneous nature of slum settings and the difficulties in identifying control groups, steps to address selection bias are needed. This is particularly pertinent for non-randomised or 'natural experiment' studies. There are a number of different statistical approaches that can be utilised to minimise selection bias. These can include analyses to adjust for unobserved differences between comparison groups (such as difference in differences, instrumental variables and regression discontinuity designs) or observed differences (such as matching control and intervention individuals or groups according to similar characteristics, adjusting for potential confounders in multiple regression analyses, and propensity score matching) ([Craig 2012](#)). Recent guidance by the Medical Research Council recommends combining analytical methods for addressing observed and unobserved variables in order to strengthen causal inference ([Craig 2012](#)).

Process evaluations and qualitative studies

Slum upgrading interventions and the settings in which they are delivered can be complex, as demonstrated in [Figure 1](#). Programmes can involve multiple interacting components and delivery to heterogeneous settings with variable living conditions and subsequent infrastructure needs. Successful slum upgrading may also require different behaviours from different organisations at local and national levels, such as government, business, civil society and local residents.

Quantitative effectiveness studies should therefore seek to incorporate process evaluations and qualitative investigation of slum dwellers' views and experiences to enhance understanding of what interventions work, for whom and why and how best to deliver facilities. In order to achieve this, data should be gathered on all intervention components, the context in which they were delivered, and whether services were provided as intended (fidelity of intervention) in addition to information regarding the resources and time required to deliver a programme. Views and perspectives of providers and slum residents should also be captured to provide insight regarding acceptability, barriers and facilitators.

This would provide valuable implementation information to help decision makers determine which interventions and combinations are most appropriate for the needs of their community, how they should be delivered, and what likely barriers and facilitators will need addressing for the effective delivery of interventions.

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8. Contributions of authors

RT was responsible for drafting the report with assistance from RS, NB, BC and ER. Literature searching, study selection, data extraction and risk of bias assessment was conducted by RT, RS and NB. RT developed the Harvest Plots, GRADE and Summary of Findings table, with methodological guidance and contributions from ER. BC provided statistical advice and contributed to writing the data collection and analysis section.

9. Declarations of interest

None

10. Differences between protocol and review

To further increase the coverage of the literature searches, three additional bibliographic databases were searched for the review - British Nursing Index, CENTRAL and PsycINFO. In addition, during the update search the sensitivity of the original search strategy was slightly increased by including additional search terms relating to improved cookstoves, mitigation of environmental hazards and home flooring. These extra search terms were incorporated in databases that allowed complex search strategies (SCOPUS, MEDLINE, EMBASE, HMIC, ICONDA and PsycINFO) and rerun for the entire search period.

It was intended that RCTs would be quality assessed using the Cochrane risk of bias tool, and supplemented with the NICE/GATE checklist. All remaining studies were to be assessed using the NICE/GATE checklist only. However to ensure a consistent approach in dealing with the breadth of study designs identified, it was deemed more appropriate for all studies to be quality assessed using the EPOC Cochrane risk of bias tool (which also incorporates items relevant to CBAs) and supplement the tool with the NICE/GATE checklist which identifies methodological issues relevant to a wider range of study designs.

It was intended that views and perspectives of slum dwellers would be collected and summarised from qualitative studies embedded within included studies. However two studies out of the five studies including views information collected quantitatively through survey questions. It was felt that, as the information still captured slum dwellers views, it was important to include this information in the results of slum dwellers views. It is clearly marked where information is collected from quantitative or qualitative methods.

The protocol originally planned to synthesise only the primary outcomes (health and quality of life) into a summary of finding (SoF) table. However, it became apparent that the narrative-based SoF format that the team designed could also be used to provide a concise overview of (secondary) socioeconomic outcomes.

11. Published notes

Characteristics of studies

Characteristics of included studies

Abelson 1996

Methods	<p>Study design Uncontrolled before and after study. Study period 1988 to 1991.</p> <p>Timing of intervention Slum improvement started in 1988 but it is not reported when the intervention was completed.</p> <p>Sampling (identification of eligible slum and participants) 800 households (one third of all households from 10 of the 45 slums improved in 1988-89) were selected for a household survey. Just over 600 households were interviewed in both 1988 and 1991. An additional nutrition and morbidity of 80 households was carried out in 1988 and 1991. Data collection Survey interview.</p>
Participants	<p>Sample size and setting 612 households in main survey, 80 households in nutrition survey. Country, region(s) India, Visakhapatnam.</p> <p>Participant characteristics Characteristics of included participants are not reported, but the general description states that the slum dwellers in the regions have problems of low income, illiteracy, high gastrointestinal and respiratory diseases and malnutrition.</p> <p>Setting background Report states that half the adults in Visakhapatnam slums are illiterate. Few households have private tap water and only half of the slums have public tap water. Under one in five houses has a toilet. Population density is high.</p>

Interventions	<p>Name of the Intervention Slum improvement project.</p> <p>Reason for community receiving intervention Not reported.</p> <p>Actors Municipal government delivered slum upgrading supported by the UK Overseas Development Administration.</p> <p>Enabling environment International government funding and micro-credit for slum residents whereby the local housing corporation provided subsidised housing loans.</p> <p>Physical environment/infrastructure intervention(s)</p> <ul style="list-style-type: none"> • Water and sanitation: improved access to shared water supply and public toilets • Environmental hazards: drainage • Transportation infrastructure: roads and street lighting <p>Other living environment intervention(s)</p> <ul style="list-style-type: none"> • Health services: health programme including primary health centres, trained nurses • Health education: food and nutrition camps and clean hut competitions • Socio-economic programmes including community centres, education centres, libraries, vocational training
Outcomes	<p>Health Delivery problems, post-natal consultations, persons sick, persons chronically ill, households undercaloried, children underweight.</p> <p>Socio-economic Children at preschool, literacy, adults employed, household income.</p>
Notes	<p>Physical upgrading focused on roads and drains which were easier to achieve. There was little improvement in slum water supply (partly because of a chronic city-wide water shortage) or in sanitary facilities (partly because public facilities were considered less effective than private ones).</p>

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - UBA
Allocation concealment (selection bias)	High risk	Not applicable - UBA
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	Unclear risk	Not reported how the sample slums were chosen (e.g. random sampling)
Baseline outcome measurements similar (selection bias)	Unclear risk	Not applicable - UBA study with no comparison group
Baseline characteristics similar (selection bias)	Unclear risk	Not applicable - UBA study with no comparison group
Incomplete outcome data adequately addressed (attrition bias)	Unclear risk	Not reported how many (if any) households dropped out of the study

Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	High risk	Not applicable - was not possible to blind
Study adequately protected against contamination? (performance bias)	Unclear risk	Not applicable - no comparison group
Study free from selective outcome reporting? (reporting bias)	High risk	Health data is described in the text but numerical values are not provided.
Other bias	High risk	Fidelity of intervention may have impacted on health results. Authors state that there was little improvement in slum water supply or in sanitary facilities (partly because public facilities were considered less effective than private ones.

Aiga 2002

Methods	<p>Study design Mixed methods: CPI study with quantitative (structured interview Survey) and qualitative (focus groups) data.</p> <p>Study period Interviews took place in August to September 1993.</p> <p>Timing of intervention The intervention (Zonal Improvement Programme –ZIP) was introduced in 1985 in the intervention slum. No information is provided on how long the intervention took to be fully delivered.</p> <p>Sampling (identification of eligible slum and participants) Systematic sampling methods used in one control slum (Maestranza) and one intervention slum (Leveriza). Three housing units in each slum were grouped into clusters. In the control slum, there were a total of 306 housing units in 102 clusters. Two housing units were selected from each cluster by systematic sampling. I.e. the first and third housing unit in the initial cluster was selected by random sampling, thus all first and third were selected in all the other households.</p> <p>Eligible participants were housewives, household heads and household members in charge of water collection in the selected households.</p> <p>Data collection Face to face household interviews and focus group sessions.</p>
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Participants	<p>Sample size and setting 402 households - 201 households within one slum community receiving intervention (Leveriza) and 201 households within one slum who did not receive the intervention (Maestranza). In each slum a focus group discussion was held (seven housewives in each group).</p> <p>Country, region(s) Phillipines, Leveriza and Maestranza. Participant characteristics Only household characteristics are reported. In 1993 (post intervention) there were an average 6.5 people per household and 5.2 in the intervention and control slums respectively. There were 3.88 persons per person in intervention households and 4.52 in control households. Intervention households had 2.1 private water faucets per housing unit compared to 7 public faucets for the slum community at preintervention. The control community shared 3 public faucets.</p> <p>Setting background Leveriza (the intervention slum) is situated in Malate, a commercial town in the southeastern part of the City of Manila. The authors describe the setting as a large squatter area facing a small river, consisting of eight community zones called barangays. Maestranza (the control slum) is situated 5km from LE in the northeastern part of the City of Manila, also faces the River and is contained in only one barangay.</p>
Interventions	<p>Name of the intervention Zonal Improvement Programme.</p> <p>Reason for the community receiving the intervention Reason Leveriza received intervention is not specifically stated. However ZIP was delivered to a number of slums in the Phillipines (in 1992 41 ZIP sites were completed plus 15 ongoing).</p> <p>Actors Limited information, but the study reports that ZIP was delivered in the Phillipines by the Government of Phillipines with advice and loan assistance provided by the World Bank.</p> <p>Enabling environment Planning and Policy: ZIP was a government led initiative. Laws and Regulation: As a result of the intervention of the ZIP, illegal settlers in a squatter community become legal residents of the relevant area without relocating to another area Financial: The intervention also aimed to build up self-reliance of the squatters by providing loans to purchase land and to set up a residential environment.</p> <p>Physical environment/infrastructure intervention(s) Zonal Improvement Program, basic infrastructures such as:</p> <ul style="list-style-type: none"> • Water supply and sanitation: private toilet, private water faucets and meter in each household • Energy infrastructure: electricity to every housing unit • Transportation infrastructure: paved roadways to the community. <p>Other living environment interventions None reported</p>

Outcomes	<p>Health</p> <p>Child diarrhoeal incidence in under 5 year olds (WHO definition used - passing watery or bloody stools more than 3 times during 24 hrs). Outcome was reported by the child's mother (i.e. the housewives included in the study).</p> <p>Socio-economic</p> <p>Financial poverty: mean household income, median income, mean household income per capita (adjustment was made for per capita calculation by weighting the number of children under the age of 12 to 0.5 times that of adults), mean household expenditure on water; proportion of income spent on water.</p>
Notes	Qualitative data was also collected to identify available sources of water, constraints caused by limited water supply and social and economic implications of the improvement of water supply in such areas.

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CPI study
Allocation concealment (selection bias)	High risk	Not applicable - CPI study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	No matching performed though selected area based on similarity to intervention site. Quote: Maestrazna was selected among these 88 squatter communities as non-ZIP area for this study because the socio- economic status and the level of water supply were similar to those of Leveriza as of 1985 prior to the implementation
Baseline outcome measurements similar (selection bias)	High risk	Not applicable - CPI study
Baseline characteristics similar (selection bias)	High risk	Not applicable - CPI study
Incomplete outcome data adequately addressed (attrition bias)	High risk	Not applicable - CPI study
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	It would not have been possible to blind slum residents or field workers to intervention, however it is not reported whether data analysers were blinded
Study adequately protected against contamination? (performance bias)	Unclear risk	Not reported
Study free from selective outcome reporting? (reporting bias)	Low risk	No evidence to suggest selective reporting

Other bias	High risk	<p>The paper presents the study as an evaluation of the impact of water improvements, however the intervention delivered was a broader zonal improvement programme (ZIP). Quote: The ZIP provides squatters with land ownership and basic infrastructure such as private water connections, private toilets and electric power supply to every housing unit, and paved roadways in the community.</p> <p>Fidelity of the water intervention is described, but not for the wider interventions.</p> <p>Furthermore it is difficult to assess whether follow-up time is meaningful as it is not reported at when the ZIP programme was completed in the intervention site.</p>
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Butala 2010

Methods	<p>Study design CBA study using difference in difference analysis.</p> <p>Study period 2001 to 2008.</p> <p>Timing of Intervention Unclear.</p> <p>Sampling (identification of eligible slum and participants) A health insurance claims database was scrutinized and all eligible claims from slums that had received the slum upgrading intervention (made either prior or after implementation of the intervention) were collected. A comparison group of claims from nearby control slums were randomly sampled.</p> <p>Data collection Sampling of existing dataset of health insurance claims.</p>
Participants	<p>Sample size and setting Final sample size unclear. 127 and 510 households were included in the intervention group. The sample size are not reported for pre-intervention or post intervention time- points or for the number of claims that were for waterborne or non-waterborne illnesses.</p> <p>Country, region(s) India, Ahmedabad.</p> <p>Participant characteristics Not reported.</p> <p>Setting background Areas included in the study are not explicitly described. However the conditions in Ahmedabad slums as a whole are described using census data. In brief – 65.% have individual water connections, 82% storm drains, 89% solid waste management, 71% individual toilet, 62% individual toilets connected to sewers. Total number of household members 4.59 and 7.94 is maximum years of education attained.</p>

Interventions	<p>Name of the Intervention Slum upgrading</p> <p>Actors</p> <ul style="list-style-type: none"> • Government: Ahmedabad Municipal Corporation. • Private sector: unclear – states participating private sector organizations or charitable trusts (we think this means the microcredit organisation) • Civil society: Mahila SEWA Trust (MHT) and target communities (slum households) <p>A partnership involving target communities and their representative community-based organizations, the Ahmedabad Municipal Corporation (AMC), local partnering nongovernmental organizations (NGOs - MHT), and participating private sector organizations or charitable trusts. The AMC is responsible for the entire cost of bringing basic infrastructure services to the entrance of the slums, and the remaining cost of providing these services within the slum is split evenly among all of the stakeholders. While individual households must pay Rs. 2000 (approx. USD 40) for this intervention, a microcredit organization offers a microfinance program with a participation rate of approximately 70%.</p> <p>The Mahila SEWA Housing Trust (MHT), formerly the housing cooperative of the Self Employed Women’s Association (SEWA), a large NGO based in the city, facilitates the implementation of this intervention.</p> <p>Enabling environment</p> <ul style="list-style-type: none"> • Laws and Regulation: Freedom from eviction for ten years • Financial: AMC covered of the cost of 70% of infrastructure • Microfinance: a microcredit organization offered a microfinance program to help slum dwellers pay the 2000 Rupees they need to provide. <p>Physical environment / infrastructure intervention(s) Connections to a water supply for individual households; underground sewage for individual households; toilets for individual households; storm water drainage, road paving, waste management, street lighting.</p> <p>Other living environment intervention(s) This was not clearly stated in the methods. However in the discussion additional interventions in the discussion were alluded to:</p> <ul style="list-style-type: none"> • Health education: organization of community health education, • Health and social service access: health clinics, pharmacy services and day care centres. <p>The authors reported that anecdotal evidence suggested the majority of this ancillary health intervention did not persist after the construction of the basic infrastructure, a period during which observations were dropped.</p>
Outcomes	<p>Health</p> <p>The probability of claiming for a waterborne disease as opposed to a non-waterborne illness.</p> <p>Each individual claim represents an observation of an illness episode, and changes in frequency of waterborne disease-related illness episodes relative to other illnesses are analysed with respect to the slum upgrading intervention.</p> <p>Socio-economic None reported.</p>
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not applicable - CBA study
Allocation concealment (selection bias)	Unclear risk	Not applicable - CBA study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	Unclear risk	Doesn't report how slums were selected to receive the intervention and control slums were selected as those non-intervention areas in the same vicinity that the field workers often work in. Difference in difference analysis was performed which would minimise selection bias related to time- invariant differences.
Baseline outcome measurements similar (selection bias)	Unclear risk	Not reported
Baseline characteristics similar (selection bias)	Unclear risk	Not reported
Incomplete outcome data adequately addressed (attrition bias)	Low risk	Results were based on analysis of health insurance claims in the community during the study period, not by following specific residents over time
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	It would not have been possible to blind slum residents to intervention but it is not reported whether data analysers (health claim coders) were blinded.
Study adequately protected against contamination? (performance bias)	High risk	The authors were unable to pinpoint exactly when the intervention took place. So it is possible some of the pre interventions or post intervention measures were actually contaminated - depending on the timing of the intervention. Quote: It was not possible to identify the exact timing of the intervention given the imprecise dates of implementation in the MHT history file.
Study free from selective outcome reporting? (reporting bias)	Unclear risk	The authors only report the percentage waterborne illnesses before and after upgrade – not the numbers in each group. This is important as the proportion of waterborne illnesses amongst health claims is sensitive to whether the number of non-waterborne health claims increases/decreases at a greater rate in the control slums.

Other bias	High risk	<p>Outcomes need to be interpreted with caution. As described above the reduction in proportion of waterborne illnesses assumes there was no significant increase in non-waterborne illnesses. Furthermore health insurance claims are only a proxy for waterborne illnesses, it is not specified what criteria data coders used to ascertain whether a diseases was waterborne.</p> <p>Quote “health insurance claims has long been used as a proxy for health outcomes in clinical research but it has clear limitations as a measure of disease incidence”. To represent disease incidence, the health insurance system must capture all disease. For the purposes of this study’s comparative analysis...the insurance must simply capture all illnesses at similar rates”. Fidelity of the intervention is not described.</p> <p>Furthermore it is difficult to assess whether follow-up time is meaningful as it is not reported at when the interventions was completed.</p>
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Cattaneo 2009

Methods	<p>Study design CPI study with matching and regressions controlling for confounders. Study period. Data collected Spring 2005. Intervention occurred 2001-2003. Timing of intervention Between 2001 and 2003, therefore two to four years follow-up since completion. Sampling (identification of eligible slum and participants) Post hoc data analysis of from a cross-sectional household survey of control and treatment groups. Data collection Household survey conducted by interview.</p>
Participants	<p>Sample size and setting 1390 households for treatment group and 1393 in the control group. Country, region(s) Mexico, State of Coahuila. Participant characteristics 4.4% households below poverty line and circa 1.45 people per household earning an income and 6.1% illiterate. Setting background Circa two rooms and five members per household, 51% with water connection in the house, and just 30% of rooms with cement floors in 2000.</p>

Interventions	Name of the Intervention Piso Firme Actors Mexican government and household members. Enabling environment Government programme funds cost of cement, and households provide labour to prepare and lay floor. Physical environment and infrastructure intervention(s) Home improvements - cement flooring. Other living environment intervention(s) None.
Outcomes	Health Parasites, diarrhoea, anaemia, cognitive development measures, height-for-age scores, weight-for-age scores, respiratory diseases, skin diseases, other diseases, quality of life, stress and depression. Socio-economic Mother and father income.
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CPI study
Allocation concealment (selection bias)	High risk	Not applicable - CPI study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	Unclear risk	Several attempts to reduce selection bias including i) Restricting intervention and control to households those residing in twin cities that straddle the border ii) randomly sampling households of treated communities iii) matching samples of treated and potential control census blocks using pre-intervention census checks.
Baseline outcome measurements similar (selection bias)	Unclear risk	As a CPI study this it is not possible to accurately measure due to the lack of baseline measures – however the authors analysed a large number of variables and used pre-intervention data to determine that the control and treatment groups are well balanced in terms of a large set of observable characteristics. Furthermore annual time series of total mortality and child mortality rates in the entire municipality and socioeconomic variables from a national household survey were analysed to determine that the regions from which the control and intervention households had similar secular trends for health and socioeconomic variables (No of HH members, consumption per capita, rooms in HH).
Baseline characteristics similar (selection bias)	Unclear risk	See response to baseline outcome measurements above

Incomplete outcome data adequately addressed (attrition bias)	High risk	Not applicable - CPI study
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	It would not have been possible to blind slum residents or field workers to intervention and it is not reported whether data analysers were.
Study adequately protected against contamination? (performance bias)	Low risk	Inclusion criteria for control households was that program had not reached their city.
Study free from selective outcome reporting? (reporting bias)	Low risk	No evidence of selective outcome reporting
Other bias	Low risk	

De Leon 1986

Methods	<p>Study design Controlled post intervention data only.</p> <p>Study period Communities surveyed in 1982, two years after project activities completed.</p> <p>Timing of intervention Between 1977 and 1980.</p> <p>Sampling (identification of eligible slum and participants) 50% random sample of residents from intervention and control area.</p> <p>Data collection Interview questionnaires - unclear if quantitative, qualitative or a mixture of both.</p>
Participants	<p>Sample size and setting 100 female heads of households or wives of heads of households (50 each from control and intervention households).</p> <p>Country, region(s) Phillipines.</p> <p>Participant characteristics Wives of the household heads or female household heads only were interviewed, no other demographic data provided.</p> <p>Setting background The major economic problem of the community was unemployment with almost half of the working age population either underemployed or totally unemployed. Four-fifths of children suffered from malnutrition; a similar proportion of the adult population was in poor health. The entire Barrio was divided into four basic political units (barangays) each with community-elected chairpersons.</p>

Interventions	<p>Name of the Intervention Barrio Escopa pilot project.</p> <p>Actors Joint venture between the United Nations Environment Programme (UNEP) and the Phillipine National Housing Authority (PNHA). Different aspects of the interventions were delivered by several groups with expertise in their field, including educational institutions.</p> <p>Enabling environment PNHA and UNEP provided funded project. Residents were provided with construction loans coordinated by the slums Cooperative Credit union to provide assistance for house improvements. Community were consulted in the design and delivery of the project, and 57 residents participated and were trained in construction to assist with the labour.</p> <p>Physical environment/infrastructure intervention(s) Upgrade an existing community Secure tenure Pathways and drain trenches Waste management Communal open spaces (parks) House upgrading Redevelop a planned unit (New Escopa) a quarter of a mile away.</p> <p>Other living environment intervention(s) Social environment: enterprise development and employment generation (EDEG), credit and finance education Health education: Nutrition, food production and processing education (NFPP)</p>
Outcomes	<p>Socio-economic Social capital (resident social interaction and citizen participation)</p>
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CPI study
Allocation concealment (selection bias)	High risk	Not applicable - CPI study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	Control group are residents from a different area of the same slum. However baseline characteristics between groups are not compared so it is unclear whether groups are similar. No matching is performed to minimise selection bias.
Baseline outcome measurements similar (selection bias)	High risk	Not applicable - CPI study
Baseline characteristics similar (selection bias)	High risk	Not applicable - CPI study
Incomplete outcome data adequately addressed (attrition bias)	High risk	Not applicable - CPI study

Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	Not possible to blind participants but unclear whether data analysis was blinded
Study adequately protected against contamination? (performance bias)	Unclear risk	Not reported
Study free from selective outcome reporting? (reporting bias)	Unclear risk	The report is a summary of a dissertation (unavailable) and it is unclear whether other outcomes were measured but unreported.
Other bias	Unclear risk	Outcomes include a comparison of attitudes and opinion and of physical conditions in the pilot and non-pilot areas. The former are subjective. Adequate details have not been provided about the steps that have been taken to increase the reliability of both measures. The sample size appears small and it is unclear whether the study was adequately powered. Results are only presented as proportions and it is not possible to estimate sample size or confidence intervals.

