

*Submission of PhD by published work:*

**Developing best available evidence to inform healthy public policy**

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*Developing best available evidence to inform healthy public policy*

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Author's declaration (*not included in e-thesis version*)

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- I: *Permissions from co-authors and stated contributions to included papers (not included in e-thesis version)*
- II: *Journal permissions for reproduction of papers in thesis*
- III: *Definitions of key terms*

## **Acknowledgements**

I would like to thank Professor Sally Macintyre and all the members of the MRC SPHSU for the many ways in which they have supported me and the work included in this thesis. In particular I would like to thank Professor Mark Petticrew who has acted as a mentor to me over the past decade. I have been profoundly influenced by Mark's reflexivity and avoidance of dogma in the pursuit and use of evidence to improve the value of public policy and investment. I hope that some of this is reflected in this thesis and in my own ongoing work.

## **ABSTRACT/OUTLINE**

### **Background & rationale**

Healthy public policy refers to the use of policies beyond the health services which have the potential to improve health, typically by improving determinants of health, for example socio-economic conditions such as employment, income, housing etc.. While improvements to living conditions have long been viewed as an important mechanism to promote public health, the concept of healthy public policy was formally described more recently in the World Health Organisation's (WHO) Ottawa Charter in 1986.

The rationale for healthy public policy rests heavily on a wealth of cross-sectional data reporting links between socio-economic factors and health. Many of these relationships are well established, providing strong empirical support for hypotheses that intervening to improve socio-economic conditions will lead to improved health. However, hypotheses around health benefits need to be validated: There are many examples of well-intended interventions which did not produce the expected benefits, and in some cases had adverse effects. Compared to many clinical interventions, social interventions are characteristically difficult to control, and likely to be more susceptible to the effect of confounding and mediating factors. These issues increase the level of uncertainty inherent in hypotheses about the impacts of social interventions, in particular health impacts which are influenced by many factors, and further underlines the need for empirical validation.

Evidence from empirical research evaluating the health impacts of social interventions needs to be used to inform and refine future policy if the potential for public policy to contribute to health improvement is to be realised. Both reviews of previous research evidence as well as the pursuit of new evidence can be used to develop the evidence base. Previous evidence needs to be reviewed rigorously and comprehensively to minimise the potential for selective interpretations which may be subject to bias; this is best done using transparent systematic review methods. New evaluations are required to provide up-to-date evidence as well as to improve the quality of evidence and plug gaps in the evidence

which systematic reviews are well placed to identify. Having synthesised previous evidence and generated newly relevant evidence, it is crucial that the available evidence is made available to those in policy and practice who are most likely to use the evidence. It is necessary that the evidence is disseminated beyond academic audiences and translate the evidence or knowledge to provide syntheses of evidence which are accessible to and tailored to the needs of potential evidence-users.

The use of systematic reviews, evaluations of health impacts, and knowledge transfer work has existed for many years within both the health and social policy field. However, the application of these approaches to the field of healthy public policy and the health impacts of social interventions is relatively novel. Application of conventional methods to this new area has required adapting and developing existing methods appropriately.

### **The proposed submission**

The portfolio of publications selected for this submission represents a selection of the applicant's publications since 2001. Hilary Thomson is the lead author on each of these publications which were prepared from work carried out with the Evaluation programme (original title Evaluation of the health impacts of non-health sector interventions) of research based at the Medical Research Council's Social & Public Health Sciences Unit, Glasgow. This programme was funded by the Chief Scientist's Office of the Scottish Government in 1999 to provide evidence on the health impacts of social interventions, and thus to inform the development of healthy public policy.

This thesis presents 10 peer reviewed international publications in this field; nine of these are from high impact public health journals, and one is an example of knowledge transfer that was commissioned by the WHO. The work is presented in three key themes each of key relevance to the development of best available evidence for healthy public policy.

*Theme I: Systematic review*

Three publications are presented in this theme, each of these reports the key findings of a systematic review. **Paper I** reports the findings of a systematic review of the health impacts of housing improvement; **Paper III** reports the findings of a similar review which has been substantially updated, both methodologically and in content. **Paper II** presents the findings of a systematic review of the health and socio-economic impacts of urban regeneration investment in the UK since 1980.

*Theme II: Evaluation & generation of new evidence*

Four publications are presented in this theme. **Paper IV** and **Paper V** report the empirical findings of studies investigating the health impacts of local community leisure facilities, and a local programme of housing-led neighbourhood regeneration respectively. **Paper VI** and **Paper VII** present a commentary and reflection based on the author's experience in the field on how to develop best available evidence to inform healthy public policy. These papers focus on assessing the health impacts of income supplementation interventions, such as welfare benefits, and housing and regeneration investment, however, the emerging lessons and issues have a relevance to the wider field of healthy public policy.