Galiani 2007

Methods	<p>Study design Cluster controlled before and after study using difference in difference analysis and outcomes controlled for per capita income.</p> <p>Study period Pre treatment survey was performed in the last two weeks of February-first week of March 2004. Post treatment surveys were completed 12 months later during February to March 2005.</p> <p>Timing of intervention Water expansion was completed in the intervention at different times (ranging from April to September 2004). Therefore follow-up varies from approximately 5 to 10 months, depending on neighbourhood location.</p> <p>Sampling (identification of eligible slum and participants) Stratified sampling of six intervention neighbourhoods and three control slums. It is not reported who participated in the household surveys (head of households, housewives etc).</p> <p>Data collection Face to face household surveys.</p>
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Participants	<p>Sample size and setting Diarrhoea outcomes are based on 649 observations, whilst water expenditures are based on 369.</p> <p>Country, region(s) Argentina. Intervention slums: San Jose, Cina Cina, San Miguel, Hipolito Yrigoyen, La Tablada, 10 de Enero; control slums: Villa Lanzone, Villa Hidalgo; La Rivera.</p> <p>Participant characteristics Not reported.</p> <p>Setting background The background to the included slum communities is not reported however, the authors describe that in 2002 there were 593 shantytown neighbourhoods with an estimated population of 2.5 million people within the concession area. Of these, 445 neighbourhoods with an estimated population of 1.1 million people were within the limits covered by the water network but were without service because of the lack of urbanization.</p>
Interventions	<p>Name of the Intervention Water expansion by a privatised water company</p> <p>Reason for community receiving intervention The slum community had to ask Aguas Argentinas for provision of the service. The service was granted if the following were met</p> <ul style="list-style-type: none"> • The firm judged the extension of water services to that area to be technically feasible • Neighbourhoods had to be less than two blocks away from a covered area • The neighbourhoods municipality approved initiation of the program <p>Actors</p> <ul style="list-style-type: none"> • Government: Municipality approved connections • Private: Aguas Argentinas evaluated feasibility and provided the water connection free • Civil society: Communities requested the connection, provided the labor for the execution of the construction works (instead of paying connection fees) and once connected pay a bimonthly service fee of about 5 pesos and eliminate any alternative installations of water <p>Enabling environment</p> <ul style="list-style-type: none"> • Policy and Planning: Water privatisation • Community engagement: Communities formed a partnership with the water company and municipality; requesting the service and helping to deliver and pay for the service <p>Physical environment/infrastructure intervention(s)</p> <ul style="list-style-type: none"> • Water supply to each household (secondary connections) <p>Other living environment intervention(s)</p> <ul style="list-style-type: none"> • None reported
Outcomes	<p>Health Child diarrhoea (less than six years old): Presence of diarrhoea episodes one month before survey; duration of episodes (days); severity of episodes (whether last episode included blood and /or parasites).</p> <p>Socio-economic</p> <ul style="list-style-type: none"> • Household water related expenditures per month (in pesos) • Household water related expenditures per month including payment for water service after the programme (in pesos)
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CBA study
Allocation concealment (selection bias)	High risk	Not applicable - CBA study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	Unclear risk	Control slums were selected on the basis that their requests for water expansion were not accepted. The reasons for not being suitable for the intervention are not explored in the paper that raises the possibility of different characteristics between intervention and control slums. The study uses difference in difference analysis though would which minimise selection bias from time invariant differences in characteristics, and confounders were adjusted for in the multivariate analyses.
Baseline outcome measurements similar (selection bias)	Unclear risk	Results for diarrhoea not reported at baseline and outcome – just DiD coefficients presented
Baseline characteristics similar (selection bias)	Low risk	All measured baseline characteristics were similar except household income – which was adjusted for in the analysis of results.
Incomplete outcome data adequately addressed (attrition bias)	Unclear risk	It is not reported if households were lost to follow-up
Knowledge of the interventions adequately prevented during the study? (performance and)	Unclear risk	It would not have been possible to blind participants as they had to request the intervention, but it is not reported whether outcome assessors could have been.
Study adequately protected against contamination? (performance bias)	Low risk	There was some contamination in that some of the sampled households in the control neighbourhood gained access to water after the baseline survey but prior to the post intervention. The authors therefore redefined the treatment and control observations, transferring the connected households from the control to treatment group. The authors also tested and confirmed that the results are robust to excluding from the analysis all the observations from this neighbourhood and to excluding only those households that received water in that neighbourhood.
Study free from selective outcome reporting? (reporting bias)	Low risk	
Other bias	Unclear risk	Concern over reliability of outcome measures – households were asked to recall diarrhoea outcomes for a relatively large recall period (one month). Fidelity of intervention not explored.

Gonzalez-Navarro 2010

<p>Methods</p>	<p>Study design Cluster RCT using difference in difference analysis and regressions controlling for confounders.</p> <p>Study period Surveys performed in February / March, 2006 for baseline and 2009 for follow-up.</p> <p>Timing of intervention By March 2009 17 of the streets in the treatment area were completely treated. Length of follow-up from completion is unclear.</p> <p>Sampling (identification of eligible slum and participants) Clustered random sampling targeting inhabited residential structures with main entrance facing the proposed road pavement projects.</p> <p>Data Collection Household survey - the Acayucan Standards of Living Survey (ASLS)</p>
<p>Participants</p>	<p>Sample size and setting Analyses are based on 900 household stayers between 2006 and 2009. The original survey collected data on 1231 households. By 2009 156 new households had immigrated.</p> <p>Country, region(s) Mexico, Acayucan. Participant characteristics 88% of those aged 15 and over have a median 8 years of schooling and 88% have ever attended school.</p> <p>Setting background Households from impoverished densely populated urban areas in Mexico. 88% declare to be owners of the property, yet only 71% have a title of property. Houses have a median of 2 rooms, 93% of homes have cement floors but asbestos or metal sheers were most common form of roofing. 25% of households use wood or charcoal as cooking fuel. 57% of households do not have a tap water line to the house and 44% of households do not have a toilet inside the house (it is either outside the house or shared in someone else's lot).</p>
<p>Interventions</p>	<p>Name of the Intervention Street-paving programme.</p> <p>Reason for community receiving intervention Neighbourhoods deprived of municipal services.</p> <p>Actors Government (Acayucan administration).</p> <p>Enabling environment City government funded and delivered the programme.</p> <p>Physical environment/infrastructure intervention(s) Road paving.</p> <p>Other living environment intervention(s) None reported.</p>
<p>Outcomes</p>	<p>Health Proportion of participants reporting: parasite or fungus infections; sickness; QoL (residents satisfaction with living in the city).</p> <p>Socio-economic Log monthly income; proportion of adults unemployed; proportion of children enrolled in school; school absenteeism in past month; perceived safety walking the street at night.</p>
<p>Notes</p>	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Not specified in the reports but correspondence with the authors confirmed that randomisation was undertaken by the authors using a computer generated random number sequence
Allocation concealment (selection bias)	Low risk	Computer generated randomisation
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	Low risk	Randomised controlled trial - see questions above
Baseline outcome measurements similar (selection bias)	Unclear risk	Labour income is slightly higher (18% higher in treatment than control group at 10% significance level).
Baseline characteristics similar (selection bias)	Low risk	Yes no significant differences for baseline characteristics
Incomplete outcome data adequately addressed (attrition bias)	Low risk	Yes; although 271 baseline households moved to other places and 183 new households arrived to experimental streets, the authors analysed whether the attrition of out-migrants and role of pavements in attracting new households was random. Results found probability of immigration does not depend on street pairing; therefore analysed just the stayers.
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Low risk	It would not have been possible to blind the field workers to the intervention or the patients however the study does state that field workers were trained not to mention that the objective was to measure offers of intervention and questionnaire does not mention this either.
Study adequately protected against contamination? (performance bias)	Unclear risk	As people from non treatment areas would potentially use these roads contamination cannot be ruled out – though the impact may be different to actually living on the street with paved roads.
Study free from selective outcome reporting? (reporting bias)	Low risk	
Other bias	Unclear risk	Unclear when projects were completed for each cluster therefore it is difficult to determine whether length of follow-up from completion of the intervention is adequate. Power calculation not reported.

<p>Methods</p>	<p>Study design Uncontrolled before and after study.</p> <p>Study period May 1997 (baseline survey) to December 2000 (follow-up survey).</p> <p>Timing of intervention Preliminary education and health activities were firstly carried out during early 1992- 1993. From June 1993 implementation of the integrated slum development programme with Community Health, Non Formal Education, Skills imparting and Community organisation programmes began. These established the foundation for more complex intervention. In 1996 the Savings and Credit, Income Generation and Physical Upgradation Programmes were launched.</p> <p>Sampling (identification of eligible slum and participants) Limited details - SAATH conducted a first socio-economic survey in May 1997 in which every tenth house was surveyed.</p> <p>Data Collection Household surveys, unclear if face to face.</p>
<p>Participants</p>	<p>Sample size and setting One slum in Pravinagar-Guptanagar (PG). A total of 101 households were surveyed at baseline. A similar survey was 3.5 years later In this survey, 84 households out of the original 101 of May 1997 were found to have the same residents and families. The remaining 17 houses were either empty or the residents had changed.</p> <p>Country, region(s) India, near Ahmedabad.</p> <p>Participant characteristics In 1997 – the majority of the study sample were aged 21-45 years old. 24.7% were illiterate. The average income was 2589 Rupees. Gender information is not provided. Men and women included in the sample.</p> <p>Setting background Prior to intervention Pravinagar was a squatter settlement and a growing slum, continuing to attract fresh migrants. Basic infrastructure and services were absent, residents did not have secure tenure, Infant mortality and malnourishment was high, rate of children not going to school or dropping out was high and access to services was poor. The land was earlier part of the wasteland of Vasna Village. There is a city bus service stop just outside the slum. The nearest government health services are at V.S. Hospital and Sarkhej hospital (about 35 km away). The nearest Municipal School is at Vasna village about 2 km away.</p>

Interventions	<p>Name of the Intervention Integrated Slum Development (ISD) programme</p> <p>Reason for community receiving intervention SAATH started working in PG and selected it for implementation of ISD because residents were open to ISD type of interventions; basic infrastructure and services were absent; It was a growing slum; it was representative of slums in Ahmedabad; and some of the residents of the slum were known to the activists of SAATH.</p> <p>Actors Civil Society:</p> <ul style="list-style-type: none"> • SAATH, an NGO co-ordinated the programme • Local slum residents had several roles – as workers of the projects (CHWs, teachers, community organisers and instructors, leadership of community based organisations, monetary contributions to project costs and consultation in design and delivery <p>Government: Government contributed funding</p> <p>Enabling environment</p> <ul style="list-style-type: none"> • Funding <ul style="list-style-type: none"> ○ Consortium of slum dweller contributions (20%), private sector (only for pilot project) and local government body • Community Engagement- <ul style="list-style-type: none"> ○ A Community Based Organisation (CBO) - Sakhi Mahila Mandal (SMM) (Women's Organisation) sustained ISD in the slum. The core group of SMM was formed with the local workers of the ISD programmes, namely, the health workers, the teachers, the instructors and the community organisers. During the course of implementing various ISD programmes, these women have acquired technical and managerial skills essential for sustaining a CBO and, more importantly, have gained credibility within the slum as leaders. ○ Community were consulted for design, quality control, payment of resident's costs and maintenance for infrastructure. For this purpose, six resident associations were formed. These six associations, SMM and AATH worked in tandem to ensure quality and financial contribution. • Economic <ul style="list-style-type: none"> ○ Skills imparting programme (marketable skills of Tailoring and embroidery, Electric gadget repairing, and Scooter repairing ○ Income generation programme for slum residents (tailoring, market research support and vegetable sorting) <p>Physical environment/infrastructure intervention(s) Slum Networking Programme (SNP):</p> <ul style="list-style-type: none"> • Water and sanitation: water connections and individual/ household toilets • Drainage • Transportation infrastructure: common roads, streetlights • Waste management: solid waste disposal. • Home improvements were not part of the programme – though many residents went on to improve these <p>Other living environment intervention(s)</p> <ul style="list-style-type: none"> • Community Health Programme • Non-Formal Education Programme
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Outcomes	Socio-economic <ul style="list-style-type: none"> • Education: Percentages for Adult illiteracy, School-going children (enrolment), school drop-out, pre-school going children; change in education level achieved • Financial poverty: Individual average monthly income
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - UBA study (no control group)
Allocation concealment (selection bias)	High risk	Not applicable - UBA study (no control group)
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	Not applicable - UBA study (no control group)
Baseline outcome measurements similar (selection bias)	High risk	Not applicable - UBA study (no control group)
Baseline characteristics similar (selection bias)	High risk	Not applicable - UBA study (no control group)
Incomplete outcome data adequately addressed (attrition bias)	Unclear risk	Small attrition (17%) due to households moving on. It is not clear whether the reasons for these households moving on were related to the intervention, or whether an intention to treat analysis was performed.
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	Not applicable - UBA study (no control group)
Study adequately protected against contamination? (performance bias)	High risk	Not applicable - UBA study (no control group)
Study free from selective outcome reporting? (reporting bias)	Low risk	No evidence to suggest selective outcome reporting

Other bias	High risk	Outcomes are not sufficiently defined. Income comparisons do not appear to have considered potential inflation changes over time. The authors state that decreases in pre-school children was due to them growing over, but do not describe whether 'school aged children' includes 'pre-school children'. If not, then it is possible that the increase in school going children, was at least in part due to the transition over time of pre-school children moving to school. Unclear if the study is adequately powered to detect statistically significant results (no sample size calculation reported). Lack of control group prevents inference of causal
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Milone 1993

Methods	<p>Study design Mixed methods - cluster uncontrolled before and after, plus qualitative data collection. Timing of intervention Unclear. Whilst the authors state that the project started in 1985, it is unclear what interventions were delivered to each included community, when the interventions began or how long implementation took to complete. Baseline surveys were conducted in 1987, a second data collection cycle was performed in 1988 and cycle three (final follow-up) was undertaken in 1989.</p> <p>Sampling (identification of eligible slum and participants) Not reported.</p> <p>Data collection Residents' responses to survey questions, nominal group meetings in which residents were asked to rank KIP components, participant observation by researchers and field surveys.</p>
Participants	<p>Sample size and setting The sample size is not reported – however the description of the STUDP project states that the intervention was delivered in 38 small and medium sized cities in Central Java. In each city four slums (kampungs) were selected to receive the intervention. It appears that this survey looks at the results from across these slums and cities.</p> <p>Country, region(s) Indonesia, Java. Participant characteristics Not reported.</p> <p>Setting background Slums had the following characteristics:</p> <ul style="list-style-type: none"> • A lack of essential amenities (potable and non-potable water, drainage, sewerage, solid waste disposal bins, latrines and paved paths and thoroughfares) • No formal tenure • Originally housing was constructed from woven bamboo panels, density increased with time and some homeowners were able to convert to permanent building materials, either wholly or partially.

Interventions	<p>Name of the intervention</p> <p>Small Towns Urban Development Project (STUDP project) – delivering a Kampung Improvement Programme to small towns and cities in Java.</p> <p>Reason for community receiving intervention</p> <p>Not stated.</p> <p>Actors</p> <p>The Government (Ministry of Public Works in Jakarta) designed the project with little or no consultation with residents. Asia Development Bank provided funds.</p> <p>Enabling environment</p> <p>Financial: Asia Development Bank funded the project.</p> <p>Physical environment / infrastructure intervention(s)</p> <p>Multi-component physical upgrading:</p> <ul style="list-style-type: none"> • Water and sanitation: public (shared) bath, laundry and latrine facilities and public water taps • Transportation infrastructure: footpaths and roads • Drainage: drains • Waste Management: solid waste disposal boxes • It appears that the infrastructure delivered may have varied across projects (for example the authors state that drains were not widely installed across the 38 projects. <p>Other living environment intervention(s)</p> <p>Although the following interventions were not part of the STUDP project, the authors report several projects that were occurring in studies areas that may have influenced results. These included ongoing government campaigns to impress methods with the importance of improved nutrition, hygiene and of using oralit dehydration powder; increased numbers of government health care clinics, and health information and dispensing posts.</p>
Outcomes	<p>Health</p> <p>Frequency of diarrhoea, dengue fever and skin diseases. Socio-economic</p> <p>Percentage of households living below the poverty line (at the 40th percentile expenditure level or less).</p>
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not applicable - UBA study
Allocation concealment (selection bias)	Unclear risk	Not applicable - UBA study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	Not applicable - UBA study
Baseline outcome measurements similar (selection bias)	Unclear risk	Not applicable - UBA study (with no baseline data)
Baseline characteristics similar (selection bias)	Unclear risk	This is not applicable as this is a CPI study with no baseline measures. However the study does not address whether groups were similar for other characteristics.
Incomplete outcome data adequately addressed (attrition bias)	Unclear risk	Not reported - Sample sizes at either stage not reported
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	High risk	Not applicable - UBA study, and would not have been possible to blind participants
Study adequately protected against contamination? (performance bias)	High risk	Not applicable - UBA study
Study free from selective outcome reporting? (reporting bias)	High risk	The study didn't clearly state outcomes it intended to measure so this is difficult to assess. However results for child mortality are described narratively but figures not provided.
Other bias	High risk	<p>Authors state changes in health could be due to a combination of factors</p> <p>QUOTE: as well as ongoing government campaigns to impress methods with the importance of improved nutrition, hygiene and of using oralit dehydration powder. The increased numbers of government health care clinics, and health information and dispensing posts, respectively, PUSKEMAS and POS YANDU and their education programs, were also quite influential.</p> <p>Unclear if study adequately powered as no sample sizes or power calculation presented.</p> <p>Measures of variance are not reported and insufficient information available to calculate. Thus cannot determine whether significant differences were identified.</p>

Moitra 1987

Methods	<p>Study design Cluster CPI study.</p> <p>Study period Economic conditions were surveyed in 1979 (literacy and employment) and health was evaluated in 1983.</p> <p>Timing of intervention First phase of the program ran between 1970 to 1977 (infrastructure upgrading) and the second phase (social and community services) lasted from 1977 until 1984.</p> <p>Sampling (identification of eligible slum and participants) Authors used survey data from Calcutta Metropolitan Development Authority (CDMA) unclear how participants were approached in original survey.</p> <p>Data Collection Survey.</p>
Participants	<p>Sample size and setting 12 unimproved slums (bustees), unclear how many improved slums included. No sample size for participants provided.</p> <p>Country, region(s) Calcutta, India.</p> <p>Participant characteristics No data provided prior to the improvements. But authors state that Calcutta Bustees have mixed but relatively low-income occupancy and mostly self-employed or unskilled and semi-skilled worker categories.</p> <p>Setting background Part of the city's recognised housing stock but have absence of services, poor quality housing and high density profile.</p>

Interventions	<p>Name of the Intervention Slum Improvement Programme.</p> <p>Reason for community receiving intervention Part of CMDA's role to improve Bustees.</p> <p>Actors Government department - CMDA.</p> <p>Enabling environment</p> <ul style="list-style-type: none"> • Policy: Government policy to improve Bustees. • Legal: CMDA acquired user rights to land as the bustees were originally on private lands. • Community engagement: Active participation of residents in planning and implementation of improvements. Citizens committees formed at the ward level to interact with CMDA officials at both the planning and implementation stages. Their major contribution was in the location and layout of services. <p>Physical environment/infrastructure intervention(s)</p> <ul style="list-style-type: none"> • Water and sanitation: Supply of potable water (one standpipe for every 100 persons). Construction of new sanitary privies (one for every 25 persons). (Please note shared sanitation is not considered 'improved sanitation' in this review - see Table 1 • Drainage: provision of improved drainage facilities • Transportation: construction of paved pathways, provision of street-lighting <p>Other living environment intervention(s)</p> <ul style="list-style-type: none"> • Facilities for recreational and community activities • Socioeconomic components were added in phase 2 and improvements of primary school facilities and healthcare components
Outcomes	<p>Health Participants reported themselves to be 'well, indifferent, or unwell'.</p> <p>Socio-economic Literacy rate, workforce participation, unemployment.</p>
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CPI and authors did not control assignment
Allocation concealment (selection bias)	High risk	Not applicable - CPI and authors did not control assignment
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	Although the authors did not have control over the survey procedure, they do not report how slums were chosen to be surveyed or how control slums were selected. Furthermore there was no apparent matching techniques used to minimise selection bias.

Baseline outcome measurements similar (selection bias)	High risk	Not applicable - CPI study (no baseline)
Baseline characteristics similar (selection bias)	High risk	Not applicable - CPI study (no baseline)
Incomplete outcome data adequately addressed (attrition bias)	High risk	Not applicable - CPI study (no baseline)
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	Not possible to blind participants, unclear if study personnel could have been.
Study adequately protected against contamination? (performance bias)	Unclear risk	Not reported
Study free from selective outcome reporting? (reporting bias)	High risk	The paper briefly summarises an unpublished survey, and narratively describes improvements in gastro-intestinal diseases without providing the numerical data.
Other bias	High risk	<p>Clustered study, but data analysis does not adjust for clustering effect. Concern that clusters within the intervention group may have received interventions at varying stages, and therefore there could be a large amount of variance due to different periods of time for outcomes to appear.</p> <p>Interventions were implemented in phases, it is unclear within these time periods given, when the sampled slums actually started and completed receiving the intervention. Also concerned that this varies between slums. The risk that there is not an adequate latency period is most marked in the socioeconomic survey - when the survey was taken halfway between the second phase of intervention (which introduced socioeconomic components - so unclear if these would have had an adequate time to have an impact).</p>

<p>Methods</p>	<p>Study design Controlled Post Intervention (clustered) and outcomes controlled for confounders.</p> <p>Study period Households observed between November 1989-November 1990.</p> <p>Timing of Intervention Drainage channels (group 2 intervention) were delivered in the mid 1980s, and the drainage plus simplified sewerage systems were delivered in the late 1980s.</p> <p>Sampling (identification of eligible slum and participants) Stratified random sampling.</p> <p>Data collection Face to face household interviews and collection of stool samples.</p>
<p>Participants</p>	<p>Sample size and setting A total of 1005 households were surveyed. 1275 children aged <5 years living in 732 households were included for measurement of diarrhoeal morbidity – 432 in group 1 (control), 426 in Group 2 (drainage) and 417 in Group 3 (drainage plus sewerage). For geohelminth infections, a total of 1893 children aged between 5 and 14 years (in groups 1 and 2) and between 4 and 15 in group 3, were included from 795 households. 631 children were included in each comparison group.</p> <p>Country, region(s) Brazil, Salvador.</p> <p>Participant characteristics Children aged 5 to 14 years old were sought. Although in group 3 to ensure the required sample size, children aged 4 to 15 were selected. The mean age = 8.86 (SD 2.79), 9.03 (SD 2.79) and 8.90 (2.71) in control, drains and sewers respectively. The percentage of males was 50.6%, 55.5% and 50.44% in control (group 1), drainage (group 2) and drainage and simplified sewer system (group 3) respectively.</p> <p>Setting background Half of the mothers in the control group, a quarter in the drainage group and a third in the drainage and sewerage group had migrated from rural areas. Households in the intervention areas had a longer mean duration of residence (17.4 years).</p>

Interventions	Name of the Intervention
	<p>Two interventions were examined in comparison to control (group 1 - no intervention). Group 2= drainage channels (also used for sewerage); Group 3 = Drainage plus simplified sewerage system.</p> <p>Reason for community receiving intervention</p> <p>Explicit criteria for priority neighbourhoods being provided the interventions were:</p> <ul style="list-style-type: none"> • Ease of access for construction • Area occupied • Current lack of basic services • Level of community organization • Type of housing • Proportion of households with low and casual incomes • Physical characteristics such as vulnerability to flooding or landslides. <p>The authors state that no health criteria were utilized. In practice, however, political patronage and pressure from construction firms preferring to work in the easiest terrain held a part.</p> <p>Actors</p> <p>Little information is provided, but the authors do report that the Municipality of Salvador constructed low cost water drainage systems and the water drainage plus simplified sewerage systems.</p> <p>Enabling environment</p> <p>Little information is provided, but the authors do report that the Municipality of Salvador constructed low cost water drainage systems and the water drainage plus simplified sewerage systems.</p> <p>Physical environment/infrastructure intervention(s)</p> <p><i>Multicomponent physical upgrading:</i></p> <p>Group 2 (drains only): Low cost surface water drainage systems (also used for sewage disposal), allowing for the entry of surface water and sewage connections from nearby houses and discharge into the river.</p> <p>Group 3 (drains and sewers): surface water drainage plus purpose-built sewerage systems. In addition to the drainage systems above, group 3 had sewerage systems installed.</p> <p><i>Other physical interventions:</i></p> <p>The drainage systems are covered and also serve as footpaths or stairways. These measures were accompanied by paving of some streets and in some areas by improvements in the water distribution system and giving the residents land tenure.</p> <p>Other living environment intervention(s)</p> <p>None reported.</p>

Outcomes	<p>Health</p> <p>The following variables were measured:</p> <ul style="list-style-type: none"> • Diarrhoea episode (1 or more days of diarrhoea separated from any other episode by at least 2 diarrhoea symptom-free days) • Annual diarrhoeal incidence (episodes / child / year) • Incidence density ratio = incidence rate experienced divided by the incidence rate in group 1. • Mean % of days with diarrhoea (duration) • % of episodes lasting more than 14 days (severity) • Proportion of children with frequent diarrhoea (more than twice the expected number of episodes) • Childhood geohelminth infections : <ul style="list-style-type: none"> ○ prevalence and intensity (geometric mean intensity eggs per gram stool) of <i>Ascaris lumbricoides</i>; <i>Trichuris Trichuria</i>; hookworm ○ strength and significance of predisposition to reinfection in children aged 5-14 years by study group: <p>Socio-economic</p> <ul style="list-style-type: none"> • Financial poverty: mean monthly income per capita • Education: mean schooling of household head
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CPI study
Allocation concealment (selection bias)	High risk	Not applicable - CPI study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	No matching was undertaken to minimise bias. The authors did attempt to recruit similar comparison groups though by selecting all areas intended to be upgraded, that, due to complex political and administrative reasons, 3 received the earlier drainage only systems, other areas received the later drainage and sewerage system and one group did not receive anything as the project funds were fully spent. It is possible though that the order in which the communities received this natural type of intervention was based on a selection bias.
Baseline outcome measurements similar (selection bias)	High risk	Not applicable - CPI study
Baseline characteristics similar (selection bias)	High risk	Not applicable - CPI study

Incomplete outcome data adequately addressed (attrition bias)	High risk	Not applicable - CPI study
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Low risk	Blinding where possible was performed - e.g. microscopists taking examining stool samples were blinded as to the intervention status of the community from whom the samples had been completed.
Study adequately protected against contamination? (performance bias)	Unclear risk	Not reported
Study free from selective outcome reporting? (reporting bias)	Low risk	All outcomes described in the methods were reported in the results.
Other bias	High risk	The authors did not adjust for the clustering effect, which may have underestimated the variance in the study.

Parikh in press

Methods	<p>Study design Mixed methods: Cluster controlled post-intervention study and qualitative interviews. Please note the study is not specifically designed to compare intervention effects between slum communities. The study aims to examine changes pre and post- intervention in each slum by asking participants to recall up to 10 years prior to the intervention date. For the purposes of this review, only the post intervention cross- sectional data is eligible comparing control and intervention slums and not the data collected retrospectively.</p> <p>Study period Household interviews and group discussions took place in 2005.</p> <p>Timing of intervention Upgrading interventions were received in 1997, it is not reported how long the interventions took to deliver or whether completion timing varied between communities.</p> <p>Sampling (identification of eligible slum and participants) The authors state that random sampling techniques were used to ensure that a representative sample was interviewed, but is unclear as to whether this relates to pilot interviews held with a small number of households, or for selection of all households included in the final sample.</p> <p>Data Collection Face to face household interviews and focus group discussions.</p>
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Participants	<p>Sample size and setting 700 households from 5 slums in India (3 that received the Slum networking programme and 2 that did not receive an intervention) and one slum in South Africa – divided into a group of households that received SNP and a group of households that had not. 100 participants 100 households were included in each group. A second publication provides information from a subsample of 20 households interviewed in Sanjaynagar (intervention community) and Khokra (control), group interviews were also held – sample size not reported.</p> <p>Country, region(s) India (Ramdevnagar, Sanjaynagar, Pravinnagar, Hansol, Khokra) and South Africa (Imizamo Yethu).</p> <p>Participant characteristics The authors report that in terms of the male-female ratio of respondents there was a slightly higher proportion of women respondents.</p> <p>Setting background Not reported for each slum included.</p>
Interventions	<p>Name of the Intervention Slum networking.</p> <p>Reason for community receiving intervention It is not clearly reported why the included intervention slums had received ‘Slum Networking’ and the control groups had not.</p> <p>Actors All intervention projects were funded by contributions from a least government and community. Ramdevnagar was also funded by Industry, Aid Agency and others. Sanjaynagar was additionally funded by industry and Pravinnagar by ‘others’.</p> <p>Enabling environment Financial: As described above, investment came from mix of sources including government, industry, slum communities, and NGOs. Laws and regulation: Land tenure was provided in the form of a ten year lease to the residents as part of the intervention (correspondence with author).</p> <p>Physical environment/infrastructure intervention(s) <i>Multicomponent physical upgrading</i></p> <ul style="list-style-type: none"> • Water and sanitation infrastructure: water supply and sewerage • Transportation infrastructure: individual roads • Drainage: rainwater drainage • Energy infrastructure: electricity • Waste management: solid waste disposal <p>Slums are located near rivers and drainage paths in cities. The natural drainage paths constitute the most efficient paths for gravity-based infrastructure. Infrastructure is provided in all the slum pockets and then interconnected along the drainage paths. Various components of infrastructure are bundled for economy and integrated from slum to city level with respect to topography.</p> <p>Other living environment intervention(s) None reported</p>

Outcomes	<p>Health Average monthly medical spending.</p> <p>Socioeconomic Financial poverty: disposable income Education: literacy</p> <p><i>Subsample</i> The subsample group of 20 households in an intervention and control group, provided the following educational variables which are not reported in the main study: % children attending school, and number of children attending private school.</p>
Notes	Qualitative data included changes in lifestyle following improvements, e.g. from water, electricity, income, education, and a diagnosis of their own needs. The study also measured self-investment into housing and goods.

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CPI study
Allocation concealment (selection bias)	High risk	Not applicable - CPI study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	DiD or matching approaches not employed.
Baseline outcome measurements similar (selection bias)	High risk	Not applicable - CPI study
Baseline characteristics similar (selection bias)	High risk	Not applicable - CPI study
Incomplete outcome data adequately addressed (attrition bias)	High risk	Not applicable - CPI study
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	Not specified
Study adequately protected against contamination? (performance bias)	Unclear risk	Not reported
Study free from selective outcome reporting? (reporting bias)	Unclear risk	Not possible to judge
Other bias	Unclear risk	Follow-up or attrition and intervention fidelity is not reported. Unclear whether study was adequately powered.

Soares 2005

Methods	<p>Study design Cluster CBA with difference in difference analysis, matching and regressions controlling for confounders.</p> <p>Study period Data used from 1991 census and 2000 census.</p> <p>Timing of Intervention Programme was financed in 1995 but unclear when the interventions began. The study only included the 38 communities for which the work had been completed by July 2000. It is unclear whether improvements could have been completed earlier than this date, and therefore how long the follow-up is post intervention completion.</p> <p>Sampling (identification of eligible slum and participants) Census data for slum communities where intervention had been completed and where data was available for both 1991 and 2000.</p> <p>Data Collection Secondary analysis of census data.</p>
Participants	<p>Sample size and setting Total number of individuals unclear. 38 treated communities were included. Comparison observations vary from 38 in the case of the Nearest Neighbour matching procedure to 272 in the regression specification.</p> <p>Country, region(s) Brazil, Rio de Janeiro.</p> <p>Participant characteristics Baseline demographic characteristics of included participants are not reported. Small and medium sized slums. Data are provided for slums in the municipality. Household head characteristics were mean 5.1 years of schooling, 19% single mothers, 60% migrated, 50% migrants from other state, 74% employed.</p> <p>Setting background Small and medium sized slums. Characteristics are not shown for included communities, but data is provided for slums in the municipality. Households have an average of 4.6 rooms, 90% piped water service, 76% sewerage service and 60% garbage collection.</p>

Interventions	<p>Name of the Intervention Favela-Bairro</p> <p>Reason for community receiving intervention Communities selected on the basis of their medium size (between 500 and 2500 households) and the cost of urbanization (those with high costs were excluded) and in a second stage based on infrastructure deficits, social deficits and the ease of completing infrastructure works.</p> <p>Actors Government and Inter-American Development Bank (IDB).</p> <p>Enabling environment Government policy delivered the programme with funding from IDB. The project also involved the community in the selection of projects, although the exact mechanism by which these choices were made, as well as the de facto magnitude of local control, were not made clear during the evaluation interviews.</p> <p>Physical environment/infrastructure intervention(s)</p> <ul style="list-style-type: none"> • sanitation supply/access: installing sanitation • water supply/access: installing water • Drainage/flood protection: installing guttering • Transportation infrastructure: road improvements and installing lighting • Waste management: rubbish collection • Home improvements <p>Other living environment intervention(s) Socio-economic interventions were planned for phase two, but these were absent at the time of the census.</p>
Outcomes	<p>Health Mortality (infant, homicide, sanitation-related).</p> <p>Socio-economic Income and illiteracy.</p>
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CBA study
Allocation concealment (selection bias)	High risk	Not applicable - CBA study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	Unclear risk	Attempted to recruit similar comparisons by selecting all communities scheduled or due for treatment. Also used propensity score matching and difference in difference to minimise selection bias.
Baseline outcome measurements similar (selection bias)	Unclear risk	Not reported
Baseline characteristics similar (selection bias)	Unclear risk	Not reported

Incomplete outcome data adequately addressed (attrition bias)	Unclear risk	Not reported
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	Couldn't blind participants but unclear if outcome assessors/field workers were blinded.
Study adequately protected against contamination? (performance bias)	Unclear risk	Contamination is not addressed in the report
Study free from selective outcome reporting? (reporting bias)	Unclear risk	No evidence outcomes were selectively reported
Other bias	Unclear risk	Follow-up / attrition and intervention fidelity is not reported. Unclear whether study was adequately powered.

Taylor 1987

Methods	<p>Study design Cluster controlled before and after study.</p> <p>Study period 1976-1981.</p> <p>Timing of intervention Period of KIP Implementation was between 1976-1978 for intervention slums. It is not clear whether the intervention was implemented and completed at the same time for each slum in this group.</p> <p>Sampling (identification of eligible slum and participants) The sampling method is not clearly reported. Baseline data is based on nearly 5000 households in 142 kampungs from a local government kampung survey. The author states that Kampungs were selected non randomly to ensure that they were initially comparable with regard to several important characteristics, but no further details are provided. The author then followed up 709 households living in the same dwellings where occupants had been surveyed. It is unclear why only 709 were followed up or how these dwellings were chosen.</p> <p>Data collection Household surveys by interview.</p>
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Participants	<p>Sample size and setting</p> <p>709 households were included at follow-up but the baseline sample size is unclear, see description above.</p> <p>Country, region(s) Indonesia, Jakarta. Participant characteristics</p> <p>Income at baseline was 29,667 Rupiah (Rp) in the control group, 40,877 in the intervention and 41493 in the reference group. Other variables are not reported.</p> <p>Setting background</p> <p>Appendix 1 shows that the average number of rooms per household ranged from 2 to 3 at baseline, the percentage with permanent walls ranged from 23.8 to 36.3%; public water supply was low (ranging from 8.9 to 13.2%) but owning toilets was higher (41.6% in controls to 60.4% in intervention). Land tenure ownership was low in control groups (23.8% in CG compared to 72.2% and 64.2% in intervention and reference groups).</p> <p>House tenure was higher in all groups (ranging from 59.2 to 72.2%).</p> <p>The authors mention that although these areas function as viable social communities, the quality of the physical environment (housing and particularly facilities like water, sanitation and local access) are very poor.</p>
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Interventions	<p>Name of the Intervention</p> <p>Jakarta Kampung Improvement Programme.</p> <p>Reason for community receiving intervention</p> <p>Not reported</p> <p>Actors</p> <p>City government (DKI) with some community participation are mentioned. No details are provided about other partners in implementation.</p> <p>Enabling environment</p> <ul style="list-style-type: none"> • Policy and Planning: Government initiative • Community engagement: Engagement varied between slums. The authors report that despite marginal consultation in planning and only some involvement during KIP implementation overall, the extent of community participation varied widely from slum to slum. In some slums residents were consulted about the location of roads and walkways, and to a lesser degree regarding the location of water standpipes and sanitary facilities. <p>Physical environment/infrastructure intervention(s)</p> <p><i>Multicomponent physical upgrading and health and social services:</i></p> <ul style="list-style-type: none"> • Water and Sanitation infrastructure: piped water supply, communal taps servicing fewer families and Individual pit privities • Transportation infrastructure: Roads and walkways • Drainage: rainwater drains • Waste Management: garbage trucks • The intervention group consisted of slums to be improved during 1976-1978, one to two years after the baseline survey. The control group were slums where improvement was not proposed in the foreseeable future. A reference group was also included involving kampungs that had previously been improved at the time of the baseline survey (neither test nor control – entitled reference group). <p>Other living environment intervention(s)</p> <ul style="list-style-type: none"> • Primary schools and health clinics
Outcomes	<p>Socio-economic</p> <p>Mean household income</p>
Note	<p>Potential household effects of household turnover reported. The authors narratively describe the health impact – but no data provided</p>

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Not applicable - CBA study
Allocation concealment (selection bias)	High risk	Not applicable - CBA study
Selection of exposure (and comparison) groups for non randomised studies (selection bias)	High risk	The authors analyse data from surveys and did not control allocation of the intervention. However it is not reported how control areas were chosen and it is unclear whether selection bias exists between the groups. Difference in difference or matching approaches are not described.
Baseline outcome measurements similar (selection bias)	High risk	Household income much lower at baseline than treatment or reference group.
Baseline characteristics similar (selection bias)	Unclear risk	Not reported
Incomplete outcome data adequately addressed (attrition bias)	Unclear risk	The authors state that only 709 of original 5000 were re-surveyed. However it is unclear if the intention was to only follow-up a proportion of the original survey, or if this represents a large attrition.
Knowledge of the interventions adequately prevented during the study? (performance and detection bias)	Unclear risk	It would not be possible to blind participants from the intervention but unclear if data collection/analysis is blinded.
Study adequately protected against contamination? (performance bias)	Unclear risk	No information provided
Study free from selective outcome reporting? (reporting bias)	Unclear risk	Several outcomes are only summarised narratively without reporting numerical values.
Other bias	High risk	The outcome for mean household income does not appear to have allowed for potential inflation changes or adjusted for the clustering effect.

Footnotes

Characteristics of excluded studies

Choudhary 2002

Reason for exclusion	No relevant intervention - relocation not slum upgrading.
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Chowdhury 2006

Reason for exclusion	No relevant outcome - only measures physical changes to the environment no health or socio-economic outcomes.
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Dasgupta 2006

Reason for exclusion	Ineligible study design - cost-benefit analysis.
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DeMoura 2009

Reason for exclusion	No relevant intervention - land titling only, no physical environment intervention included.
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Field 2003

Reason for exclusion	No relevant intervention - land titling only, no physical environment intervention included.
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Field 2007

Reason for exclusion	No relevant intervention - land titling only, no physical environment intervention included
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Galdo 2005

Reason for exclusion	Ineligible setting - not specific to slum settings, city-wide intervention and outcomes.
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Galiani 2005

Reason for exclusion	Ineligible setting - not specific to slum settings, city-wide intervention and outcomes.
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Gamper-Rabindran 2008

Reason for exclusion	ineligible setting and intervention - analysis of census data broken into regions, but no region is clearly identifiable as a slum area. A specific upgrading program is not pinpointed, authors just note the change conditions between 1970 and 1990 and look at association with child mortality.
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Genser 2008

Reason for exclusion	Ineligible setting - not specific to slum settings, city-wide intervention and outcomes.
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Gross 1989

Reason for exclusion	Ineligible study design - non-comparative cross-sectional survey. No pre-test measures or comparison groups to directly examine effect of upgrading.
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Hanchett 2003

Reason for exclusion	No relevant outcome - only measures physical changes to the environment no health or socio-economic outcomes.
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Hayuma 1979

Reason for exclusion	Ineligible study and no relevant intervention - non-comparative case report of processes of training personnel (no physical environment intervention described).
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Izeogu 1993

Reason for exclusion	Ineligible study design and outcomes - case report at one timepoint with no control group and no relevant outcomes.
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Marcano 2008

Reason for exclusion	Not relevant setting - confirmed with authors that the programme was not targeted to slum dwellers.
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Mathey 2005

Reason for exclusion	Ineligible study design - cross-sectional feasibility study looking at existing crime and violence, and views and experiences of slum dwellers, prior to intervention.
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Nientied 1987

Reason for exclusion	No relevant outcomes - measures implementation and residential mobility only.
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Parikh 2007

Reason for exclusion	Ineligible study design - although research compares quantitative and qualitative before and after data, it was confirmed with the author that participants were interviewed at just one time-point after the intervention. Pre-intervention measures are based on asking subjects to recall outcomes. Therefore for the purposes of this review the study is considered a non-comparative cross-sectional study. A different study by Parikh is included whereby the data is cross-sectional but compared to control slums.
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Perlman 2008

Reason for exclusion	Ineligible study design - non-comparative observational longitudinal study with predominantly qualitative data. Doesn't evaluate and compare the effects of one 'slum upgrading programme' to another, but observes attitudes, experiences and perceptions of slum communities over time. The communities may have received clearance, or upgrading initiatives at some point in the long follow-up period, but doesn't compare outcomes.
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Rakodi 1988

Reason for exclusion	Ineligible study design - cross-sectional study design. Although the one relevant outcome (household income) is presented separately for those residents who were relocated and those that remained in place, the study is not considered to be comparative as the intervention was the same - just the in situ upgrading necessitated that some residents needed to be relocated to adjacent overspill areas.
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Ruprah 2008

Reason for exclusion	Ineligible setting - the paper deals with the evaluation of a crime prevention strategy which included crime prevention - but does not appear specific to slums (no mention of slum communities or UN slum criteria apparent).
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Takeuchi 2008

Reason for exclusion	Ineligible study design - cost benefit analysis.
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Tironi 2009

Reason for exclusion	Ineligible setting/population and intervention - comparison of two forms of public housing, by means of a survey in 1985 and 2001. Not identified as change from slums to public housing, rather comparison between two types of poor populations (new and old) in public housing. Authors state the study is not designed to evaluate any type of housing effect.
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Footnotes

Characteristics of studies awaiting classification

Footnotes

Characteristics of ongoing studies

Cooper 2007

Study name	Un Techo Para Mi Pas
Methods	Randomised controlled trial
Participants	Slum dwellers
Interventions	Pre-fabricated houses (improved housing) provided to slum dwellers in situ
Outcomes	Housing conditions, general well being, dwellers perception of security
Starting date	2007
Contact information	Ryan Cooper <rcooper@povertyactionlab.org>
Notes	Further information available at http://www.3ieimpact.org/en/evidence/impact-evaluations/details/23/ and http://www.povertyactionlab.org/evaluation/slum-housing-upgrading-el-salvador-uruguay

Footnotes

12. Summary of findings tables

Summary of findings - health and quality of life

What are the effects of slum upgrading strategies on the health and quality of life of slum dwellers?			
<p>Patient or population: Slum dwellers</p> <p>Settings: Urban/peri-urban slums from low and middle income countries</p> <p>Intervention: Slum upgrading involving physical environment and infrastructure interventions</p> <p><i>GRADE is used to describe the quality of the body of main evidence. Main studies are those eligible for the main synthesis of findings (RCTs, ITS, CBA). Supporting studies are UBAs and CPIs that cannot determine causality and are reported only as supplemental information, to explore consistency with main study findings or summarise the limited 'best available evidence' where main studies do not evaluate a relevant outcome</i></p>			
Outcomes	Impact of Intervention	No of Participants (main studies)	Quality of the body of main evidence for each outcome category (GRADE)
Communicable diseases	<p>Four main studies evaluated different outcomes related to communicable diseases and observed mixed effects of slum upgrading.</p> <p>One CBA found a reduction in diarrhoea episodes (RR = 0.53; 95% CI 0.27 1.04; P = 0.07) and severity (RR = 0.48; 95% CI 0.17 to 1.22; P = 0.12) but not duration of diarrhoea. One CBA indicated that private water supply reduces the relative risk of making an insurance claim for a waterborne illness (RR = 0.64; 95% CI 0.41 to 0.98; P = 0.04).</p> <p>There was no significant effect of road paving on the incidence of parasite and fungus infections or sickness in 1 RCT, or of multicomponent slum upgrading on mortality caused by diseases related to lack of sanitation in one CBA.</p>	<p>973 observations, 4 main studies.</p>	<p>⊕⊕⊖⊖ low*</p>

	Supplemental information Four supporting studies found associations between slum upgrading interventions and reduced incidence of communicable diseases in intervention groups compared to control / baseline. All four studies reinforced the main study finding, by observing lower diarrhoeal incidence in intervention groups. Two studies also observed lower incidence of parasitic infections which is inconsistent with main study findings.		
Maternal and perinatal conditions and infant mortality	One main CBA study reported no effect of slum upgrading (multi- component) on infant mortality.	306 observations, 1 main study	⊕⊕⊖⊖ low*
	Supplemental information One supporting study reported either a decrease or no change in maternal and perinatal conditions following slum upgrading depending on the indicator measured.		
Nutritional deficiencies	No studies were identified for the main analysis that examined the effect of slum upgrading on nutritional deficiencies.	N/A	N/A
	Two further studies reported slum upgrading was associated with either lower incidence of nutritional deficiencies or no difference, depending on the indicator measured.		
Non-communicable diseases	No main studies examining the effect of slum upgrading on specific non-communicable diseases were identified for the main analysis of results.	N/A	N/A
	Supplemental information One supporting study found evidence for an association between slum upgrading (providing homes with cement floors) and improved maternal mental health.		
Injuries	One CBA study, reported no effect of slum upgrading (multi- component) on the proportion of deaths due to homicides.	306 observations, 1 main study	⊕⊕⊖⊖ Very low**
	Supplemental information No eligible supporting studies were identified examining associations between slum upgrading and injuries.		
General health measures	No main studies reported other general health measures.	N/A	N/A
	Supplemental information: Four further supporting studies examined a range of general health measures (e.g. self reported ill health or sickness, and average monthly medical spending). Across the different measures, slum upgrading interventions were associated with outcomes that were either beneficial, adverse or showed no difference,		

Quality of life	One main study reported no effect of slum upgrading (road paving) on residents satisfaction with living in the city.	897 observations, 1 main study	⊕⊕⊖⊖ low***
	Supplemental information One supporting study found a statistically significant association between providing cement flooring to households and satisfaction with quality of life.		

GRADE Working Group grades of evidence

High quality: Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low quality: We are very uncertain about the estimate.

* Lowest body of evidence included is from CBAs with no downgrading

** CBA evidence downgraded once due to limitations with directness of evidence (applicability of homicides to broader injury measures)

*** RCT evidence downgraded twice due to 'very serious' limitations with directness of evidence (narrow focus of intervention and QoL measures in relation to other slum upgrading strategies and broader QoL outcomes)

Footnotes

Summary of findings - socio-economic outcomes

What are the effects of slum upgrading strategies on the socio-economic wellbeing of slum

Patient or population: Slum dwellers

Settings: Urban/peri-urban slums from low and middle income countries

Intervention: Slum upgrading involving physical environment and infrastructure interventions

Main studies are those eligible for the main synthesis of findings (RCTs, ITS, CBA). Supporting studies are UBAs and CPIs that can indicate associations between interventions and outcomes, but not whether the intervention caused the not determine causality and are reported only as supplemental information, to explore consistency with main study findings or summarise the limited 'best available evidence' where main studies do not evaluate a relevant outcome .