*Theme III: Knowledge transfer*

Three publications are presented in this theme. Each of these illustrates how my work has gone beyond reviewing and generating evidence for an academic audience, by providing accessible evidence syntheses which are accessible to and tailored to the needs of policy makers and practitioners who wish to use evidence in their work. **Paper VIII** and **Paper IX** were commissioned by the Scottish Health Impact Assessment Network and report how I developed evidence syntheses on housing improvement and transport policy. **Paper X** presents an evidence synthesis on housing and health commissioned by the WHO for use by European policymakers.

## **Preface**

I joined the MRC Social & Public Health Sciences Unit in November 1999 as a research associate on the newly created programme entitled 'Evaluating the health effects of social interventions' (from now on this will be referred to as the Evaluation programme). This programme, funded by the Chief Scientist Office of the then Scottish Executive (now Scottish Government), was set up to conduct primary and secondary research assessing the health impacts of non-health sector interventions and was led by Dr Mark Petticrew. In 2004 I was promoted to the post of research scientist within this programme. Prior to joining the Evaluation programme I had completed a Bachelor of Nursing Degree and a Masters in Public Health and I had worked for three years in primary care research.

Since my original appointment I have developed an active research interest within the field of housing and urban regeneration and I have led much of the programme's work on this topic. I have carried out systematic reviews of existing research, developed evaluations to assess the health impacts of housing and neighbourhood change, as well as working closely with policy makers and practitioners to produce appropriate translations of the research. This body of work has been developed with the overarching aim to provide policy relevant evidence to help promote the pursuit of health outcomes through non-health sector policies, i.e. to promote the development of healthy public policy.

The ten papers which I am submitting for the degree of PhD by published works are listed below; these are grouped into three key themes relevant to the development of evidence to develop healthy public policy. In the explanatory essay I provide a brief background to the field, a summary of each paper and what the paper has contributed to the field both in terms of substantive knowledge and methodological development. This collection of ten papers has been selected from a larger body of my published work. For each of these papers I am the lead author and guarantor, preparing the first and subsequent drafts of the papers in light of co-author and referees' comments. I led on developing the original research idea, developing the methods being used, refining the research question, and performing the analysis being reported within the paper (see Appendix for co-author signatures confirming this).

## List of submitted publications

### Theme I: Systematic Review

- Paper I** Thomson H, Petticrew M, Morrison D. Health effects of housing improvement: systematic review of intervention studies. *BMJ* 2001;323(7306):187-190.
- Paper II** Thomson H, Atkinson R, Petticrew M, Kearns A. Do urban regeneration programmes improve public health and reduce health inequalities? A synthesis of the evidence from UK policy and practice (1980-2004). *Journal of Epidemiology & Community Health* 2006; 60 (2):108-115.
- Paper III** Thomson H, Thomas S, Sellstrom E, Petticrew M. The health impacts of housing improvement: a systematic review of intervention studies from 1887 to 2007. *American Journal of Public Health* 2009;99(S3):S681-S692.

### Theme II: Evaluation & generation of new evidence

- Paper IV** Thomson H, Kearns A, Petticrew M. Assessing the health impact of local amenities: a qualitative study of contrasting experiences of local swimming pool and leisure provision in two areas of Glasgow. *Journal of Epidemiology & Community Health* 2003;57(9):663-667.
- Paper V** Thomson H, Morrison D, Petticrew M. The health impacts of housing-led regeneration: a prospective controlled study. *Journal of Epidemiology & Community Health* 2007;61(3):211-214.
- Paper VI** Thomson H, Hoskins R, Petticrew M, Ogilvie D, Craig N, Quinn T, Lindsay G. Evaluating the health effects of social interventions. *BMJ* 2004; 328 (7434):282-285.
- Paper VII** Thomson H. A dose of realism for healthy urban policy: lessons from area-based initiatives in the UK. *Journal of Epidemiology & Community Health* 2008; 62 (10):932-936.

### Theme III: Knowledge Transfer

- Paper VIII** Thomson H, Petticrew M, Douglas M. Health Impact Assessment of housing improvements: incorporating research evidence. *Journal of Epidemiology & Community Health* 2003;57:11-16.
- Paper IX** Thomson H, Petticrew M. Is housing improvement a potential health improvement strategy? (commissioned report for European policy makers) ([http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214\\_2](http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214_2)). WHO Health Evidence Network. Copenhagen, 2005.
- Paper X** Thomson H, Jepson R, Hurley F, Douglas M. Assessing the unintended health impacts of road transport policies and interventions: translating research evidence for use in policy and practice. *BMC Public Health* 2008; 8 (339): (<http://www.biomedcentral.com/1471-2458/8/339>).