Outcomes	Impact of Intervention	No of Participants (main studies)	Quality of the body of main evidence for each outcome category (GRADE)
Financial Poverty	One CBA of multicomponent slum upgrading found a significant reduction in monthly water expenditure after including costs associated with the intervention (MD = -17.11 pesos; 95% CI -32.6 to -1.62; P = 0.03). Three main studies (1 RCT and 2 CBAs) reported no effect on income of slum dwellers following slum upgrading (road paving or multi- component interventions).	1130 participants or observations\$, 4 main studies	⊕⊖⊖⊖ very low [^]
	Supplemental information Six further supporting studies reported slum upgrading was associated with improvements in different measures of financial poverty. While one study reinforced the main study finding of reduced water expenditure, five supporting studies reported increased household income which was inconsistent with the main study findings. Two supporting studies also observed a reduction in households living below the poverty threshold.		
Employment	One RCT reported no effect of slum upgrading (road paving) on the proportion of unemployed adult slum dwellers.	1066 observations, 1 main study	⊕⊕⊖⊖ low ^{^^}
	Supplemental information Three further supporting studies with a high risk of bias reported mixed results; finding either positive employment outcomes or no difference in intervention groups compared to controls.		
Education	Two main studies reported slum upgrading had no effect on education outcomes. One RCT reported no effect of road paving on the proportion of children enrolled in school or school absenteeism. One CBA found no effect of multicomponent slum upgrading on illiteracy rate of head of slum households.	898 observations\$\$, 2 main studies	⊕⊕⊖⊖ low ^{^*}
	Supplemental information Five further supporting studies had mixed results, so could not reinforce main study findings. Four studies reported associations between slum upgrading and improved education outcomes, and one study reported no change.		
Crime and violence	One RCT reported no effect of slum upgrading (road paving) on the proportion of residents feeling safe walking the street at night or the proportions of households reporting burglaries or vehicles stolen.	893 observations, 1 main study	⊕⊕⊖⊖ low ^{^^}

	No supporting studies were identified that evaluated associations between slum upgrading and crime or violence.		
Social capital	No main studies were identified that examined the effect of slum upgrading on social capital.	N/A	N/A
	Supplemental information: One further supporting study found limited evidence of an association of multi-component slum upgrading and improvements in perceived resident social interaction and citizen participation.		
<p>GRADE Working Group grades of evidence.</p> <p>High quality: Further research is very unlikely to change our confidence in the estimate of effect.</p> <p>Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.</p> <p>Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.</p> <p>Very low quality: We are very uncertain about the estimate.</p> <p>^ Lowest body of evidence included is from CBAs, downgraded once for precision, due to wide confidence intervals in results</p> <p>^^ RCT evidence downgraded twice for directness of evidence and precision, due to narrow focus of intervention in relation to other slum upgrading strategies and wide confidence intervals for effect estimates</p> <p>^* Lowest body of evidence included is from CBAs with no downgrading</p> <p>\$Unclear number of participants / observations in two studies</p> <p>\$\$ Unclear number of participants / observations in one study</p>			

Footnotes

13. Additional tables

Review inclusion criteria

Characteristic	Include
Study Design	Inclusion in main analysis: <ul style="list-style-type: none"><li data-bbox="459 434 735 465">• RCTs, CBAs, ITS Inclusion in supporting Information: <ul style="list-style-type: none"><li data-bbox="459 555 1469 622">• controlled post-intervention studies (CPI) an uncontrolled before and after studies (UBA) Process evaluations or qualitative studies were only included if linked to the above studies

<p>Population/ Setting</p>	<p>1. Alternative words used to describe slums</p> <p>aashwa'i, ahata, arrabal, asentamiento , barraca, barrida, barrio, basti, bidon, bidonville, brarek, bustee, campamento, cantegril, chawl, chacarita, ciudad perdida, colonia popular, comuna, comunidade, conventillos, cortiço, elendsviertel, favela, foundouks, gecekondu, ghetto, illegal settlement, imijondolo, informal city/settlement, habitat précaire, habitat spontané, hood, jhopadpatti, kampong, kartonsko naselje, katchi abadi, katra, kijiji, lahbach, loteamento, mabanda, masseque, medina achouaia, morro, mudal safi, pelli gewal, poblacion callampa, precario, pueblos jóvene, quartier irrégulier, quartos do slum, shack, shanty house/town, squatter city / camp/settlement, tanake, taudis, truschobi, tugurio, umjondolo, villa miseria, watta</p> <p>2. Named slum communities</p> <p>If a study conducts an upgrading intervention in a named community but does not identify the area as a slum, further information will be sought from the authors, research literature or key organisations as to whether the community is considered a slum. <i>Examples of large well-known slums include:</i> Dharavi (India), Kibera (Nairobi, Kenya), Cite Soleil (Haiti), Khayelitsha (Capetown, South Africa), Orangi Town (Pakistan).</p> <p>3. UN Habitat criteria</p> <ul style="list-style-type: none"> • Access to improved water: piped water into dwelling, plot or yard. Other Improved: public tap/standpipe; tube well/borehole; protected dug well; protected spring; and rainwater collection. Bottled water is only considered an improved water source when water from an improved source is used for cooking and personal hygiene) • Access to improved sanitation: flush or pour-flush to piped sewer system, septic tank or pit latrine; ventilated improved pit latrine; pit latrine with slab; and composting toilet. Only facilities that are not shared or not public are considered improved • Sufficient-living area: No more than three people share the same habitable (minimum of four square metres) room • Durability of housing: a house built on a non-hazardous location and has a structure permanent and able to protect its inhabitants from the extremes of climatic conditions, such as rain, heat, cold and humidity • Security of tenure: evidence of documentation that can be used as proof of secure tenure status or when there is either de facto or perceived protection against forced evictions
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Interventions	<ul style="list-style-type: none"> • Examples of eligible physical environment interventions • Water and sanitation: improved access to sanitation (e.g. private latrines), access to adequate water quality and quantity for drinking and other needs (e.g. piped water into dwelling), drainage and flood protection • Energy infrastructure e.g. gas and electricity supply, improved cook stoves • Transportation infrastructure e.g. building road networks, emergency access roads, public transportation, paved sidewalks and footpaths, installing street lighting • Mitigation of environmental hazards (flood, landslide and waste) via ground stabilisation, water drainage, sewerage systems, waste disposal and collection • Waste management e.g. kerbside waste collection • Housing improvements e.g. improved flooring
Outcomes	<p>Health and quality of life (QoL) Primary outcomes for this review were objective or subjective measures Mortality and morbidity related to:</p> <ul style="list-style-type: none"> • Communicable diseases • Non-communicable diseases • Injuries • QoL <p>Socio-economic wellbeing</p> <ul style="list-style-type: none"> • Indicators of financial poverty <ul style="list-style-type: none"> ○ household income ○ household assets ○ time or proportion of income spent on water or fuel collection ○ households above/below poverty threshold • Employment and occupation • Crime and violence • Education • Social capital - example measures include membership with formal or informal clubs, societies; contact with social groups including families, religious groups, friends; presence and reliance on networks of support; shared norms and values within a community; trust in neighbours, family members, government and community members such as politicians and police; and civic participation or shared decision making. <p>Slum dwellers views and preferences Where reported, data regarding slum dweller perspectives and experiences was collected from the eligible studies examining the health, QoL, or socio-economic outcomes described above.</p>

Summary of the themes identified from slum dwellers views and experiences

Conditions of unimproved slums and residents diagnosis of their own needs

Water, drainage and sanitation infrastructure were the most important needs to slum communities, in preference to health, education and employment

- Water ([Joshi 2002](#) and [Parikh in press](#)), sanitation ([Parikh in press](#)) and drains ([Joshi 2002](#)) were given top priorities in preference to housing health, education and employment
- Following the implementation of water and drainage facilities, the majority of residents listed education facilities and health facilities as the next priority ([Joshi 2002](#))

Waiting and filling time from water faucets

- Collection time for water at public faucets was very long, particularly during the morning ([Aiga 2002](#))

Options for accessing water

- Rainwater collection was not considered a suitable option for domestic water use. Most households collected water from public water faucets. Households used expensive water delivery services or designated one household member responsible for water collection, due to long collection times ([Aiga 2002](#))

Consequences of poor water access

- Poor water availability restricted water consumption and impacted slum residents' financial situation, owing to the expenses involved in acquiring water and reduction of work opportunities ([Aiga 2002](#))

Desire for secure tenure

- 21% of the control (no intervention) group in one study stated that certificate of lot ownership should be given to improve slum improvement project activities ([De Leon 1986](#))

Perceived intervention effects and factors that may mediate or enhance impact

Water and Sanitation perceived to improve health, health behaviour and quality of life

- No longer having to carry buckets of water reduced back problems ([Parikh in press](#))
- Bathing everyday made their bodies feel "furt" (energetic) ([Parikh in press](#))
- Water and sanitation reduced days lost to illness ([Parikh in press](#))
- Girls listed hygiene and time saved as the main benefit of regular water supply, whereas elders listed hygiene improvements as the main benefit ([Joshi 2002](#))

Water and Sanitation perceived to affect gender dimensions

- Girls who previously had to spend time disposing waste water because the boys wouldn't do this work, could now wake up late and sleep more ([Parikh in press](#))

Upgraded infrastructure frees resident's time which can be used for productive activities (income generating or educational opportunities)

- Water ([Parikh in press](#), [Joshi 2002](#)) and sanitation freed time and fewer days lost to illness ([Parikh in press](#))
- "Previously there was no time to send children to school" ([Parikh in press](#))
- The majority of men, women and boys stated that the main benefit of the regular water supply was the time saved ([Aiga 2002](#))
- Footpaths and roads improved access to the rest of the city, and made efficient and quicker transport possible. This improved and quickened access to market, schools and to work all year round and in some instances, facilitated the establishment of small sidewalk enterprises ([Milone 1993](#))
- Previous water collection time constrained income generating activities. Most control residents in charge of water collection expressed their willingness to work for additional income when water supply improved ([Aiga 2002](#))
- "Children go to school now. Previously there was no time to send children to school" ([Parikh in press](#))

Water supply reduces financial burden

- Water and sanitation resulted in fewer days lost to illness, lessening medical expenses ([Parikh in press](#))
- Financial burden of water had been reduced by the improvement of water supply, and the appropriate level of financial burden of loan repayment on the household economy had encouraged the residents (particularly those formerly in charge of water collection) to work for income ([Aiga 2002](#))

Upgraded infrastructure and tenure encourages residents to invest in their homes

- Provision of physical infrastructure was reported as the most important reason for making investments in upgrading of their shelter, followed by better social standing and security of tenure ([Parikh in press](#))

Footpaths increase safety

- Residents often said that paved paths increased security, as residents had at their own expense installed lighting along the footpaths ([Milone 1993](#))
- Residents expressed preferences for straight pathways to facilitate neighbourhood vigilance, though the authors stated this should be weighed carefully against technical considerations of using existing pathways to avoid affecting sound structures ([De Leon 1986](#))

Infrastructure improves social cohesion

- Flag holders were constructed along the paths for national celebrations and kampung gates constructed, reflecting heightened community identity ([Milone 1993](#))

Energy infrastructure improves access to information

- “Ignorance is now reducing and TV shows like Discovery channel shows us things that we have never dreamt or seen before.” ([Parikh in press](#))

Slum upgrading perceived to be proof of governments concern'

- Prior to a multicomponent slum upgrading programme, 90% of slum residents in one study felt that the government was not concerned about residents' housing problems. After the slum upgrading project, 80.4% of intervention residents in comparison to 60% of control residents were satisfied that the housing upgrading aspect of the programme was proof of the government's concern ([De Leon 1986](#))

Acceptability of interventions and barriers to use, implementation or maintenance of upgraded services

Cemented footpaths and roads were highly appreciated, toilets were adjudged as the second most important component by kampung residents and drains were deemed to be very essential ([Milone 1993](#)).

Location of facilities

- Barrier: examples were described of not locating facilities where they were needed most, siting them in areas that were impractical or did not consider gender (too far away for women to carry water home) and social class sensitivities (poorer residents ashamed to use facilities housed in affluent family's yard) ([Milone 1993](#)).
- Facilitator: latrines were only used by the absolute poor when they were sited in a secluded public area ([Milone 1993](#)).

Shared facilities were not valued

- Barrier: shared bath, laundry and latrine services were poorly used. Many residents instead installed private slab toilets and taps. This may be linked to implementation issues observed by authors: i.e. a delay in delivering the shared facilities during which time opportunities to install private slab toilets arose, and the lack of maintenance of installed services ([Milone 1993](#)).

Delivery and design of service

- Barrier: solid waste disposal boxes were unsuccessful because the cities did not have the capacity to pick up rubbish from the sampah boxes on a regular basis. This was partly because a subproject had not yet been implemented ([Milone 1993](#)).
- Barrier: poorly designed, implemented and dysfunctional drains ([Milone 1993](#)).

Maintenance

- Barrier: no system developed for maintaining the taps or keeping the drains or public latrines. So a majority of residents objected to having the public baths, laundry and

latrine facilities nearby due to the bad odour ([Milone 1993](#)).

Affordability of scheme for residents

- Barrier: PAM (a water company) closed taps down as not enough fees were collected to cover the water they dispersed. User groups cited inability to pay user fees on a sustained basis ([Milone 1993](#)).

Role of local leadership

- In kampungs where drains were kept clean it was due to effective leadership of the kepala Rukka Warga (community) kepala Rukka Tetanga (neighbourhoods within), and policy setting by the Lurah (leadership of the overall village) ([Milone 1993](#)).

Community self-investment

- A degree of self-help was stimulated: residents in some kampungs cemented over the centre earth dividers of the footpaths in front or alongside their property and cemented the earth on each side of the footpaths as well ([Milone 1993](#)).
- In some kampungs paths were valued as safe pedestrian thoroughfares - to the extent residents constructed barriers to prevent vehicle entry ([Milone 1993](#)).

Footnotes

Quality assessment of main studies using NICE/GATE tool

	Butala 2010	Galiani 2007	Gonzalez-Navarro 2010	Soares 2005	Taylor 1987
	CBA	CBA	RCT	CBA	CBA
Internal Validity	-	+	+	+	-
External Validity	+	+	++	+	-
1.1 Well described source population or source area? (E)	++	++	+	++	+
1.2 Eligible population or area representative of the source population or area? (E)	+	+	++	+	NR
1.3 Selected participants or areas represent the eligible population or area? (E)	++	+	++	-	NR
2.1 Allocation to intervention (or comparison) - How was selection bias minimised?	+	+	++	+	-
2.2 Interventions (and comparisons) well described and appropriate?	+	+	+	NR	-
2.3 Allocation concealed?	NA	NA	+	NA	NA
2.4 Participants and/or investigators blind to exposure and comparison?	NR	NR	+	NR	NR
2.5 Exposure to intervention and comparison adequate?	NR	NR	+	++	+
2.6 Contamination acceptably low?	-	+	+	NR	NR
2.7 Other interventions similar in both groups?	+	NR	++	+	NR
2.8 Participants accounted for at study conclusion?	NA	NR	+	NR	NR
2.9 Confounders considered and adjusted for?	++	+	++	++	-

3.1 Reliable outcome measures?	-	-	+	+	NR
3.2 Outcome measurement complete?	+	NR	+	NR	-
3.3 All important outcomes assessed?	+	+	+	+	-
3.4 Outcomes relevant? (E)	-	+	++	+	NR
3.5 Similar follow-up times in exposure and comparison groups?	++	+	++	+	+
3.6 Follow-up time meaningful? (E)	-	++	NR	NR	-
4.1 Exposure and comparisons groups similar at baseline? If not were they adjusted for?	+	++	++	NR	NR
4.2 Intention-to-treat (ITT) analysis conducted?	NA	-	+	NR	NR
4.3 Study sufficiently powered to detect an intervention effect (if one exists)?	NR	NR	NR	NR	NR
4.4 Estimates of effect size given or calculable?	+	+	++	+	+
4.5 Analytical methods appropriate?	+	+	++	+	+
4.6 Precision of intervention effects given or calculable?	+	++	++	+	+

Footnotes

(E) denotes questions considered in judgement of external validity

Quality assessment of supporting studies using NICE/GATE tool

	<u>Abelson 1996</u>	<u>Aiga 2002</u>	<u>Cattaneo 2009</u>	<u>De Leon 1986</u>	<u>Joshi 2002</u>	<u>Milone 1993</u>	<u>Moitra 1987</u>	<u>Moraes 2004</u>	<u>Parikh in press</u>
	UBA	CPI / QUAL	CPI	CPI	UBA	UBA/ QUAL	CPI	CPI	CPI/ QUAL
Internal Validity	-	-	+	-	-	-	-	-	-
External Validity	+	+	+	+	++	+	+	++	+
1.1 Well described source population or source	++	++	+	++	++	++	+	++	++
1.2 Eligible population or area	+	+	+	+	++	+	-	+	+
1.3 Selected participants or areas represent the eligible	++	++	++	-	+	NR	NR	++	+
2.1 Allocation to intervention (or comparison) - Was	NA	-	+	-	NA	NA	-	-	-
2.2 Interventions (and comparisons) well	+	-	++	++	++	-	++	+	++
2.3 Allocation concealed?	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.4 Participants and/or investigators blind to exposure and comparison?	NA	NR	NR	NR	NA	NA	NA	++	NR

2.5	Exposure to intervention	NR	-	++	+	+	-	+	+	NR
2.6	Contamination acceptably low?	NA	NR	+	++	NA	NA	+	NR	+
2.7	Other interventions similar in both	NA	NR	+	+	NA	NA	NR	+	NR
2.8	Participants accounted for at	NR	NA	NA	NR	+	NR	NA	NA	NA
2.9	Confounders considered and adjusted for?	-	+	+		-	-	-	++	-
3.1	Reliable outcome measures?	+	+	++	-	-	-	-	++	-
3.2	Outcome measurement complete?	NR	+	++	NR	NR	NR	-	+	NR
3.3	All important outcomes assessed?	++	+	++	+	+	+	+	++	+
3.4	Outcomes relevant? (E)	+	+	++	+	+	+	+	++	+
3.5	Similar follow-up times in exposure and comparison groups?	NA	++	NA	NA	NA	NR	NA	NR	-
3.6	Follow-up time meaningful? (E)	NR	NR	+	+	NR	NR	NR	NR	NR
4.1	Exposure and comparisons groups similar at baseline? If not were they adjusted for?	NA	+	++	NR	NA	NA	-	NA	NA
4.2	Intention-to-treat (ITT) analysis conducted?	NR	NA	++		NR	NR	NR	NA	NA
4.3	Study sufficiently powered to detect an intervention effect (if one exists)?	NR	+	NR						
4.4	Estimates of effect size given or	+	-	++	-	-	-	-	++	-
4.5	Analytical methods appropriate?	-	+	++	+	-	NR	-	++	-
4.6	Precision of intervention effects given or calculable? Were they meaningful?	-	+	++	-	-	-	-	++	-

Footnotes

(E) denotes questions considered in judgement of external validity

Main study findings - health and QoL outcomes

Outcome category	Outcome definition	Estimate of effect (intervention compared to control)	Intervention	Study characteristics (No. of participants or
Communicable diseases	Diarrhoea			
	Participants reporting a diarrhoeal episode within last two weeks	RR = 0.53 (95% CI 0.26 to 1.04; P=0.07)	Water supply	649 observations, (Galiani 2007 CBA+/+)
	Severity of diarrhoea episodes (whether episodes included blood and/or parasites)	RR = 0.48 (95% CI 0.19 to 1.22; P=0.12)	Water supply	649 observations (Galiani 2007 CBA+/+)
	Duration of diarrhoea episodes	MD = -1.24 days (95% CI -2.68 to 0.43; P=0.16)	Water supply	649 observations, (Galiani 2007 CBA+/+)
	Parasitic infections			
	Participants reporting parasite or fungus infection over the past year	RR = 1.06 (95% CI 0.70 to 1.62; P=0.79)	Road paving	3145 observations, (Gonzalez-Navarro 2010 RCT ++/++)
	General measures of communicable diseases			
	Claims for a waterborne disease as opposed to a non-waterborne disease	RR = 0.64 (95% CI 0.41 to 0.98; P=0.04)	Multicomponent physical upgrading plus wider co-interventions	637 participants (Butala 2010 CBA -/+)
	Proportion of death caused by diseases related to lack of sanitation as opposed to all registered deaths	DiD coefficient $\beta = -0.007$ (95% CI -0.02 to -0.01, reported not to be significant at 5% or 10% level)	Multicomponent slum upgrading	306 observations (Soares 2005 +/-)
	Participants reporting sickness (vomit, diarrhoea, bronchitis, stomach pain, flu, fever or coughing) within the last month	RR = 0.98 (95% CI 0.85 to 1.14; P=0.83)	Road paving	3152 observations (Gonzalez-Navarro 2010 RCT ++/++)
Maternal and perinatal conditions and infant mortality	Proportion of infant deaths (under the age of one year) as opposed to all registered deaths	DiD $\beta = 0.03$ (95% CI -0.02, to 0.07, reported not to be significant at 5% or 10% level)	Multicomponent slum upgrading	306 observations (Soares 2005 CBA +/-)
Nutritional deficiencies	N/A	N/A	N/A	No main studies identified. See Table 7 for results from supporting studies

Injuries	Proportion of deaths caused by diseases related to lack of sanitation as opposed to all registered deaths	DiD coefficient $\beta = -0.05$ (95% CI - 0.02 to 0.07, reported not to be significant at 5% or 10% level)	Multicomponent slum upgrading	306 observations (Soares 2005 CBA+/+)
Non-communicable	N/A	N/A	N/A	No main studies identified. See Table 7 for results from supporting studies
General health measures	N/A	N/A	N/A	No main studies identified. See Table 7 for results from supporting studies
QoL	Residents satisfaction with living in the city (increasing scale 1-4)	Mean satisfaction score was 3 (satisfied) (MD = 0.01; 95% CI - 0.10 to 0.02; P=0.92)	Road paving	897 observations (Gonzalez-Navarro 2010 RCT++/++)

Footnotes

Main study findings - socio-economic outcomes

Outcome category	Outcome definition	Estimate of effect (intervention compared to control)	Intervention	Size of evidence (No. of participants, studies, study ref and risk of bias)
Poverty	Income			
	Increase in mean household income	Total mean household income increased by 36,348 in intervention and 57,382 rupiah in control group over time, P>0.05.	Multicomponent physical upgrading plus wider co-interventions	Unclear number of participants, (Taylor 1987, CBA -/-)
	Monthly income of head of household	DiD coefficient $\beta = -0.11$ (95% CI -0.31 to 0.31, reported not to be significant at 5% or 10% level)	Multicomponent slum upgrading	Unclear number of observations, (Soares 2005 CBA +/+)
	Log monthly labour income	MD = 0.05 (95%CI -0.13 to 0.23; P=0.67)	Road paving	765 observations (Gonzalez-Navarro 2010 RCT++/++)
	Water expenditure			
	Monthly water expenditure after including costs associated with the intervention	MD = -17.11 pesos (95% CI - 32.6 to -1.62; P=0.03).	Water supply	369 observations (Galiani 2007 CBA +/+)
Employment	Adults (aged 18 to 65) unemployed	RR = 1.05 (95% CI 0.39 to 2.83; P=0.92)	Road paving	1066 observations, (Gonzalez-Navarro 2010 RCT ++/++)

	Plans to migrate in search of work	RR = 0.78 (95% CI 0.60 to 1.01; P=0.06)	Road paving	801 observations, (Gonzalez-Navarro 2010 RCT ++/++)
	Weekly hours worked	MD = 4.68 (95% CI -0.46 to 9.82; P=0.07)	Road paving	892 observations, (Gonzalez-Navarro 2010 RCT ++/++)
Education	Illiteracy of head of household	DiD coefficient $\beta = 0.01$ (95% CI -0.03 to 0.06; reported not to be significant at 5% or 10% level)	Multicomponent slum upgrading	Unclear number of observations, (Soares 2005 CBA +/+)
	Children (aged 5 to 17) enrolled in school	RR = 1.03 (95% CI 0.96 to 1.12; P>0.1)	Road paving	898 observations, (Gonzalez-Navarro 2010 RCT ++/++)
	Children (aged 5 to 17) absent from school last month	RR = 1.49 (95% CI 0.75 to 2.93; P>0.1)	Road paving	743 observations, (Gonzalez-Navarro 2010 RCT ++/++)
Crime and violence	Households reporting a burglary in the past 12 months	RR = 1.83 (95% CI 0.84 to 4.02; P=0.13)	Road paving	893 observations, (Gonzalez-Navarro 2010 RCT ++/++)
	Households reporting vehicles stolen in the past 12 months	RR = 1.07 (95% CI 0.25 to 4.57; P=0.92)	Road paving	111 observations, (Gonzalez-Navarro 2010 RCT ++/++)
	Household members reporting whether they feel safe walking the street at night	RR = 1.08 (95% CI 0.88 to 1.32; P=0.48)	Road paving	888 observations, (Gonzalez-Navarro 2010 RCT ++/++)
Social capital	N/A	N/A	N/A	No main studies identified. See Table 8 for results from supporting studies

Footnotes

Supporting study findings - health and QoL outcomes

Outcome category	Outcome definition	Estimate of association	Intervention	Study characteristics (No. of participants or observations, studies, study ref and risk of bias/external validity)
Communicable diseases	Diarrhoea			
	Having diarrhoea in two weeks among old children, in group compared to group.	RR = 0.29 (95% CI 0.2 to 0.42; P<0.001)	Multicomponent slum upgrading	401 households. Observations for outcome measure = 372 (Aiga 2002 CPI +/-)
	Children under 5 having frequent	Drains group: RR = 0.42 *	Multicomponent slum upgrading	Total number of children in study 1275

than twice the expected number	Drains and sewerage: RR = 0.14 *	including, either a) improved drains b) improved drains and sewerage	Morales 2004 CPI -/++
Often or seldom reported amongst following the compared to before intervention.	RR = 0.43 **	Multicomponent slum upgrading	1120 household heads were selected for questioning, sample sizes for measured outcomes are not reported or whether loss to follow-up (Milone 1993 UBA -/+).
Children (less than old) having diarrhoea four weeks, in compared to control	RR = 0.87 (95% CI 0.76 to 1.00; P=0.05)	Cement flooring (Piso Firme)	2755 households included in study. Result based on total 4035 observations (Cattaneo 2009 CPI +/-).

Parasitic infections

Children aged 5 to 14 years having a parasitic infection in intervention slums compared to control sites	Drains group: Ascaris RR = 0.71* Trichuris RR = 0.82* Hookworm RR = 0.34* Drains and sewerage: Ascaris RR = 0.57* Trichuris RR = 0.78* Hookworm RR = 0.37*	Multicomponent slum upgrading including, either a) improved drains b) improved drains and sewerage	Total number of children in study 1275 (Morales 2004 CPI -/++)
Children (less than six years old) having parasites present in their stool sample, in intervention groups compared to controls	RR = 0.81 (95% CI 0.66 to 1.00; P=0.05)	Cement Flooring (Piso Firme)	2755 households included in study. Result based on 3094 Cattaneo 2009 CPI +/-)
Intensity of parasitic infections (eggs per gram stool) among children aged 5 to 14 years in intervention sites compared to control^.	Drains group: Ascaris: MD = 1501\$ Trichuris: MD = -522* Hookworm: MS = 111* Drains and sewerage: Ascaris: MD = 1822\$ Trichuris: MD = -469* Hookworm: MS = -33*	Multicomponent slum upgrading including, either a) improved drains b) improved drains and sewerage. Compared to no intervention	Total number of children in study Morales 2004 CPI -/++)
Predisposition to reinfection among children (aged 5 to 14	See Morales 2004 . For each species there is a tendency	Multicomponent slum upgrading	Total number of children in study

	years) following treatment with mebendazole. Calculated by comparing treated children to children who were initially infected for each type of infection, per study intervention group group^.	for the relative risks of predisposition to both reinfection and heavy re-infections to be greater in the sanitation groups than in the control group. Results did not account for clustering.	including, either a) improved drains b) improved drains and sewerage. compared to no intervention group	Morales 2004 CPI -/++)
Dengue fever^				
	Dengue fever reported to be often or seldom amongst households. Relative risk calculated comparing final follow up to to cycle II (whereby intervention had already been installed)^.	RR = 0.38**	Multicomponent slum upgrading	1120 household were selected for questioning, sizes for outcomes are not reported or loss to follow-up Milone 1993 UBA -/+)
Skin diseases^				
	Skin diseases reported to be often or seldom amongst households. Relative risk calculated comparing final follow up to baseline^.	RR = 0.38**	Multicomponent slum upgrading	1120 household were selected for questioning, sizes for outcomes are not reported or loss to follow-up Milone 1993 UBA -/+)
	Children (less than six years old) reported to have a skin disease in the previous four weeks^.	RR = 1.02 (95% CI 0.84 to 1.24; P=0.84)	Cement flooring (Piso Firme)	2755 households included in study. Result based on total of 4032 observations (Cattaneo 2009 CPI +/+)
Maternal and perinatal conditions and infant mortality	No birth delivery problems, after intervention compared to before^.	RR = 0.98* [§]	Multicomponent physical upgrading plus wider co-interventions	612 households included (Abelson 1996 -/+)
	Post natal consultations, after intervention compared to before^.	RR = 0.32*	Multicomponent physical upgrading plus wider co-interventions	612 households included (Abelson 1996 -/+)
Injuries	N/A	N/A	N/A	No supporting studies identified. One main study
Nutritional deficiencies	Households undercaloried, after intervention compared to	RR = 0.96* [§]	Multicomponent physical	80 households included

	before^.		plus wider co-interventions	
	Children 20% plus underweight, after intervention compared to before^.	RR = 0.68*	Multicomponent physical upgrading plus wider co-interventions	80 households (Abelson 1996 -
	Height-for-age z score for children less than six years old in intervention group compared to control^.	MD = 0.002 (95% CI -0.07 to 0.08; P0 0.96)	Cement flooring (Piso Firme)	2755 households included in study. Result based on 3918 Cattaneo 2009 CPI +/-)
	Weight-for-height z scores for children less than six years old in intervention group compared to control^.	MD = -0.011 (95% CI -0.01 to 0.06; P=0.77)	Cement flooring (Piso Firme)	2755 households included in study. Result based on 3939 Cattaneo 2009 CPI +/-)
Cognitive Development^	MacArthur Communicative Development Test score for children aged 12-30 months in intervention group compared to control^.	MD = 5.57 (95% CI 2.35 to 16.49; P=0.01)	Cement flooring (Piso Firme)	2755 households included in study. Result based on 596 observations Cattaneo 2009 CPI +/-)
	Picture Peabody Vocabulary Test percentile scores for children aged 36-71 months in intervention group compared to control^.	MD = 3.08 (95% 0.32 to 5.85; P=0.03)	Cement flooring (Piso Firme)	2755 households included in study. Result based on 1574 Cattaneo 2009 CPI +/-)
Non-Communicabl	Maternal depression (CES-D Scale), in intervention group compared to control. Low scores indicate lower self-reported depressive symptomatology^.	MD = -2.37 (95% CI -3.48 to -1.26; P<0.001)	Cement flooring (Piso Firme)	2755 households included in study. Result based on 2742 Cattaneo 2009 CPI +/-)
	Maternal stress (perceived stress scale, PSS), in intervention group compared to control. Low scores indicate lower perceived stress symptoms^.	MD = -1.74 (95% CI -2.52 to -0.97; P<0.001)	Cement flooring (Piso Firme)	2755 households included in study. Result based on 2746 Cattaneo 2009
General health measures^	Residents reporting themselves to be 'well' as opposed to 'indifferent or unwell' between beneficiaries of the Bustee Improvement intervention and non-beneficiaries^	RR = 1.05**	Multicomponent physical upgrading plus wider co-interventions	Sample size not reported (Moitra CPI +/-)
	Average monthly medical expenses^	Results are not reported numerically, only reported graphically. Non-serviced slum households appeared to encounter higher medical expenses compared to serviced households.	Multicomponent slum upgrading	700 households included, intervention and control slums press CPI +/-)
	Reported 'persons sick' in intervention slums compared to	RR = 3.0*	Multicomponent slum upgrading	612 households included

	controls^		with wider health and social co-interventions.	-/+)
	Persons reporting being chronically ill in intervention slums compared to controls^	RR = 2.29*	Multicomponent slum upgrading with wider health and social co-interventions.	612 households included -/+)
	Children (less than six years old) reported to have 'another disease' in the previous four weeks in intervention group compared to control^.	RR = 1.17 (95% CI 0.79 to 1.74; P=0.4364 ^{\$\$})	Cement flooring (Piso Firme)	2755 households included in study. Result based on total of 4036 Cattaneo 2009 CPI +/+)
	Children (less than six years old) reported to have had a respiratory disease in the previous four weeks in intervention group compared to control^.	RR = 1.05 (95% CI 0.95 to 1.16; P=0.35 ^{\$\$})	Cement flooring (Piso Firme)	2755 households included in study. Result based on 4037 observations (
QoL	Mothers satisfied or very satisfied with their quality of life, in the intervention group compared to control.	RR = 1.19 (95% CI 1.11 to 1.27; P<0.001)	Cement flooring (Piso Firme)	2755 households included in study. Result based on total of 2755 observations (Cattaneo 2009 CPI +/+)

Footnotes

^ Individual outcomes or outcome categories reported in supporting studies but not main studies.

* CIs and P values not shown because study did not account for clustering

** 95% CIs not shown as sample sizes were not reported. Relative risks estimated by authors from disease percentage frequencies provided.

\$ Results not statistically significant, but confidence intervals and P-Values are not shown as study did not account for clustering.

\$\$ Robustness check. Study authors did not anticipate outcomes to be affected by the intervention and were examined as a robustness check.

Supporting study findings - socio-economic outcomes

Outcome Category	Outcome definition	Estimate of effect (intervention compared to control)	Intervention	Size of evidence (No. of participants, studies, study ref and risk of bias)
Poverty indicators	Income			
	Mean adjusted household income per capita, intervention versus	1563 vs. 1130 pesos/person/month, Reported P-Value <0.05	Multicomponent slum upgrading	401 households. (Aiga 2002 CPI +/-)
	Monthly household capita income given as the mean proportion of (Brazilian Minimum in August 1983) in intervention compared to control ^{\$\$}	MD = 0.3* Drainage and sewers MD = 0.2* Drainage only	Multicomponent slum upgrading including, either a) improved drains b) improved drains and sewerage. Compared to no intervention group	Total number of households 1005. (Morales 2004 CPI - /++)
	Household income capita	MD = -26.97 (95% CI -272.31 to P=0.83)	Cement flooring (Piso Firme)	2755 households included in study (Cattaneo 2009 CPI +/-)
	Monthly income after intervention before intervention (rupees). Does not whether the paper for changes in	Less than <1000 Rs: RR = 0.10.02 to 0.44; P=0.002) 1001-2000 Rs: RR = 0.33 (95% to 0.60; P<0.001) 2001-3000 Rs: RR = 0.122 0.69 to 2.16; P=0.50) 3001-4000 Rs: RR = 0.95 (95% to 2.16; P=0.87) >4000: RR = 2.49 (95% CI 1.36 4.54; P=0.003)	Multicomponent physical upgrading plus wider co-interventions	101 households were surveyed at the start of the study, 84 were followed up (Joshi 2002 UBA -/++)
	Household income, intervention before.	15.2% increase in household 854 Rs to 1348 Rs between 1991, after inflating 1988 values prices	Multicomponent physical upgrading plus wider co-interventions	612 households included (Abelson 1996 UBA -/+)
	Family disposable in intervention compared to	Higher disposable outcomes are in intervention slums, but results reported numerically, only graphically. Non-serviced slum households appeared to medical expenses compared to households.	Multicomponent slum upgrading	700 households were included, amongst four intervention and three control slums (Parikh in press CPI - /+)
	Water expenditure			
	Mean monthly water expenditure in compared to control households	109 versus 234 Reported P<0.01.	Multicomponent slum upgrading	401 households. (Aiga 2002 CPI +/-)
	Mean proportion of monthly income	2.8% in intervention slum 10.1% in control slum, reported	Multicomponent slum upgrading	401 households. (Aiga 2002 CPI +/-)

	water in intervention versus control households			
Living below the poverty threshold				
	Living below the line (at the 40 th percentile expenditure level) at final follow-up compared to	RR = 0.74**	Multicomponent slum upgrading	1120 household heads were selected for questioning, sample sizes for measured outcomes are not reported or whether any loss to follow-up (Milone 1993 UBA -/+)
	Households living below the poverty threshold in intervention group compared to control.	RR = 0.47 (95% CI 0.37 to 0.59; P<0.001)	Multicomponent slum upgrading	401 households. (Aiga 2002 CPI +/-)
Employment	Work force participation in intervention compared control slums	RR = 1.00**	Multicomponent physical upgrading plus wider co-interventions	Sample size not reported (Moitra 1987 CPI +/-)
	Unemployment in intervention compared to control group	RR = 0.53**	Multicomponent physical upgrading plus wider co-interventions	Sample size not reported (Moitra 1987 CPI +/-)
	Adults employed following intervention compared to before the intervention	No change. RR = 1.01*\$	Multicomponent physical upgrading plus wider co-interventions	612 households included (Abelson 1996 UBA -/+)
	Proportion of workers engaged in different occupation groups (Government, private job, unskilled worker, skilled worker, vendor, recycling / sweeper, household- based activity, cattle / milk related activities).	There was a significant change in only one type of occupation amongst slum residents - the proportion of workers engaged in casual and unskilled occupations decreased following the intervention (RR 0.5; 95% CI 0.28 to 0.88; P=0.02). There was no difference for other occupation groups.	Multicomponent physical upgrading plus wider co-interventions	101 households were surveyed at the start of the study, 84 were followed up (Joshi 2002 UBA -/+++)
Education	Literacy			
	Literacy rate (ability read a newspaper)	India slums: Serviced slums had higher proportion of literate the serviced slums than non-despite the fact that there was no in educational infrastructure in slums. South African slums: little literacy levels, and the author was due to universally high levels	Multi-component slum upgrading	700 households were included, amongst four intervention and three control slums (Parikh in press CPI -/+)

	literacy to begin with.		
Literacy (ability to read newspaper) in group compared to	RR = 1.05**	Multicomponent physical plus wider co-interventions	Sample size not reported (Moitra 1987 CPI -/+)
Adult literacy after physical slum programme before.	RR = 1.16*	Multicomponent physical plus wider co-interventions	612 households included (Abelson 1996 UBA -/+)
Overall literacy physical slum programme before	RR = 1.17*	Multicomponent physical plus wider co-interventions	612 households included (Abelson 1996 UBA -/+)
Other educational outcomes			
Children going to preschool	RR = 1.94*	Multicomponent physical plus wider co-interventions	612 households included (Abelson 1996 UBA -/+)
Range of Education outcomes –change proportions of the adult literate, adult literate, school-children, school preschool children	The majority of educational were not statistically significant, increases in school-going 1.34; 95% CI 1.07 to 1.60; small but statistically significant in the relative risk of illiterate also observed between baseline follow-up (RR 1.34; 95% CI 0.99 P=0.05).	Multicomponent physical plus wider co-interventions	101 households were surveyed at the start of the study, 84 were followed up (Joshi 2002 UBA -/++)
Schooling of head (years), comparing intervention households to controls^.	Drains: MD = 1.60 years* Drains and sewerage: MD = 1.40 years*	Multi-component slum upgrading including, either a) improved drains b) improved and sewerage compared to no intervention	Total number of households 1005. (Moraes 2004 CPI -/++)
Social Capital	Residents agreeing there was an in resident social interaction and participation in receiving the than no intervention.	RR 1.14; 95% CI 1 to 1.31; Multicomponent physical plus wider co-interventions	100 participants (De Leon 1986 CPI -/+)

Footnotes

^ Individual outcomes or outcome categories reported in supporting studies but not main studies.

* CIs and P values not shown because study did not account for clustering

** 95% CIs not shown as sample sizes were not reported. Relative risks estimated by authors from disease percentage frequencies provided.

\$ Results not statistically significant, but confidence intervals and P values are not shown as study did not account for clustering.

\$\$ Robustness check. Study authors did not anticipate outcomes to be affected by the intervention and were examined as a robustness check.

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Figures

Figure 1: Logic model to outline slum upgrading interventions.

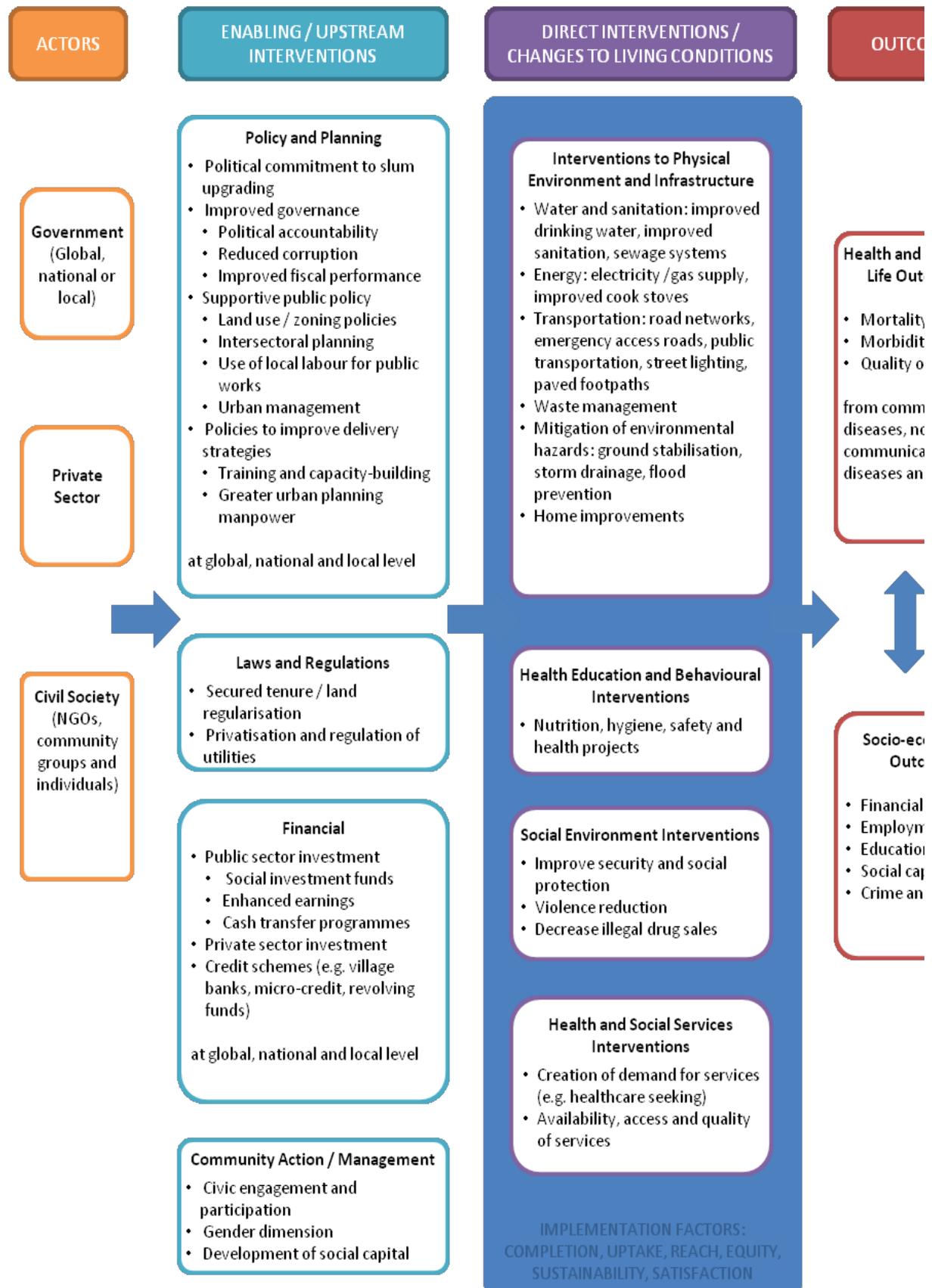


Figure 2: Original literature search.

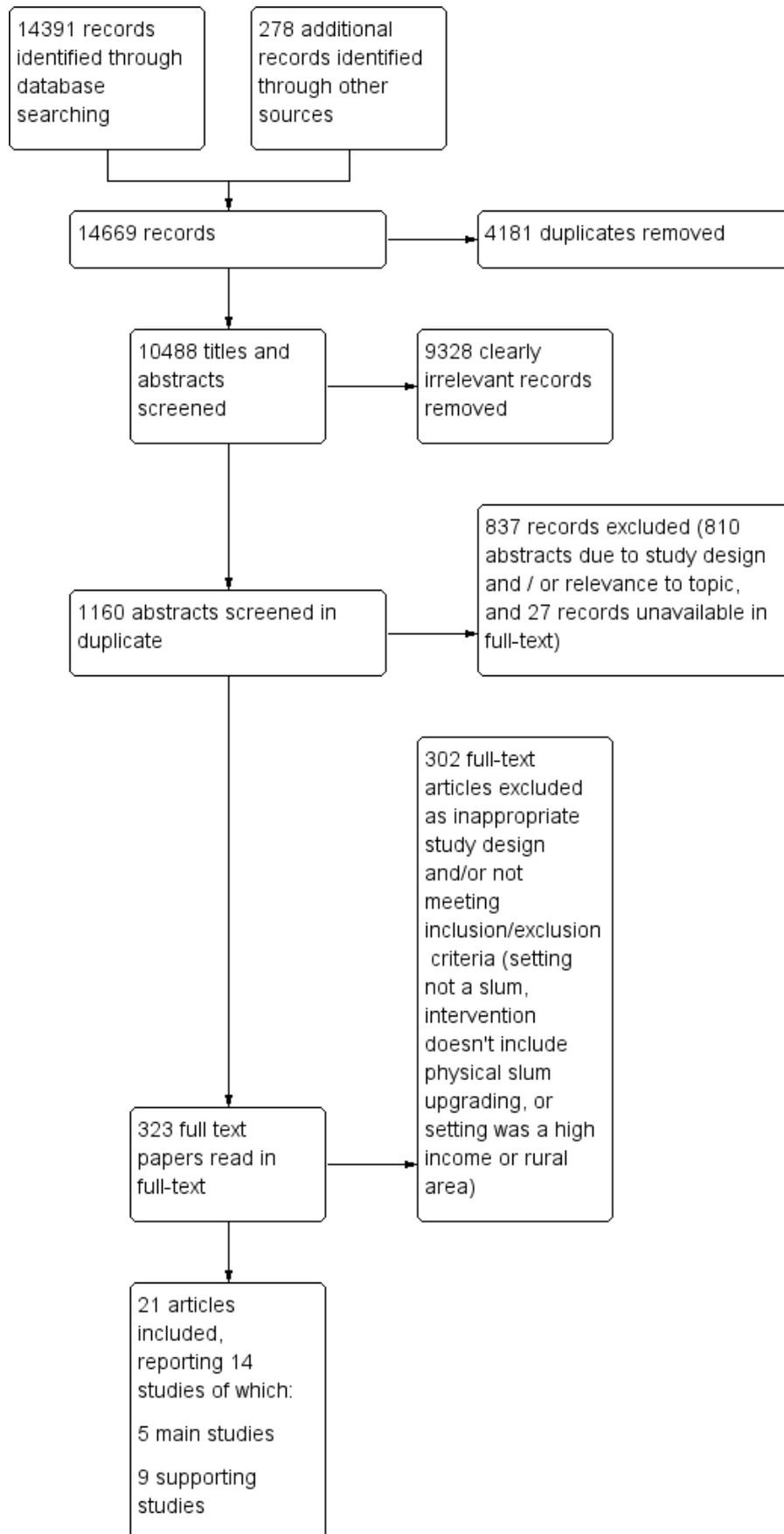


Figure 3: Main studies - overview of intervention components and outcomes.

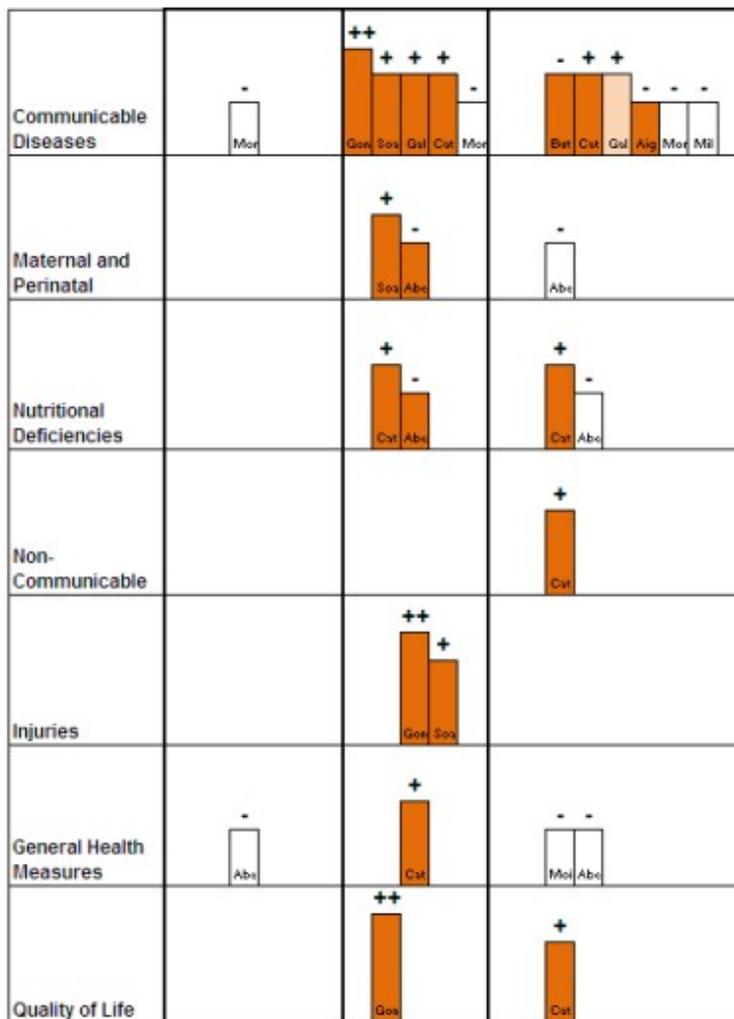
		Galliani 2007	Gonzalez-Navarro 2010	Soares 2005	Butala 2010	Taylor 1987
Enabling Environment	Policy & Planning		G	G		
	Community Participation	P, L		C	P	P
	Legal			T	T	
	Financial			F	M	
Physical Interventions	Water and Sanitation	W		W,S	W,S	W,S
	Improved Housing		SI			SI
	Energy Infrastructure					
	Environmental Hazards			Dr	Dr	
	Waste management					
	Roads and Transportation				R, L	R
Other Interventions	Social Environment					
	Health Education / Behaviour					
	Health /Social Services					
	Social Environment					
Health Outcomes	Communicable Diseases					
	Nutritional Deficiencies					
	Maternal and Perinatal					
	Injuries					
	Non-communicable Diseases					
	General health measures					
	Quality of life					
Socioeconomic Outcomes	Poverty					
	Employment					
	Education					
	Social Capital					
	Crime					

Government-led project
 C = consultation of needs; CM = community management; L = residents provided labour; P = payments made by community
 T = secure tenure
 M = microcredit; F = external funding
 W = water improvements; S = sanitation improvements
 SI = self improvements (by residents)
 Dr = drainage
 R = roads; L = street lighting

Figure 4: Supporting studies - overview of intervention components and outcomes.