## **Explanatory essay**

### ***Healthy public policy and its underlying rationale***

Individual factors such as sex, genetic inheritance, and lifestyle choices are key determinants of health.<sup>1</sup> However, socio-economic factors, such as income, housing, education, and transport, are now acknowledged to be of at least similar importance to individual biological and behavioural factors in determining health, and may also be important determinants of health behaviours.<sup>2 3</sup> The place of socio-economic factors in determining health has important implications for the promotion of health, and addressing poor health at a population level. While health service provision is important for health, in particular to treat illness, it is beyond the scope of health services to tackle the wider socio-economic determinants of health. These wider determinants of health are themselves largely determined at a higher level through public policies, both national and international. It follows that there is considerable potential for population health to be influenced, for better or worse, by public policies beyond health policies, and that policy development and delivery could be exploited to contribute to a public health strategy:<sup>4</sup> This is what is often referred to as healthy public policy.

### ***Development of healthy public policy***

The concept of healthy public policy is at the heart of the World Health Organisation's Ottawa Charter of 1986<sup>5</sup> and has been defined as policies which improve living conditions; its adequacy measured by consequent health impacts.<sup>6</sup> This concept has been adopted in many countries to shape a public health approach which uses public policy as leverage for health improvement by tackling the socio-economic roots of poor health and health inequalities,<sup>7-13</sup> as opposed to focussing solely on disease prevention and health behaviours. Initiatives such as the WHO's Healthy Cities network,<sup>14</sup> development of Health Impact Assessment (HIA),<sup>15</sup> and policy strategies to reduce health inequalities,<sup>7 11 12</sup> illustrate some national and international attempts to implement the concept of healthy public policy and integrate health into public policy following the publication of the Ottawa Charter.

### ***Healthy public policy in the UK***

In the UK there is now established political interest in using public policy as a health improvement strategy. The move within the UK government to exploit overlapping policy interests was an important part of the newly elected Labour government's approach to policy making. This new 'joined-up' approach was required to strategically consider the various synergies across apparently unrelated policy areas, not only in relation to health interests. This shift reflected a change in the policy making climate both in the UK <sup>8</sup> and elsewhere. {Perri 6 , 1999 #1560} Developments in public health thinking over the previous decade, partly initiated by the Ottawa Charter, made healthy public policy an area ripe for a move from concept to the more tangible area of policy development.

In 1997 the newly elected Labour administration commissioned an Independent Inquiry into Health Inequalities (hereafter referred to as the Acheson Report). <sup>17</sup> The remit for the Acheson inquiry was to collate evidence on health inequalities and life expectancy and identify priority areas where government policy may be used "*to develop beneficial, cost effective and affordable interventions to reduce health inequalities*". <sup>17</sup> The Acheson report made specific recommendations covering a wide range of policy areas including welfare, education, employment, transport, and housing. In addition, Acheson recommended that "*all policies likely to have a direct or indirect effect on health should be evaluated in terms of their impact on health inequalities*". <sup>17</sup>

Links between social policies and health now appear as an acknowledged component in UK and Scottish government strategy to improve health and reduce health inequalities. <sup>7</sup> <sup>18</sup> For example, in 2001, HM Treasury undertook a number of major spending reviews; one of these was specifically set up to look at how local and central government policy may be used to reduce health inequalities. <sup>7</sup> In addition to recommending behavioural and therapeutic interventions to reduce individual level cardiac risk factors, the report highlighted the need for housing improvements which tackle cold and damp conditions, and provision of safe neighbourhoods where residents can benefit from good public services, including transport and health services.

### *Evidence to inform healthy public policy*

The shift towards joined-up policy making was accompanied by an increased interest in empirical support for policy effectiveness and ‘what works’. In February 2000, the then UK Secretary of State David Blunkett MP delivered a speech to the ESRC (Economic & Social Research Council, UK) about the place of social science research in government. In it he emphasised the need for research evidence to support policymaking, concluding: “*We need to be able to rely on social science and social scientists to tell us what works and why and what types of policy initiatives are likely to be most effective*”.<sup>19</sup>

There is an important distinction between evidence of policy effectiveness, which relates to evidence of the direct and intended effects of a policy, and evidence for healthy public policy, which relates to evidence of secondary health impacts which may or may not have been an intended effect of a policy or investment. This has inevitable implications for the availability of evidence on health impacts; assessment of primary impacts likely to be of greater priority in terms of monitoring and evaluation activity for accountability purposes. Other issues related to assessing secondary health impacts as opposed to primary impacts include uncertainty around the timescale, nature and size of a possible health impact. It may be that both primary socio-economic impacts and later secondary health impacts should be used to indicate the potential for long-term health improvement through public policy. Despite these issues, the central principles for developing empirical support for policy and validation of predicted impacts, whether primary or secondary impacts, of policies are similar.