		Cattaneo 2009	Aiga 2002	Moraes 2004	Milone 1993	Parikh in-press	Abelson 1996	De Leon 1986	Joshi 1992	Moirtra 1987	
Enabling Environment	Policy & Planning	G	G	G	G	G	G			G	Government-led project
	Community Participation	L	P			P	CM	L, C	P, C, CM	C	C = consultation of needs; CM = community management; L = residents provided labour; P = payments made by
	Legal			T			T	T			T = secure tenure
	Financial		M, F		F	F	M, F	M, F	M, P		M = microcredit; F = external funding
Physical Interventions	Water and Sanitation		W, S	W / W,S	W,S	W,S	W,S		W,S	W,S	W = water improvements; S = sanitation improvements
	Improved Housing					SI	SI		SI	SI	SI = self improvements (by residents)
	Energy Infrastructure					E					
	Environmental Hazards			Dr	Dr	Dr	Dr	Dr	Dr	Dr	Dr = drainage
	Waste management										
	Roads and Transportation		R	R	R	R	R, L		R, L	R, L	R = roads; L = street lighting
Other Interventions	Social Environment										
	Health Education / Behaviour										
	Health /Social Services										
	Social Environment										
Health Outcomes	Communicable Diseases										
	Nutritional Deficiencies										
	Maternal and Perinatal										
	Injuries										
	Non-communicable Diseases										
	General health measures										
	Quality of ife										
Socioeconomic Outcomes	Poverty										
	Employment										
	Education										
	Social Capital										
	Crime										

Figure 5: Harvest plot to show health and QoL findings across main and supporting studies.



Direction of result: Favours control No difference Favours Intervention

KEY

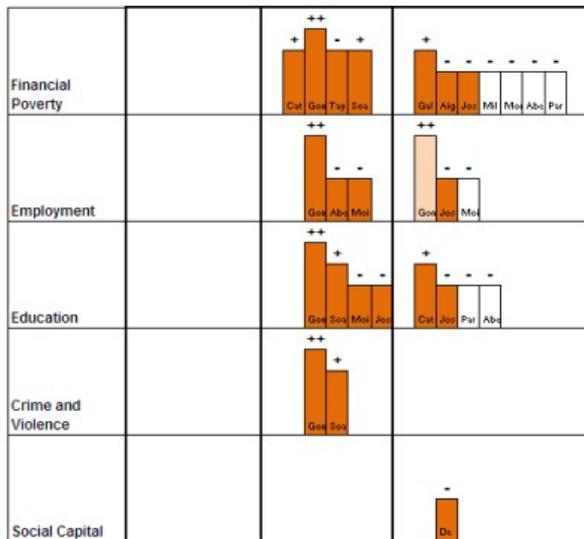
Each bar represents a study, referenced by the first three letters of the first authors' surname. Key study characteristics are represented by the following:

- Shading of bar: statistical confidence in point estimate**
- Evidence of no effect or statistically significant effect at 5 % level
 - Statistically significant effect at 10% level
 - Confidence intervals and p-values not reported /estimable

- Height of bar: appropriateness of study design**
- High bar = design can examine causal effect of intervention (RCT)
 - Mid-height bar = design can infer plausible causality (CBA / CPI with matching)
 - Low bar = design cannot examine causality (UBA / CPI)

- Symbol: Risk of bias of study**
- ++** Low risk of bias
 - +** Mixed / unclear risk of bias
 - High risk of bias

Figure 6: Harvest plot to show socioeconomic findings across main and supporting studies. Note that outcome measures within each broad category varied, and should be considered alongside the narrative synthesis.



Direction of result: Favours control No difference Favours Intervention

KEY

Each bar represents a study, referenced by the first three letters of the first authors' surname. Key study characteristics are represented by the following:

Shading of bar: statistical confidence in point estimate
 Dark orange: Evidence of no effect or statistically significant effect at 5% level
 Light orange: Statistically significant effect at 10% level
 White: Confidence intervals and p-values not reported /estimable

Height of bar: appropriateness of study design
 High bar = design can examine causal effect of intervention (RCT)
 Mid-height bar = design can infer plausible causality (CBA / CPI with matching)
 Low bar = design cannot examine causality (UBA / CPI)

Symbol: Risk of bias of study
 ++ Low risk of bias
 + Mixed / unclear risk of bias
 - High risk of bias

14. Sources of support

Internal sources

- No sources of support provided

External sources

- International Initiative for Impact Evaluation (3ie), UK
3ie have provided grant funding for the design and completion of the review
- Jawaharlal Nehru Institute of Advanced Study, Jawaharlal Nehru University, India
Support was provided during Ruhi Saith's fellowship with the Institute.
- Victorian Health Promotion Foundation (VicHealth), Australia
VicHealth provided funding to support the editorial process for this Cochrane Public Health Group review

15. Feedback Appendices

Adverse health outcomes associated with slum defining characteristics

Characteristic	Physical or Legal	Physical/Legal Outcome	Adverse Health Outcomes
Insecure residential status	Households without: <ul style="list-style-type: none"> formal title deeds to either land or residence enforceable agreements as a proof of tenure 	<ul style="list-style-type: none"> Eviction Exposure to toxic/chemical waste and pollution Low service utilization 	<ul style="list-style-type: none"> Poor access to health care services traffic injuries Acute poisoning, respiratory diseases, cancer Intentional injuries, STDs/HIV, unwanted pregnancy, substance abuse-related diseases
Poor structural quality of housing	Households residing in hazardous sites: <ul style="list-style-type: none"> geologically hazardous (landslide, earthquake/flood areas) industrial pollution unprotected hazards (e.g., dumps, railroads, power lines) Households living in temporary and/or dilapidated structures: <ul style="list-style-type: none"> inferior building materials (cardboard, corrugated tin, mud, low-grade concrete/bricks) substandard construction (e.g., inadequate foundation or support structures, insecure joints/connections) 	<ul style="list-style-type: none"> Land and mud slides Flooding Fire Vertical, multistory housing construction Residence in or near dumps; spontaneous combustion of garbage 	<ul style="list-style-type: none"> Unintentional injuries Leptospirosis, diarrhoeal diseases, cholera, malaria, dengue, hepatitis, drowning Falling injuries Burn injuries
Overcrowding	Households with more than two persons per room or less than five square meters per person	<ul style="list-style-type: none"> Enhanced opportunity for disease transmission 	<ul style="list-style-type: none"> Tuberculosis and other respiratory illnesses, meningitis, scabies, skin infections, bacterial pharyngitis, rheumatic heart disease

Inadequate access to safe water	Less than 50% of households have access to a: <ul style="list-style-type: none"> household connection access to public stand pipe rainwater collection 	<ul style="list-style-type: none"> Contaminated water source Water scarcity 	<ul style="list-style-type: none"> Diarrheal diseases, cholera, typhoid, hepatitis Scabies, bacterial skin infections, acute glomerulonephritis
Inadequate access to sanitation and other infrastructure	Less than 50% of households have improved sanitation: <ul style="list-style-type: none"> public sewer pour-flush latrine ventilated improved pit latrine 	<ul style="list-style-type: none"> Increased rat density Open or broken sewers Suboptimal schools Inadequate/inappropriate health care service 	<ul style="list-style-type: none"> Typhus, leptospirosis, diarrhoeal diseases, cholera, malaria, dengue, hookworm, hepatitis, chronic respiratory diseases, growth retardation Under-utilization of services, maternal health complications, vaccine-preventable diseases, perinatal diseases, rheumatic heart disease, suicide Poor access to health education Drug-resistant infections, poorly controlled hypertension, diabetes, and other chronic illnesses

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Physical and legal characteristics of slums

UN Habitat have devised a working definition of slums in order to monitor progress. This systematic review will adopt these criteria in order to identify studies for inclusion in the review, for studies that do not specify whether the setting(s) receiving the intervention is a slum. The table below examples of each criteria, and is adapted from the 2010 updated chapter 1 of the Global Report on Human Settlements 2003 (UN 2010) and the WHO/UNICEF Joint Monitoring Programme to highlight different degrees of improved/unimproved water and sanitation access in relation to shared and private facilities (WHO/UNICEF JMP).

	Examples of Improved access	Examples of unimproved access
Access to improved water	Improved: piped water into dwelling, plot or yard Other Improved: public tap/standpipe; tube well/borehole; protected dug well; protected spring; and rainwater collection. Bottled water is only considered an improved water source when water from an improved source is used for cooking and personal hygiene)	Unprotected dug well; unprotected spring; cart with small tank/drum; bottled water; tanker-truck; and surface water (river, dam, lake, pond, stream, canal, irrigation channels).
Access to improved sanitation	Flush or pour-flush to piped sewer system, septic tank or pit latrine; ventilated improved pit latrine; pit latrine with slab; and composting toilet. Only facilities that are not shared or not public are considered improved.	Shared sanitation facilities: Sanitation facilities of an otherwise acceptable type shared between two or more households. Unimproved sanitation facilities: flush or pour-flush to elsewhere (e.g. street, yard or plot, open sewer, ditch); pit latrine without slab or open pit; bucket; hanging toilet or hanging latrine; no facilities or bush or field.
Sufficient-living area	No more than three people share the same habitable (minimum of four square meters) room.	More than three people share the same habitable room.
Durability of housing	A house built on a non-hazardous location and has a structure permanent and able to protect its inhabitants from the extremes of climatic conditions, such as rain, heat, cold and humidity.	House built on a hazardous location and/or with a non permanent structure unable to protect inhabitants from extremes of climatic conditions.
Security of tenure	Evidence of documentation that can be used as proof of secure tenure status or when there is either de facto or perceived protection against forced evictions.	No protection against forced evictions.

SCOPUS search strategy

Key

TITLE-ABS-KEY: searches the title, abstract, index keywords and authors keywords

: truncates the word: e.g. favela will retrieve favela or favelas

"...": Searches for the exact phrase, i.e. terms contained within quotation marks will be identified if adjacent to each other in the record.

W/n: Restricts to n words between the two words, in any order. E.g. squatter w/2 settlement will retrieve records with the terms squatter and settlement appearing in any order, with up to two unspecified words between them.

Describing slum settings or populations

#1 (TITLE-ABS-KEY(slum OR slums OR shanty OR shanties OR shantyhouse* OR barrio OR barrios OR favela* OR kampung OR tugurio* OR ghetto OR ghettos OR bidon OR bidons OR bidonville*))

#2 (TITLE-ABS-KEY((informal W/2 shack*) OR (informal W/2 housing) OR (informal W/2 settlement*) OR (irregular W/2 settlement*) OR (illegal W/2 settlement*) OR (informal W/2 tenement*) OR (irregular W/2 tenement*) OR (squatter W/2 settlement*) OR (squatter W/2 area*) OR (illegal W/2 tenement*)))

#3 (TITLE-ABS-KEY("public squalor" OR "public squalor" OR "squalid housing" OR "squalid accommodation" OR "human settlement development" OR "urban poor"))

#4 (TITLE-ABS-KEY("cardboard cit*" OR "tenement district*" OR "tenement hous*" OR "rundown neighborhood*" OR "rundown neighbourhoood*" OR "rundown settlement*"))

#5 (TITLE-ABS-KEY(lahbach OR elendsviertel OR brarek OR foundouks OR tanake OR aashwa* OR truschobi OR taudis OR morro OR loteamento OR comunidade OR ahata OR katra OR watta OR jhopadpatti OR umjondolo OR mabanda OR kijiji OR barraca* OR conventillos))

#6 (TITLE-ABS-KEY("kartonsko naselje" OR "habitat precaire" OR "habitat spontane" OR "quartier irregulier" OR "asentamiento irregular" OR "colonia popular" OR "villa* miseria" OR "ciudad perdida" OR "edina achouaia" OR "mudal safi" OR "pelli gewal"))

#7 (TITLE-ABS-KEY(bustee* OR gecekondu* OR chawls* OR basti OR masseque* OR "squatter cit*" OR "katchi abadi*" OR dharavi OR kibera OR "cite soleil" OR khayelitsha OR "orangi town"))

#8 (TITLE-ABS-KEY("informal shack*" OR "irregular shack*" OR "illegal shack*" OR "shack dweller*" OR "shackdweller*" OR "shack town*" OR "skid row" OR "urban blight" OR squatter camp* OR shack settlement* OR arrabal OR asentamiento* OR campamento* OR cantegril* OR comuna OR comunas OR " Pueblos jóvene*" OR barriada* OR "Poblacion callampa" OR tugurio OR precario OR chacarita OR tent cit* OR informal cit* OR imijondolo OR migrant camp* OR migrant settlement* OR refugee camp* OR refugee settlement*))

#9 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8

Describing interventions

#10 (TITLE-ABS-KEY(improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*))

#11 (TITLE-ABS-KEY("flood protect*" OR "ground stabili*" OR "slope stabili*" OR (mitigat* W/2 landslide) OR (drain* W/2 stormwater*) OR (drain* W/2 surface) OR (drain* W/2 system*) OR (drain* W/2 water*) OR (sewage W/2 collect*) OR (sewage W/2 dispos*) OR (sewage W/2 manag*) OR (sewage W/2 remov*) OR (sewage W/2 service*) OR (sewage W/2 system*) OR (sewage W/2 treatment*) OR (sewer* W/2 collect*) OR (sewer* W/2 dispos*) OR (sewer* W/2 expansion) OR (sewer* W/2 manag*) OR (sewer* W/2 prov*) OR (sewer* W/2 remov*) OR (sewer* W/2 service*) OR (sewer* W/2 suppl*) OR (sewer* W/2 system*) OR (sewer* W/2 treatment*) OR (trash W/2 collect*) OR (trash W/2 dispos*) OR (trash W/2 dispos*) OR (trash W/2 manag*) OR (trash W/2 remov*) OR (trash W/2

service*) OR (waste W/2 scheme*) OR (manag* W/2 stormwater*) OR (manag* W/2 surface water)))

#12 (TITLE-ABS-KEY(electric W/2 cooker*) OR (electric W/2 cookstove*) OR (electric W/2 stove*) OR (electric W/2 stoves) OR (electric* W/2 provid*) OR (electric* W/2 provis*) OR (electric* W/2 suppl*) OR (garbage W/2 service*) OR (gas W/2 cooker*) OR (gas W/2 cookstove*) OR (gas W/2 stove*) OR (gas W/2 stoves) OR (improv* W/2 cooker*) OR (improv* W/2 cookstove*) OR (improv* W/2 stove*) OR (improv* W/2 stoves) OR (lpg W/2 cooker*) OR (lpg W/2 cookstove*) OR (lpg W/2 stove*) OR (lpg W/2 stoves))

#13 (TITLE-ABS-KEY((water W/2 suppl*) OR (water W/2 prov*) OR (water W/2 expansion) OR (water W/2 access) OR (water W/2 service*) OR (sanitation W/2 suppl*) OR (sanitation W/2 prov*) OR (sanitation W/2 expansion) OR (sanitation W/2 access) OR (sanitation W/2 service*) OR (sewerage W/2 suppl*) OR (sewerage W/2 prov*) OR (sewerage W/2 expansion) OR (water W/2 access) OR (sewerage W/2 service*) OR (water W/2 system*) OR (sanitation W/2 system*) OR (sewerage W/2 system*)))

#14 (TITLE-ABS-KEY("rain water collection" OR "piped water" OR "public tap*" OR "tube well*" OR standpipe* OR "protected spring" OR "protected dug well" OR "deliver* water" OR "septic tank*" OR toilet* OR "safe water" OR borewell* OR "bore well*" OR "drinking water"))

#15 (TITLE-ABS-KEY("sewer system*" OR "buil* road*" OR "new road*" OR "road* buil*" OR "access road*" OR "drainage system" OR "underground sewerage" OR "street light*" OR "pave* road*" OR "pave* footpath*" OR "pave* sidewalk" OR pavement* OR (infrastructure W/2 develop*)))

#16 (TITLE-ABS-KEY((waste W/2 collect*) OR (waste W/2 service*) OR (waste W/2 manag*) OR (waste W/2 dispos*) OR (garbage W/2 collect*) OR (disposal W/2 scheme) OR (disposal W/2 service*) OR (garbage W/2 manag*) OR (garbage W/2 dispos*) OR (garbage W/2 collect*) OR (refuse W/2 manag*) OR (refuse W/2 dispos*) OR (refuse W/2 collect*) OR (waste W/2 remov*) OR (refuse W/2 remov*) OR (garbage W/2 remov*)))

#17 (TITLE-ABS-KEY((storm W/2 drain*) OR (environment* W/2 hazard*) OR (mitigat* W/2 hazard*) OR electricity OR gas OR "power supply" OR "energy supply" OR utilities))

#18 (TITLE-ABS-KEY("Housing strateg*" OR "housing polic*" OR "housing project*" OR "housing program*" OR "new* buil*" OR "social housing*" OR "SI project*" OR "urban management" OR manpower OR capacity OR political accountability OR "scal* up" OR home OR homes OR dwelling*))

#19 (TITLE-ABS-KEY((secur* W/2 tenure*) OR (land W/2 titl*) OR (property W/2 titl*) OR (property W/2 rights) OR (land W/2 tenur*) OR (land W/2 rights) OR "development rights"))

#20 (TITLE-ABS-KEY("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*"))

#21 (TITLE-ABS-KEY(kip OR "permanent hous*" OR "formal hous*" OR "hous* building" OR "new hous*"))

#22 (TITLE-ABS-KEY(subsid* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR "social fund*" OR microfinance

OR loan OR loans OR "monetary support" OR "monetary assist*" OR "financ* support" OR "financ* assist*"))

#23 #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22

Search history

Original search (May to July 2011)

ASSIA, AVERY and Sociological abstracts

((KW= (slum or slums OR shanty OR shanties OR shantyhouse* OR favela* OR kampung OR tugurio* OR bidon OR bidons OR bidonville* OR ghetto OR ghettos OR "informal shack*" OR "irregular shack*" OR "illegal shack*" OR "shack dweller*" OR shackdweller OR "shack town*" OR "skid row" OR "urban blight" OR bustee* OR gecekondu* OR chawls* OR basti OR masseque* OR "squatter cit*" OR "katchi abadi*" OR dharavi OR kibera OR cite soleil OR khayelitsha OR "orangi town" OR "kartonsko naselje" OR "habitat precaire" OR "habitat spontane" OR "quartier irregulier" OR "asentamiento irregular" OR "colonia popular" OR "villa miseria" OR "ciudad perdida" OR "edina achouaia" OR "mudal safi" OR "pelli gewal" OR lahbach OR elendsviertel OR brarek OR foundouks OR tanake OR aashwa'i OR truschobi OR taudis OR morro OR loteamento OR comunidade OR ahata OR katra OR watta OR jhopadpatti OR umjondolo OR mabanda OR kijiji OR barraca OR conventillos)) and((KW=(kip or housing or home or homes OR "Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*" OR improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat* OR road* OR drainage OR "street light*" OR sidewalk OR pavement* OR infrastructure OR subsidy OR subsidi* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR microfinance OR loan OR loans OR "storm drain*" OR electricity OR gas OR "power supply" OR "energy supply" OR utilities OR "public tap*" OR "tube well*" OR standpipe* OR "dug well" OR "septic tank*" OR toilet* OR "scal* up" or water OR sanitation OR sewerage)) or(KW=((waste or garbage or refuse) NEAR (collect* or manag* or service* or system* or dispos*))))

BNI

1. poverty areas/
2. urban environment/
3. (slum or slums or shanty or shanties or shantyhouse* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos giovane* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekondu* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.

6. (kartonsko naselje or habitat precaire or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement*).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
14. (kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
15. (improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
16. ((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
19. ((water or sanitation or sewerage) adj2 (suppl* or prov* or expan* or access or service* or system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.

- 23. "Water Quality and Supply"/
- 24. or/12-23
- 25. 11 and 24

CENTRAL

- #1 (poverty) and ("urban population" or "urban health" or urbanization): ti, ab, kw
- #2 "Poverty Areas":ti, ab, kw
- #3 (slum or slums or shanty or shanties or shantyhouse* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*) :ti,ab,kw
- #4 ("informal shack*" or "irregular shack*" or "illegal shack*" or "shack dweller*" or shackdweller or "shack town*" or "skid row" or "urban blight squatter camp*" or "shack settlement*" or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or "Pueblos jovenes*" or barriada* or "Poblacion callampa" or tugurio or precario or chacarita or "tent cit*" or "informal cit*" or imijondolo*) :ti,ab,kw
- #5 (bustee* or gecekondu* or chawls* or basti or masseque* or "squatter cit*" or "katchi abadi*" or dharavi or kibera or "cite soleil" or khayelitsha or "orangi town"):ti,ab,kw
- #6 (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos)
:ti,ab,kw
- #7 ("public squalor" or "public squalor" or "squalid housing" or "squalid accommodation" or "human settlement development" or "urban poor"):ti,ab,kw
- #8 ((informal NEAR/2 shack*) or (informal NEAR/2 settlement*) or (irregular NEAR/2 settlement*) or (illegal NEAR/2 settlement*) or (informal NEAR/2 tenement*) or (irregular NEAR/2 tenement*) or (squatter NEAR/2 settlement*) or (squatter NEAR/2 area*) or (illegal NEAR/2 tenement*)):ti,ab,kw
- #9 ("kartonsko naselje" or "habitat precare" or "habitat spontane" or "quartier irregulier" or "asentamiento irregular" or "colonia popular" or "villa miseria" or "ciudad perdida" or "edina achouaia" or "mudal safi" or "pelli gewal") :ti,ab,kw
- #10 ("cardboard cit*" or "tenement district*" or "tenement hous*" or "rundown neighborhood*" or "rundown neighbourhood*" or "rundown settlement*") :ti,ab,kw
- #11 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10)
- #12 ((secur* or land or propert) NEAR/2 (tenur* or rights or titl*)):ti,ab,kw
- #13 ("Communit* involv*" or "participatory model*" or "participat* communit*" or "communit* manag*" or "communit* organi*" or "communit* group*"):ti,ab,kw
- #14 (kip or "permanent hous*" or "formal hous*" or "hous* building" or "new hous*"):ti,ab,kw
- #15 (improv* or upgrad* or transform* or retransform* or redevelop* or renewal or

rehabilit* or regenerat*):ti,ab,kw

#16 ((waste or garbage or refuse) NEAR/2 (collect* OR service* OR "manag* dispos*" OR scheme* or remov*)):ti,ab,kw

#17 ("sewer system*" or "buil* road*" or "new road*" or "road* buil*" or "access road*" or "drainage system" or "underground sewerage" or "street light*" or "pave* road*" or "pave* footpath*" or "pave* sidewalk" or pavement* or (infrastructure NEAR/2 develop*)):ti,ab,kw

18 ("rain water collection" or "piped water" or "public tap*" or "tube well*" or standpipe* or "protected spring" or "dug well" or "deliver* water" or "septic tank*" or toilet* or "safe water" or borewell* or "bore well*" or "drinking water"):ti,ab,kw

#19 ((water or sanitation or sewerage) NEAR/2 (suppl* OR prov* or expan* OR access or service* OR system\$1)):ti,ab,kw

#20 (subsid* or investment* or partnership* or microcredit or credit or "village bank*" or microcredit* or mortgage* or "social fund*" or microfinance or loan or loans or "monetary support" or "monetary assis*" or "financ* support" or "financ* assist*"):ti,ab,kw

#21 ((storm NEAR/2 drain*) or (environment* NEAR/2 hazard*) or (mitigat* NEAR/2 hazard*) or electricity or gas or "power supply" or "energy supply" or utilities):ti,ab,kw

#22 ("Housing strateg*" or "housing polic*" or "housing project*" or "housing program*" or "new* buil*" or "social housing*" or "SI project*" or "urban management" or manpower or capacity or "political accountability" or "scal* up" or home or homes or dwelling*):ti,ab,kw

#23 ("water purification") or ("water supply") or ("urban renewal") or ("waste management") or ("urban renewal") or ("consumer participation"):ti,ab,kw

#24 (#12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23)

#25 (#11 AND #24)

CINAHL and Greenfile S14 S12 and S13

S13 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 S12 S9 or S10 or S11

S11 TX (slum or slums)

S10 TX (shanty OR shanties OR shantyhouse* OR favela* OR kampung)

S9 TX ("informal settlement*" or "illegal settlement*" or "squatter settlement*") S8 TX (kip or housing or home or homes)

S7 TX ("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*")

S6 TX (improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*) S5 TX (road* OR drainage OR "street light*" OR sidewalk OR pavement* OR infrastructure)

S4 TX (subsidy OR subsidi* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR microfinance OR loan OR loans)

S3 TX ("storm drain*" OR electricity OR gas OR "power supply" OR "energy supply" OR utilities) S2 TX((waste or garbage or refuse) AND (collect* or manag* or service* or system* or dispos*))

S1 TX ("public tap*" OR "tube well*" OR standpipe* OR "dug well" OR "septic tank*" OR toilet* OR "scal* up" or water OR sanitation OR sewerage)

Current Controlled Trials Search Results

(slum OR slums OR kampung* OR informal settlement OR urban poor OR squatter)

Ei compendex

(((((slum OR slums OR kampung* OR favela* OR bidon* OR tugurio* OR {informal settlement*} OR {illegal settlement*} OR

{squatter settlement*} OR {shack settlement*} OR {shack dwell*})) WN KY) AND (1884-2011 WN YR)) AND (((((kip OR housing OR home OR homes OR {Communit* involv*} OR {participatory model*} OR {participat* communit*} OR {communit* manag*} OR {communit* organi*} OR {communit* group*} OR improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat* OR road* OR drainage OR {street light*} OR sidewalk OR pavement* OR infrastructure OR subsidy OR subsidi* OR investment* OR partnership* OR microcredit OR credit OR {village bank*} OR microcredit* OR mortgage* OR microfinance OR loan OR loans OR {storm drain*} OR electricity OR gas OR {power supply} OR {energy supply} OR utilities OR {public tap*} OR {tube well*} OR standpipe* OR {dug well} OR {septic tank*} OR toilet* OR {scal* up} OR water OR sanitation OR sewerage)) WN KY) AND (1884-2011 WN YR)) OR ((((waste OR garbage OR refuse) AND (collect* OR manag* OR service* OR system* OR dispos*)) WN ALL) AND (1884-2011 WN YR)))

ELDIS

Slum*, Barrio, Kampung*, Favela

EMBASE

1. (poverty/ or lowest income group/) and (urban population/ or urban area/ or urbanization/)
2. urban slum/
3. (slum or slums or shanty or shanties or shantyhouse* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovene* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekondu* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precare or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or

taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.

8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhoood* or rundown settlement* or immigrant camp\$1 or immigrant settlement\$ or migrant camp\$1 or migrant settlement\$ or refugee camp\$1 or refugee settlement\$1).ti,ab.

9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.

10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.

11. or/1-10

12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.

13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.

14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.

15. (improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.

16.((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.

17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.

18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.

19.((water or sanitation or sewerage) adj2 (suppl* or prov* or expan* or access or service* or system\$1)).ti,ab.

20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.

21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.

22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.

23. water supply/ or sanitation/ 24. or/12-23

24.11 and 24

Georef

1. urban environment/ and developing countries/
2. slum.ti,ab.
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovenes* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekondus* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precare or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement*).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
- 14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
- 15.(improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
- 16.((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.

19. ((water or sanitation or sewerage) adj2 (suppl* or prov* or expan* or access or service* or system\$1)).ti,ab.

20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.

21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.

22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.

23. waste disposal/ or water supply/ or drinking water/ 24. or/12-23

25. 11 and 24

Global Health Library

Across all sources:

(slum or slums or urban poor or informal settlement* or kampung* or squatter settlement* OR refugee camp*) AND (water OR sanitation OR improv* OR upgrad* OR develop* OR infrastructure* OR tenure* OR invest*)

HMIC

1. poverty/ and (urban areas/ or urban expansion/ or urban health/)

2. poverty/ and (urban areas/ or urban expansion/ or urban health/)

3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.

4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos Jovenes* or barrada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.

5. (bustee* or gecekondus* or chawls* or basti or masseques* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.

6. (kartonsko naselje or habitat precario or habitat spontaneo or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.

7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.

8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement*).ti,ab.

9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.

10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
- 14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
- 15.(improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
- 16.((waste or garbage or refuse) adj2 (collect* or service*OR manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
- 19.((water or sanitation or sewerage) adj2 (suppl*OR prov* or expan*OR access or service*OR system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.
23. Water supply distribution systems/ or exp Water supply/ or exp Water supply services/ or exp Surface water drainage/ or exp Waste water drainage/ or sanitation/ or urban renewal/ or urban regeneration/
24. or/12-23
25. 11 and 24

ICONDA

1. slum.de.
2. informal settlements.de.
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.

4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovenes* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekondur* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precare or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement*).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
- 14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
- 15.(improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
16. ((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
- 19.((water or sanitation or sewerage) adj2 (suppl*OR prov* or expan* or access or service* or system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.

21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up).ti,ab.
23. (upgrading or upgrading program or upgrading slums).de. 24. or/12-23
25. 11 and 24

IDEAS

(slum | slums | favela | kampung) (upgrading | improving | redevelop | transform | water | sanitation).

IndMed

(slums) or (slum) or (kampung) or (barrio) or (kampungs)

Medcarib

(slum or slums or urban poor or informal settlement* or kampung* or squatter settlement* or barrio)

MEDLINE and MEDLINE in Process

1. poverty/ and (urban population/ or urban health/ or urbanization/)
2. Poverty Areas/
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovene* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekond* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precaire or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement* or immigrant camp\$1 or immigrant settlement\$ or migrant camp\$1 or migrant settlement\$ or refugee camp\$1 or refugee settlement\$1).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.

10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
- 14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
- 15.(improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
- 16.((waste or garbage or refuse) adj2 (collect*OR service*OR manag* dispos*OR scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
- 19.((water or sanitation or sewerage) adj2 (suppl* OR prov* or expan*OR access or service*OR system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.
23. water purification/ or water supply/ or urban renewal/ or waste management/ or urban renewal/ or consumer participation/ 24. or/12-23
25. 11 and 24

PsycINFO

1. poverty/ and urban environment/
2. Poverty Areas/
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento*or campamento* or cantegril* or comuna or comunas or Pueblos jovene* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.

5. (bustee* or gecekondu* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precaire or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement*).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
- 14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
- 15.(improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
- 16.((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
19. ((water or sanitation or sewerage) adj2 (suppl*OR prov* or expan* or access or service* or system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.

22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.

23. water safety/ or housing/ or waste disposal/ or water quality/ or drinking water/ or housing.mp. or water safety/ [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]

24. or/12-23

25. 11 and 24

Planex

slum OR slums OR favela* OR Kampung* OR "informal settlement*"

REPIDISCA

(slum or slums or "urban poor" or "informal settlement*" or kampung* or "squatter settlement*" or barrio) AND (water OR sanitation OR improv* OR upgrad* OR develop* OR infrastructure* OR tenure* OR investment)

SCOPUS

((TITLE-ABS-KEY((secur* W/2 tenure*) OR (land W/2 titl*) OR (property W/2 titl*) OR (property W/2 rights) OR (land W/2 tenur*) OR (land W/2 rights) OR "development rights")) OR (TITLE-ABS-KEY("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*")) OR (TITLE-ABS-KEY(kip OR "permanent hous*" OR "formal hous*" OR "hous* building" OR "new hous*")) OR (TITLE-ABS-KEY(improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*)) OR (TITLE-ABS-KEY((waste W/2 collect*) OR (waste W/2 service*) OR (waste W/2 manag*) OR (waste W/2 dispos*) OR (garbage W/2 collect*) OR (disposal W/2 scheme) OR (disposal W/2 service*) OR (garbage W/2 manag*) OR (garbage W/2 dispos*) OR (garbage W/2 collect*) OR (refuse W/2 manag*) OR (refuse W/2 dispos*) OR (refuse W/2 collect*) OR (waste W/2 remov*) OR (refuse W/2 remov*) OR (garbage W/2 remov*))) OR (TITLE-ABS-KEY("sewer system*" OR "buil* road*" OR "new road*" OR "road* buil*" OR "access road*" OR "drainage system" OR "underground sewerage" OR "street light*" OR "pave* road*" OR "pave* footpath*" OR "pave* sidewalk" OR pavement* OR (infrastructure W/2 develop*))) OR (TITLE-ABS-KEY("rain water collection" OR "piped water" OR "public tap*" OR "tube well*" OR standpipe* OR "protected spring" OR "protected dug well" OR "deliver* water" OR "septic tank*" OR toilet* OR "safe water" OR borewell* OR "bore well*" OR "drinking water")) OR (TITLE-ABS-KEY((water W/2 suppl*) OR (water W/2 prov*) OR (water W/2 expansion) OR (water W/2 access) OR (water W/2 service*) OR (sanitation W/2 suppl*) OR (sanitation W/2 prov*) OR (sanitation W/2 expansion) OR (sanitation W/2 access) OR (sanitation W/2 service*) OR (sewerage W/2 suppl*) OR (sewerage W/2 prov*) OR (sewerage W/2 expansion) OR (water W/2 access) OR (sewerage W/2 service*) OR (water W/2 system*) OR (sanitation W/2 system*) OR (sewerage W/2 system*))) OR (TITLE-ABS-KEY(subsid* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR "social fund*" OR microfinance OR loan OR loans OR "monetary support" OR "monetary assis*" OR "financ* support" OR "financ* assist")) OR (TITLE-ABS-KEY((storm W/2 drain*) OR (environment* W/2 hazard*) OR (mitigat* W/2

hazard*) OR electricity OR gas OR "power supply" OR "energy supply" OR utilities)) OR (TITLE-ABS-KEY("Housing strateg*" OR "housing polic*" OR "housing project*" OR "housing program*" OR "new* buil*" OR "social housing*" OR "SI project*" OR "urban management" OR manpower OR capacity OR political accountability OR "scal* up" OR home OR homes OR dwelling*)) AND ((TITLE-ABS-KEY(slum OR slums OR shanty OR shanties OR shantyhouse* OR barrio OR barrios OR favela* OR kampung OR tugurio* OR ghetto OR ghettos OR bidon OR bidons OR bidonville*)) OR (TITLE-ABS-KEY("informal shack*" OR "irregular shack*" OR "illegal shack*" OR "shack dweller*" OR "shackdweller*" OR "shack town*" OR "skid row" OR "urban blight" OR squatter camp* OR shack settlement*or arrabal OR asentamiento*or campamento* OR cantegril* OR comuna OR comunas OR " Pueblos jóvene*" OR barriada* OR "Poblacion callampa" OR tugurio OR precario OR chacarita OR tent cit*or informal cit*or imijondolo*)) OR (TITLE-ABS-KEY(bustee* OR gecekondu* OR chawls* OR basti OR masseque* OR "squatter cit*" OR "katchi abadi*" OR dharavi OR kibera OR "cite soleil" OR khayelitsha OR "orangi town")) OR (TITLE-ABS-KEY("kartonsko naselje" OR "habitat precaire" OR "habitat spontane" OR "quartier irregulier" OR "asentamiento irregular" OR "colonia popular" OR "villa* miseria" OR "ciudad perdida" OR "edina achouaia" OR "mudal safi" OR "pelli gewal")) OR (TITLE-ABS-KEY(lahbach OR elendsviertel OR brarek OR foundouks OR tanake OR aashwa* OR truschobi OR taudis OR morro OR loteamento OR comunidade OR ahata OR katra OR watta OR jhopadpatti OR umjondolo OR mabanda OR kijiji OR barraca* OR conventillos)) OR (TITLE-ABS-KEY("cardboard cit*" OR "tenement district*" OR "tenement hous*" OR "rundown neighborhood*" OR "rundown neighbourhood*" OR "rundown settlement*")) OR (TITLE-ABS-KEY("public squalor" OR "public squalor" OR "squalid housing" OR "squalid accommodation" OR "human settlement development" OR "urban poor")) OR (TITLE-ABS-KEY((informal W/2 shack*) OR (informal W/2 settlement*) OR (irregular W/2 settlement*) OR (illegal W/2 settlement*) OR (informal W/2 tenement*) OR (irregular W/2 tenement*) OR (squatter W/2 settlement*) OR (squatter W/2 area*) OR (illegal W/2 tenement*))))

Web of Science (SSCI and SCI)

6 #5 OR #4

5 #3 AND #1

4 #3 AND #2

3 TS=((informal OR illegal OR informal) SAME (settlement*)) OR TS=(slum OR slums OR shanty OR shanties OR shantyhouse* OR barrio OR barrios OR favela* OR kampung)

2 TS=(road* OR drainage OR "street light*" OR sidewalk OR pavement* OR infrastructure) OR TS=(improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*) OR TS=("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*") OR TS=((informal OR illegal OR informal) SAME (settlement*))

1 TS=(kip or housing or home* OR "public tap*" OR "tube well*" OR standpipe* OR "dug well" OR "septic tank*" OR toilet* OR "scal* up") OR TS=(water OR sanitation OR sewerage) OR TS=(waste or garbage or refuse) OR TS=("storm drain*" OR electricity OR gas OR "power supply" OR "energy supply" OR utilities) OR TS=(subsid* OR investment* OR partnership* OR microcredit OR credit OR village bank* OR microcredit* OR mortgage* OR social fund* OR microfinance OR loan OR loans)

Databases=SCI-EXPANDED, SSCI Timespan=1955-2011

3ie impact database

The following individual terms were searched: slum, slums, urban poor, informal settlement, informal settlements, kampung, squatter, barrio, favela.

Update searches - April 2012

ASSIA, AVERY, BNI and Sociological

abstracts (via Proquest)

S14 s13 and s12

S13 S9 or s10 or s11

S12 S1 or S2 or S3 or S4 or s5 or s6 or s7 or s8

S11 ALL(slum or slums)

S10 ALL(shanty OR shanties OR shantyhouse* OR favela* OR kampung)

S9 ALL("informal settlement*" or "illegal settlement*" or "squatter settlement*") S8
ALL(kip or housing or home or homes)

S7 ALL("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*")

S6 ALL(improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*) S5 ALL(road* OR drainage OR "street light*" OR sidewalk OR pavement* OR infrastructure)

S4 ALL(subsidy OR subsidi* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR microfinance OR loan OR loans)

S3 ALL("storm drain*" OR electricity OR gas OR "power supply" OR "energy supply" OR utilities) S2 ALL((waste or garbage or refuse) AND (collect* or manag* or service* or system* or dispos*))

S1 ALL("public tap*" OR "tube well*" OR standpipe* OR "dug well" OR "septic tank*" OR toilet* OR "scal* up" or water OR sanitation OR sewerage)

CENTRAL

#1 (poverty) and ("urban population" or "urban health" or urbanization):ti,ab,kw

#2 "Poverty Areas":ti,ab,kw

#3 (slum or slums or shanty or shanties or shantyhouse* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*) :ti,ab,kw

#4 ("informal shack*" or "irregular shack*" or "illegal shack*" or "shack dweller*" or shackdweller or "shack town*" or "skid row" or "urban blight squatter camp*" or "shack settlement*" or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or "Pueblos giovane*" or barriada* or "Poblacion callampa" or tugurio or precario or chacarita or "tent cit*" or "informal cit*" or imijondolo*) :ti,ab,kw

#5 (bustee* or gecekondur* or chawls* or basti or massequ* or "squatter cit*" or "katchi abadi*" or dharavi or kibera or "cite soleil" or khayelitsha or "orangi town"):ti,ab,kw

#6 (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos)

:ti,ab,kw

#7 ("public squalor" or "public squalor" or "squalid housing" or "squalid accommodation" or "human settlement development" or "urban poor"):ti,ab,kw

#8 ((informal NEAR/2 shack*) or (informal NEAR/2 settlement*) or (irregular NEAR/2 settlement*) or (illegal NEAR/2 settlement*) or (informal NEAR/2 tenement*) or (irregular NEAR/2 tenement*) or (squatter NEAR/2 settlement*) or (squatter NEAR/2 area*) or (illegal NEAR/2 tenement*)):ti,ab,kw

#9 ("kartonsko naselje" or "habitat precaire" or "habitat spontane" or "quartier irregulier" or "asentamiento irregular" or "colonia popular" or "villa miseria" or "ciudad perdida" or "edina achouaia" or "mudal safi" or "pelli gewal") :ti,ab,kw

#10 ("cardboard cit*" or "tenement district*" or "tenement hous*" or "rundown neighborhood*" or "rundown neighbourhood*" or "rundown settlement*") :ti,ab,kw

#11 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10)

#12 ((secur* or land or propert) NEAR/2 (tenur* or rights or titl*)):ti,ab,kw

#13 ("Communit* involv*" or "participatory model*" or "participat* communit*" or "communit* manag*" or "communit* organi*" or "communit* group*"):ti,ab,kw

#14 (kip or "permanent hous*" or "formal hous*" or "hous* building" or "new hous*"):ti,ab,kw

#15 (improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*):ti,ab,kw

#16 ((waste or garbage or refuse) NEAR/2 (collect* OR service* OR "manag* dispos*" OR scheme* or remov*)):ti,ab,kw

#17 ("sewer system*" or "buil* road*" or "new road*" or "road* buil*" or "access road*" or "drainage system" or "underground sewerage" or "street light*" or "pave* road*" or "pave* footpath*" or "pave* sidewalk" or pavement* or (infrastructure NEAR/2 develop*)):ti,ab,kw

18 ("rain water collection" or "piped water" or "public tap*" or "tube well*" or standpipe* or "protected spring" or "dug well" or "deliver* water" or "septic tank*" or toilet* or "safe water" or borewell* or "bore well*" or "drinking water"):ti,ab,kw

#19 ((water or sanitation or sewerage) NEAR/2 (suppl* OR prov* or expan* OR access or service* OR system\$1)):ti,ab,kw

#20 (subsid* or investment* or partnership* or microcredit or credit or "village bank*" or microcredit* or mortgage* or "social fund*" or microfinance or loan or loans or "monetary support" or "monetary assis*" or "financ* support" or "financ* assist*"):ti,ab,kw

#21 ((storm NEAR/2 drain*) or (environment* NEAR/2 hazard*) or (mitigat* NEAR/2 hazard*) or electricity or gas or "power supply" or "energy supply" or utilities):ti,ab,kw

#22 ("Housing strateg*" or "housing polic*" or "housing project*" or "housing program*" or "new* buil*" or "social housing*" or "SI project*" or "urban management" or manpower or capacity or "political accountability" or "scal* up" or home or homes or dwelling*):ti,ab,kw

#23 ("water purification") or ("water supply") or ("urban renewal") or ("waste management") or ("urban renewal") or ("consumer participation"):ti,ab,kw

#24 (#12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23)

#25 (#11 AND #24)

CINAHL (via EBSCOhost)

S14 S12 and S13

S13 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 S12 S9 or S10 or S11

S11 TI (slum or slums) OR SU (slum or slums) OR AB (slum or slums) OR KW (slum or slums)

S10 TI ((shanty OR shanties OR shantyhouse* OR favela* OR kampung)) OR AB ((shanty OR shanties OR shantyhouse* OR favela* OR kampung)) OR MW ((shanty OR shanties OR shantyhouse* OR favela* OR kampung))

S9 TI (("informal settlement*" or "illegal settlement*" or "squatter settlement*")) OR AB (("informal settlement*" or "illegal settlement*" or "squatter settlement*")) OR MW (("informal settlement*" or "illegal settlement*" or "squatter settlement*"))

S8 TX (kip or housing or home or homes)

S7 TX ("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*")

S6 TX (improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*) S5 TX (road* OR drainage OR "street light*" OR sidewalk OR pavement* OR infrastructure)

S4 TX (subsidy OR subsidi* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR microfinance OR loan OR loans)

S3 TX ("storm drain*" OR electricity OR gas OR "power supply" OR "energy supply" OR utilities) S2 TX((waste or garbage or refuse) AND (collect* or manag* or service* or system* or dispos*))

S1 TX ("public tap*" OR "tube well*" OR standpipe* OR "dug well" OR "septic tank*" OR toilet* OR "scal* up" or water OR sanitation OR sewerage)

Cochrane Public Health Specialised Register

Searched titles and abstracts with the following keywords: slum, slums, squatters, barrio, barrios, favela, favelas, shanty **Current Controlled Trials Search Results**

(slum OR slums OR kampung* OR informal settlement OR urban poor OR squatter)

Ei compendex

(((((slum OR slums OR kampung* OR favela* OR bidon* OR tugurio* OR {informal settlement*} OR {illegal settlement*} OR

{squatter settlement*} OR {shack settlement*} OR {shack dwell*})) WN KY) AND (1884-2011 WN YR)) AND (((((kip OR housing OR home OR homes OR {Communit* involv*} OR {participatory model*} OR {participat* communit*} OR {communit* manag*} OR {communit* organi*} OR {communit* group*} OR improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat* OR road* OR drainage OR {street light*} OR sidewalk OR pavement* OR infrastructure OR subsidy OR subsidi* OR investment* OR partnership* OR microcredit OR credit OR {village bank*} OR microcredit* OR mortgage* OR microfinance OR loan OR loans OR {storm drain*} OR electricity OR gas OR {power supply} OR {energy supply} OR utilities OR {public tap*} OR {tube well*} OR standpipe* OR {dug well} OR {septic tank*} OR toilet* OR {scal* up} OR water OR sanitation OR sewerage)) WN KY) AND (1884-2011 WN YR)) OR ((((waste OR garbage OR refuse) AND (collect* OR manag* OR service* OR system* OR dispos*)) WN ALL) AND (1884-2011 WN YR)))

ELDIS

Slum*, Barrio, Kampung*, Favela

EMBASE

1. (poverty/ or lowest income group/) and (urban population/ or urban area/ or urbanization/)
2. urban slum/
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos joven* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekond* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precare or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement* or immigrant camp\$1 or immigrant settlement\$ or migrant camp\$1 or migrant settlement\$ or refugee camp\$1 or refugee settlement\$1).ti,ab.

9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
- 14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
- 15.(improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
- 16.((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
- 19.((water or sanitation or sewerage) adj2 (suppl* or prov* or expan* or access or service* or system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.
- 23.water supply/ or sanitation/
24. ((electric adj2 cooker*) or (electric adj2 cookstove*) or (electric adj2 stove*) or (electric adj2 stoves) or (electric* adj2 provid*) or (electric* adj2 provis*) or (electric* adj2 suppl*) or (garbage adj2 service*) or (gas adj2 cooker*) or (gas adj2 cookstove*) or (gas adj2 stove*) or (gas adj2 stoves) or (improv* adj2 cooker*) or (improv* adj2 cookstove*) or (improv* adj2 stove*) or (improv* adj2 stoves) or (lpg adj2 cooker*) or (lpg adj2 cookstove*) or (lpg adj2 stove*) or (lpg adj2 stoves)).ti,ab.
25. (floor or floors or flooring or flood protect* or ground stabili* or slope stabili* or (mitigat* adj2 landslide) or (drain* adj2 stormwater*) or (drain* adj2 surface) or (drain*

adj2 system*) or (drain* adj2 water*) or (sewage adj2 collect*) or (sewage adj2 dispos*) or (sewage adj2 manag*) or (sewage adj2 remov*) or (sewage adj2 service*) or (sewage adj2 system*) or (sewage adj2 treatment*) or (sewer* adj2 collect*) or (sewer* adj2 dispos*) or (sewer* adj2 expansion) or (sewer* adj2 manag*) or (sewer* adj2 prov*) or (sewer* adj2 remov*) or (sewer* adj2 service*) or (sewer* adj2 suppl*) or (sewer* adj2 system*) or (sewer* adj2 treatment*) or (trash adj2 collect*) or (trash adj2 dispos*) or (trash adj2 dispos*) or (trash adj2 manag*) or (trash adj2 remov*) or (trash adj2 service*) or (waste adj2 scheme*) or (manag* adj2 stormwater*) or (manag* adj2 surface water)).ti,ab.

26. or/12-25

27. 11 and 26

Georef

No access for update search

Global Health Library

Across all sources:

(slum or slums or urban poor or informal settlement* or kampung* or squatter settlement* OR refugee camp*) AND (water OR sanitation OR improv* OR upgrad* OR develop* OR infrastructure* OR tenure* OR invest*)

Greenfile (via EBSCOhost)

S14 S12 and S13

S13 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 S12 S9 or S10 or S11

S11 TI (slum or slums) OR SU (slum or slums) OR AB (slum or slums) OR KW (slum or slums) S10 TX (shanty OR shanties OR shantyhouse* OR favela* OR kampung)

S9 TX ("informal settlement*" or "illegal settlement*" or "squatter settlement*") S8 TX (kip or housing or home or homes)

S7 TX ("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*")

S6 TX (improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*) S5 TX (road* OR drainage OR "street light*" OR sidewalk OR pavement* OR infrastructure)

S4 TX (subsidy OR subsidi* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR microfinance OR loan OR loans)

S3 TX ("storm drain*" OR electricity OR gas OR "power supply" OR "energy supply" OR utilities) S2 TX((waste or garbage or refuse) AND (collect* or manag* or service* or system* or dispos*))

S1 TX ("public tap*" OR "tube well*" OR standpipe* OR "dug well" OR "septic tank*" OR toilet* OR "scal* up" or water OR sanitation OR sewerage)

HMIC

1. poverty/ and (urban areas/ or urban expansion/ or urban health/)
2. poverty/ and (urban areas/ or urban expansion/ or urban health/)
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovene* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekond* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precaire or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement* or immigrant camp\$1 or immigrant settlement\$ or migrant camp\$1 or migrant settlement\$ or refugee camp\$1 or refugee settlement\$1).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
14. (kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
15. (improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
16. ((waste or garbage or refuse) adj2 (collect* or service* OR manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.

18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
- 19.((water or sanitation or sewerage) adj2 (suppl* or prov* or expan* or access or service* or system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.
23. Water supply distribution systems/ or exp Water supply/ or exp Water supply services/ or exp Surface water drainage/ or exp Waste water drainage/ or sanitation/ or urban renewal/ or urban regeneration/
24. (floor or floors or flooring or flood protect* or ground stabili* or slope stabili* or (mitigat* adj2 landslide) or (drain* adj2 stormwater*) or (drain* adj2 surface) or (drain* adj2 system*) or (drain* adj2 water*) or (sewage adj2 collect*) or (sewage adj2 dispos*) or (sewage adj2 manag*) or (sewage adj2 remov*) or (sewage adj2 service*) or (sewage adj2 system*) or (sewage adj2 treatment*) or (sewer* adj2 collect*) or (sewer* adj2 dispos*) or (sewer* adj2 expansion) or (sewer* adj2 manag*) or (sewer* adj2 prov*) or (sewer* adj2 remov*) or (sewer* adj2 service*) or (sewer* adj2 suppl*) or (sewer* adj2 system*) or (sewer* adj2 treatment*) or (trash adj2 collect*) or (trash adj2 dispos*) or (trash adj2 dispos*) or (trash adj2 manag*) or (trash adj2 remov*) or (trash adj2 service*) or (waste adj2 scheme*) or (manag* adj2 stormwater*) or (manag* adj2 surface water)).ti,ab.
25. ((electric adj2 cooker*) or (electric adj2 cookstove*) or (electric adj2 stove*) or (electric adj2 stoves) or (electric* adj2 provid*) or (electric* adj2 provis*) or (electric* adj2 suppl*) or (garbage adj2 service*) or (gas adj2 cooker*) or (gas adj2 cookstove*) or (gas adj2 stove*) or (gas adj2 stoves) or (improv* adj2 cooker*) or (improv* adj2 cookstove*) or (improv* adj2 stove*) or (improv* adj2 stoves) or (lpg adj2 cooker*) or (lpg adj2 cookstove*) or (lpg adj2 stove*) or (lpg adj2 stoves)).ti,ab.

26. or/12-25

27. 11 and 26

ICONDA

1. slum.de.

2. informal settlements.de.

3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.

4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovenes* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekondur* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precario or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement* or immigrant camp\$1 or immigrant settlement\$ or migrant camp\$1 or migrant settlement\$ or refugee camp\$1 or refugee settlement\$1).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
14. (kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
15. (improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
16. ((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
19. ((water or sanitation or sewerage) adj2 (suppl*OR prov* or expan* or access or service* or system\$1)).ti,ab.

20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assist* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up).ti,ab.
- 23.(upgrading or upgrading program or upgrading slums).de.
24. (floor or floors or flooring or flood protect* or ground stabili* or slope stabili* or (mitigat* adj2 landslide) or (drain* adj2 stormwater*) or (drain* adj2 surface) or (drain* adj2 system*) or (drain* adj2 water*) or (sewage adj2 collect*) or (sewage adj2 dispos*) or (sewage adj2 manag*) or (sewage adj2 remov*) or (sewage adj2 service*) or (sewage adj2 system*) or (sewage adj2 treatment*) or (sewer* adj2 collect*) or (sewer* adj2 dispos*) or (sewer* adj2 expansion) or (sewer* adj2 manag*) or (sewer* adj2 prov*) or (sewer* adj2 remov*) or (sewer* adj2 service*) or (sewer* adj2 suppl*) or (sewer* adj2 system*) or (sewer* adj2 treatment*) or (trash adj2 collect*) or (trash adj2 dispos*) or (trash adj2 dispos*) or (trash adj2 manag*) or (trash adj2 remov*) or (trash adj2 service*) or (waste adj2 scheme*) or (manag* adj2 stormwater*) or (manag* adj2 surface water)).ti,ab.
25. ((electric adj2 cooker*) or (electric adj2 cookstove*) or (electric adj2 stove*) or (electric adj2 stoves) or (electric* adj2 provid*) or (electric* adj2 provis*) or (electric* adj2 suppl*) or (garbage adj2 service*) or (gas adj2 cooker*) or (gas adj2 cookstove*) or (gas adj2 stove*) or (gas adj2 stoves) or (improv* adj2 cooker*) or (improv* adj2 cookstove*) or (improv* adj2 stove*) or (improv* adj2 stoves) or (lpg adj2 cooker*) or (lpg adj2 cookstove*) or (lpg adj2 stove*) or (lpg adj2 stoves)).ti,ab.
26. or/12-25
27. 26 and 11

IDEAS

(slum | slums | favela | kampung) (upgrading | improving | redevelop | transform | water | sanitation).

IndMed

(slums) or (slum) or (kampung) or (barrio) or (kampung)

Jolis

Keywords anywhere "slum or slums or kampung\$ or favela\$" AND Keywords anywhere "upgrad\$ or improv\$"

Medcarib

(slum or slums or urban poor or informal settlement* or kampung* or squatter settlement* or barrio)

MEDLINE and MEDLINE in Process

1. poverty/ and (urban population/ or urban health/ or urbanization/)
2. Poverty Areas/
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.
4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovene* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekondur* or chawls* or basti or massequ* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precare or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement* or immigrant camp\$1 or immigrant settlement\$ or migrant camp\$1 or migrant settlement\$ or refugee camp\$1 or refugee settlement\$1).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
- 14.(kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
- 15.(improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
- 16.((waste or garbage or refuse) adj2 (collect*OR service*OR manag* dispos*OR scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.

18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
- 19.((water or sanitation or sewerage) adj2 (suppl* or prov* or expan* or access or service* or system\$1)).ti,ab.
20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assis* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling* or floor or floors or flooring).ti,ab.
- 23.water purification/ or water supply/ or urban renewal/ or waste management/ or urban renewal/ or consumer participation/
24. (flood protect* or ground stabili* or slope stabili* or (mitigat* adj2 landslide) or (drain* adj2 stormwater*) or (drain* adj2 surface) or (drain* adj2 system*) or (drain* adj2 water*) or (sewage adj2 collect*) or (sewage adj2 dispos*) or (sewage adj2 manag*) or (sewage adj2 remov*) or (sewage adj2 service*) or (sewage adj2 system*) or (sewage adj2 treatment*) or (sewer* adj2 collect*) or (sewer* adj2 dispos*) or (sewer* adj2 expansion) or (sewer* adj2 manag*) or (sewer* adj2 prov*) or (sewer* adj2 remov*) or (sewer* adj2 service*) or (sewer* adj2 suppl*) or (sewer* adj2 system*) or (sewer* adj2 treatment*) or (trash adj2 collect*) or (trash adj2 dispos*) or (trash adj2 dispos*) or (trash adj2 manag*) or (trash adj2 remov*) or (trash adj2 service*) or (waste adj2 scheme*) or (manag* adj2 stormwater*) or (manag* adj2 surface water)).ti,ab.
25. ((electric adj2 cooker*) or (electric adj2 cookstove*) or (electric adj2 stove*) or (electric adj2 stoves) or (electric* adj2 provid*) or (electric* adj2 provis*) or (electric* adj2 suppl*) or (garbage adj2 service*) or (gas adj2 cooker*) or (gas adj2 cookstove*) or (gas adj2 stove*) or (gas adj2 stoves) or (improv* adj2 cooker*) or (improv* adj2 cookstove*) or (improv* adj2 stove*) or (improv* adj2 stoves) or (lpg adj2 cooker*) or (lpg adj2 cookstove*) or (lpg adj2 stove*) or (lpg adj2 stoves)).ti,ab.

26. or/12-25

27. 11 and 26

PsycINFO

1. poverty/ and urban environment/
2. Poverty Areas/
3. (slum or slums or shanty or shanties or shantyhous* or barrio or barrios or favela* or kampung or tugurio* or ghetto or ghettos or bidon or bidons or bidonville*).ti,ab.

4. (informal shack* or irregular shack* or illegal shack* or shack dweller* or shackdweller or shack town* or skid row or urban blight squatter camp* or shack settlement* or arrabal or asentamiento* or campamento* or cantegril* or comuna or comunas or Pueblos jovenes* or barriada* or Poblacion callampa or tugurio or precario or chacarita or tent cit* or informal cit* or imijondolo*).ti,ab.
5. (bustee* or gecekondur* or chawls* or basti or masseque* or squatter cit* or katchi abadi* or dharavi or kibera or cite soleil or khayelitsha or orange town).ti,ab.
6. (kartonsko naselje or habitat precario or habitat spontane or quartier irregulier or asentamiento irregular or colonia popular or villa miseria or ciudad perdida or edina achouaia or mudal safi or pelli gewal).ti,ab.
7. (lahbach or elendsviertel or brarek or foundouks or tanake or aashwa or truschobi or taudis or morro or loteamento or comunidade or ahata or katra or watta or jhopadpatti or umjondolo or mabanda or kijiji or barraca or conventillos).ti,ab.
8. (cardboard cit* or tenement district* or tenement hous* or rundown neighborhood* or rundown neighbourhood* or rundown settlement* or immigrant camp\$1 or immigrant settlement\$ or migrant camp\$1 or migrant settlement\$ or refugee camp\$1 or refugee settlement\$1).ti,ab.
9. (public squalor or public squalor or squalid housing or squalid accommodation or human settlement development or urban poor).ti,ab.
10. ((informal adj2 shack*) or (informal adj2 settlement*) or (irregular adj2 settlement*) or (illegal adj2 settlement*) or (informal adj2 tenement*) or (irregular adj2 tenement*) or (squatter adj2 settlement*) or (squatter adj2 area*) or (illegal adj2 tenement*)).ti,ab.
11. or/1-10
12. ((secur* or land or propert) adj2 (tenur* or rights or titl*)).ti,ab.
13. (Communit* involv* or participatory model* or participat* communit* or communit* manag* or communit* organi* or communit* group*).ti,ab.
14. (kip or permanent hous* or formal hous* or hous* building or new hous*).ti,ab.
15. (improv* or upgrad* or transform* or retransform* or redevelop* or renewal or rehabilit* or regenerat*).ti,ab.
16. ((waste or garbage or refuse) adj2 (collect* or service* or manag* dispos* or scheme* or remov*)).ti,ab.
17. (sewer system* or buil* road* or new road* or road* buil* or access road* or drainage system or underground sewerage or street light* or pave* road* or pave* footpath* or pave* sidewalk or pavement* or (infrastructure adj2 develop*)).ti,ab.
18. (rain water collection or piped water or public tap* or tube well* or standpipe* or protected spring or dug well or deliver* water or septic tank* or toilet* or safe water or borewell* or bore well* or drinking water).ti,ab.
19. ((water or sanitation or sewerage) adj2 (suppl*OR prov* or expan* or access or service* or system\$1)).ti,ab.

20. (subsid* or investment* or partnership* or microcredit or credit or village bank* or microcredit* or mortgage* or social fund* or microfinance or loan or loans or monetary support or monetary assist* or financ* support or financ* assist*).ti,ab.
21. ((storm adj2 drain*) or (environment* adj2 hazard*) or (mitigat* adj2 hazard*) or electricity or gas or power supply or energy supply or utilities).ti,ab.
22. (Housing strateg* or housing polic* or housing project* or housing program* or new* buil* or social housing* or SI project* or urban management or manpower or capacity or political accountability or scal* up or home or homes or dwelling*).ti,ab.
23. water safety/ or housing/ or waste disposal/ or water quality/ or drinking water/ or housing.mp. or water safety/ [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
24. ((electric adj2 cooker*) or (electric adj2 cookstove*) or (electric adj2 stove*) or (electric adj2 stoves) or (electric* adj2 provid*) or (electric* adj2 provis*) or (electric* adj2 suppl*) or (garbage adj2 service*) or (gas adj2 cooker*) or (gas adj2 cookstove*) or (gas adj2 stove*) or (gas adj2 stoves) or (improv* adj2 cooker*) or (improv* adj2 cookstove*) or (improv* adj2 stove*) or (improv* adj2 stoves) or (lpg adj2 cooker*) or (lpg adj2 cookstove*) or (lpg adj2 stove*) or (lpg adj2 stoves)).ti,ab.
25. (floor or floors or flooring or flood protect* or ground stabili* or slope stabili* or (mitigat* adj2 landslide) or (drain* adj2 stormwater*) or (drain* adj2 surface) or (drain* adj2 system*) or (drain* adj2 water*) or (sewage adj2 collect*) or (sewage adj2 dispos*) or (sewage adj2 manag*) or (sewage adj2 remov*) or (sewage adj2 service*) or (sewage adj2 system*) or (sewage adj2 treatment*) or (sewer* adj2 collect*) or (sewer* adj2 dispos*) or (sewer* adj2 expansion) or (sewer* adj2 manag*) or (sewer* adj2 prov*) or (sewer* adj2 remov*) or (sewer* adj2 service*) or (sewer* adj2 suppl*) or (sewer* adj2 system*) or (sewer* adj2 treatment*) or (trash adj2 collect*) or (trash adj2 dispos*) or (trash adj2 dispos*) or (trash adj2 manag*) or (trash adj2 remov*) or (trash adj2 service*) or (waste adj2 scheme*) or (manag* adj2 stormwater*) or (manag* adj2 surface water)).ti,ab.
26. or/12-25
27. 11 and 26

Planex

slum OR slums OR favela* OR Kampung* OR "informal settlement*"

SCOPUS

#1 (TITLE-ABS-KEY(slum OR slums OR shanty OR shanties OR shantyhous* OR barrio OR barrios OR favela* OR kampung OR tugurio* OR ghetto OR ghettos OR bidon OR bidons OR bidonville*))

#2 (TITLE-ABS-KEY((informal W/2 shack*) OR (informal W/2 housing) OR (informal W/2 settlement*) OR (irregular W/2 settlement*) OR (illegal W/2 settlement*) OR (informal W/2 tenement*) OR (irregular W/2 tenement*) OR (squatter W/2 settlement*) OR (squatter W/2 area*) OR (illegal W/2 tenement*)))

#3 (TITLE-ABS-KEY("public squalor" OR "public squalor" OR "squalid housing" OR "squalid accommodation" OR "human settlement development" OR "urban poor"))

- #4 (TITLE-ABS-KEY("cardboard cit*" OR "tenement district*" OR "tenement hous*" OR "rundown neighborhood*" OR "rundown neighbourhood*" OR "rundown settlement*"))
- #5 (TITLE-ABS-KEY(lahbach OR elendsviertel OR brarek OR foundouks OR tanake OR aashwa* OR truschobi OR taudis OR morro OR loteamento OR comunidade OR ahata OR katra OR watta OR jhopadpatti OR umjondolo OR mabanda OR kijiji OR barraca* OR conventillos))
- #6 (TITLE-ABS-KEY("kartonsko naselje" OR "habitat precaire" OR "habitat spontane" OR "quartier irregulier" OR "asentamiento irregular" OR "colonia popular" OR "villa* miseria" OR "ciudad perdida" OR "edina achouaia" OR "mudal safi" OR "pelli gewal"))
- #7 (TITLE-ABS-KEY(bustee* OR gecekondu* OR chawls* OR basti OR masseque* OR "squatter cit*" OR "katchi abadi*" OR dharavi OR kibera OR "cite soleil" OR khayelitsha OR "orangi town"))
- #8 (TITLE-ABS-KEY("informal shack*" OR "irregular shack*" OR "illegal shack*" OR "shack dweller*" OR "shackdweller*" OR "shack town*" OR "skid row" OR "urban blight" OR squatter camp* OR shack settlement* OR arrabal OR asentamiento* OR campamento* OR cantegril* OR comuna OR comunas OR " Pueblos jóvene*" OR barriada* OR "Poblacion callampa" OR tugurio OR precario OR chacarita OR tent cit* OR informal cit* OR imijondolo OR migrant camp* OR migrant settlement* OR refugee camp* OR refugee settlement*))
- #9 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8
- #10 (TITLE-ABS-KEY(improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*))
- #11 (TITLE-ABS-KEY("flood protect*" OR "ground stabili*" OR "slope stabili*" OR (mitigat* W/2 landslide) OR (drain* W/2 stormwater*) OR (drain* W/2 surface) OR (drain* W/2 system*) OR (drain* W/2 water*) OR (sewage W/2 collect*) OR (sewage W/2 dispos*) OR (sewage W/2 manag*) OR (sewage W/2 remov*) OR (sewage W/2 service*) OR (sewage W/2 system*) OR (sewage W/2 treatment*) OR (sewer* W/2 collect*) OR (sewer* W/2 dispos*) OR (sewer* W/2 expansion) OR (sewer* W/2 manag*) OR (sewer* W/2 prov*) OR (sewer* W/2 remov*) OR (sewer* W/2 service*) OR (sewer* W/2 suppl*) OR (sewer* W/2 system*) OR (sewer* W/2 treatment*) OR (trash W/2 collect*) OR (trash W/2 dispos*) OR (trash W/2 dispos*) OR (trash W/2 manag*) OR (trash W/2 remov*) OR (trash W/2 service*) OR (waste W/2 scheme*) OR (manag* W/2 stormwater*) OR (manag* W/2 surface water)))
- #12 (TITLE-ABS-KEY(electric W/2 cooker*) OR (electric W/2 cookstove*) OR (electric W/2 stove*) OR (electric W/2 stoves) OR (electric* W/2 provid*) OR (electric* W/2 provis*) OR (electric* W/2 suppl*) OR (garbage W/2 service*) OR (gas W/2 cooker*) OR (gas W/2 cookstove*) OR (gas W/2 stove*) OR (gas W/2 stoves) OR (improv* W/2 cooker*) OR (improv* W/2 cookstove*) OR (improv* W/2 stove*) OR (improv* W/2 stoves) OR (lpg W/2 cooker*) OR (lpg W/2 cookstove*) OR (lpg W/2 stove*) OR (lpg W/2 stoves))
- #13 (TITLE-ABS-KEY((water W/2 suppl*) OR (water W/2 prov*) OR (water W/2 expansion) OR (water W/2 access) OR (water W/2 service*) OR (sanitation W/2 suppl*) OR (sanitation W/2 prov*) OR (sanitation W/2 expansion) OR (sanitation W/2 access) OR (sanitation W/2 service*) OR (sewerage W/2 suppl*) OR (sewerage W/2 prov*) OR (sewerage W/2 expansion) OR (water W/2 access) OR (sewerage W/2 service*) OR (water W/2 system*) OR (sanitation W/2 system*) OR (sewerage W/2 system*)))

#14 (TITLE-ABS-KEY("rain water collection" OR "piped water" OR "public tap*" OR "tube well*" OR standpipe* OR "protected spring" OR "protected dug well" OR "deliver* water" OR "septic tank*" OR toilet* OR "safe water" OR borewell* OR "bore well*" OR "drinking water"))

#15 (TITLE-ABS-KEY("sewer system*" OR "buil* road*" OR "new road*" OR "road* buil*" OR "access road*" OR "drainage system" OR "underground sewerage" OR "street light*" OR "pave* road*" OR "pave* footpath*" OR "pave* sidewalk" OR pavement* OR (infrastructure W/2 develop*)))

#16 (TITLE-ABS-KEY((waste W/2 collect*) OR (waste W/2 service*) OR (waste W/2 manag*) OR (waste W/2 dispos*) OR (garbage W/2 collect*) OR (disposal W/2 scheme) OR (disposal W/2 service*) OR (garbage W/2 manag*) OR (garbage W/2 dispos*) OR (garbage W/2 collect*) OR (refuse W/2 manag*) OR (refuse W/2 dispos*) OR (refuse W/2 collect*) OR (waste W/2 remov*) OR (refuse W/2 remov*) OR (garbage W/2 remov*)))

#17 (TITLE-ABS-KEY((storm W/2 drain*) OR (environment* W/2 hazard*) OR (mitigat* W/2 hazard*) OR electricity OR gas OR "power supply" OR "energy supply" OR utilities))

#18 (TITLE-ABS-KEY("Housing strateg*" OR "housing polic*" OR "housing project*" OR "housing program*" OR "new* buil*" OR "social housing*" OR "SI project*" OR "urban management" OR manpower OR capacity OR political accountability OR "scal* up" OR home OR homes OR dwelling*))

#19 (TITLE-ABS-KEY((secur* W/2 tenure*) OR (land W/2 titl*) OR (property W/2 titl*) OR (property W/2 rights) OR (land W/2 tenur*) OR (land W/2 rights) OR "development rights"))

#20 (TITLE-ABS-KEY("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*"))

#21 (TITLE-ABS-KEY(kip OR "permanent hous*" OR "formal hous*" OR "hous* building" OR "new hous*"))

#22 (TITLE-ABS-KEY(subsid* OR investment* OR partnership* OR microcredit OR credit OR "village bank*" OR microcredit* OR mortgage* OR "social fund*" OR microfinance OR loan OR loans OR "monetary support" OR "monetary assis*" OR "financ* support" OR "financ* assist"))

#23 #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22

REPIDISCA

(slum or slums or "urban poor" or "informal settlement*" or kampung* or "squatter settlement*" or barrio) AND (water OR sanitation OR improv* OR upgrad* OR develop* OR infrastructure* OR tenure* OR investment)

Web of Science (SSCI and SCI)

6 #5 OR #4

5 #3 AND #1

4 #3 AND #2

3 TS=((informal OR illegal OR informal) SAME (settlement*)) OR TS=(slum OR slums OR shanty OR shanties OR shantyhouse* OR barrio OR barrios OR favela* OR kampung)

2 TS=(road* OR drainage OR "street light*" OR sidewalk OR pavement* OR infrastructure) OR TS=(improv* OR upgrad* OR transform* OR retransform* OR redevelop* OR renewal OR rehabilit* OR regenerat*) OR TS=("Communit* involv*" OR "participatory model*" OR "participat* communit*" OR "communit* manag*" OR "communit* organi*" OR "communit* group*") OR TS=((informal OR illegal OR informal) SAME (settlement*))

1 TS=(kip or housing or home* OR "public tap*" OR "tube well*" OR standpipe* OR "dug well" OR "septic tank*" OR toilet* OR "scal* up") OR TS=(water OR sanitation OR sewerage) OR TS=(waste or garbage or refuse) OR TS=("storm drain*" OR electricity OR gas OR "power supply" OR "energy supply" OR utilities) OR TS=(subsid* OR investment* OR partnership* OR microcredit OR credit OR village bank* OR microcredit* OR mortgage* OR social fund* OR microfinance OR loan OR loans)

3ie impact database

The following individual terms were searched: slum, slums, urban poor, informal settlement, informal settlements, kampung, squatter, barrio, favela. In addition, database records were browsed.

5 Glossary

CBA	Controlled Before and After Study
CI	Confidence Interval
CIDG	Campbell International Developing Group
CMO	Community Management Organisation
CPI	Controlled post intervention only study
DiD	Difference in difference analysis
EPOC	Effective Practice and Organisation of Care
GATE	Graphical Appraisal Tool for Epidemiological
IADB	Inter-American Development Bank
ISD	Integrated Slum Development
KIP	Kampung Improvement Programme
LMIC	Low and Middle Income Countries
NGO	Non-Governmental Organisation
NICE	National Institute for Health and Clinical Excellence
QoL	Quality of Life
PSM	Propensity Score matching
RCT	Randomised Controlled Trial
RR	Relative risk
Rs	Rupees
Rps	Rupiahs

SNP	Slum Networking Programme
STUD	Small Towns Urban Development Project
UBA	Uncontrolled before and after study
WHO	World Health Organization
ZIP	Zonal Improvement Programme

Graphs

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