Hypotheses about the impacts of a policy or intervention may be grounded in a wealth of evidence linking a detrimental impact to exposure to a specific factor, but it cannot be assumed that an intervention to reduce this exposure will result in the expected benefit. There are many examples of well intentioned, and evidence informed interventions which did not have the expected beneficial effects and may even have had adverse effects.<sup>20 21</sup> For example, in the field of transport there are documented cases where education to improve safe cycling or driving behaviour has been followed by increases in injuries and

accidents.<sup>22 23</sup> Evidence from studies which have assessed the actual impacts of an intervention is required to validate the hypotheses that a policy or intervention will have the desired impacts. For example, assessments of changes in health outcomes following an intervention such as housing improvement, to assess the health impacts of housing improvement.

In addition to the need for evidence from single intervention studies and impact evaluations, reviews of previous research are an essential resource to develop evidence-informed policy. Systematic reviews set out transparent methods to bring together data from similar studies. The use of data from a body of studies provides an interpretative context which facilitates a test of the generalisability of a pre-specified theory of change across a variety of contexts. The synthesis of data from more than one study can also, where appropriate, increase the statistical power of an overall effect size. Rigorous, comprehensive syntheses of research evidence not only establish what evidence is available and what is known, but they are also valuable in pointing to critical gaps in knowledge. Thus well conducted reviews can provide strong justification for development of new research and generation of new research evidence which is policy-informed and which may be used to provide a firmer evidence base to support future policy making.<sup>24</sup>

Having produced policy-informed research evidence, either in new studies or by reviewing existing research, the research evidence needs to be prepared and disseminated in a format which is accessible to the potential evidence users. Research syntheses or new research findings published in academic journals and presented at scientific conferences are unlikely to bridge the research-policy gap. Dissemination of research evidence to potential evidence users requires tailoring the evidence to meet their specific needs, presentation in an accessible format, and delivery through channels which are likely to reach the target audience.<sup>25</sup>

Thus there could be said to be three key strands to the development of evidence informed policy, whether in relation to health or not. These are evidence synthesis of existing

research to establish what is known and knowledge gaps; generation of new evidence in the form of new primary studies designed to fill the knowledge gaps; and knowledge translation, providing evidence for use in policy and practice in a relevant and accessible format. These relate directly to the three key components of my own work and the three themes presented in this thesis.

- Systematic review: rigorous synthesis of existing evidence
- Evaluation and generation of new evidence: primary studies, evaluations and related methodological development
- Knowledge transfer: developing accessible research syntheses applied to needs of evidence users.

### ***Initiatives to support evidence informed policy***

The increased interest in using research evidence to inform policy was accompanied by a number of initiatives within the social policy and public health arena, both in the UK and beyond. For example, the establishment of the Campbell Collaboration in 2000 which is closely aligned to the more health-care oriented Cochrane Collaboration to promote systematic reviews; the WHO's Health Evidence Network (HEN); and other local (UK) initiatives such as the ESRC's Evidence Based Policy & Practice Initiative; the Social Care Institute for Excellence; and a new research programme at the MRC Social & Public Health Sciences Unit to develop evidence on the health effects of social interventions (Evaluation programme). Alongside work to develop systematic reviews and generate new research evidence, there were concurrent initiatives health to promote translation and utilisation of research in policy and practice. Two examples of such initiatives are the Research Unit for Research Utilisation at the University of St Andrews and the Centre for Translational Research in Public Health based at Newcastle University.

### **The published work**

The publications presented here represent a selection of my published work. Each of the publications presented in this thesis are peer-reviewed publications which have been conducted under the auspices of the Evaluation programme funded by the Chief Scientist

Office of the Scottish Government. Over the nine years of the Evaluation programme, its work has covered three main themes: housing and urban regeneration, transport, and employment.

***Focus on housing and transport***

The MRC SPHSU Evaluation programme is funded by the Scottish Government's Chief Scientist Office and the programme output was intended to assist in assessing the health impacts of non-health policies. The focus of the programme's early work was on housing, transport and employment. This reflects some of the policy recommendations in the then recently published Acheson report.<sup>17</sup> In addition, the work on housing and neighbourhood investment was able to build on the long-standing programme investigating the social and spatial patterning of health which was set up and is led by Professor Sally Macintyre.

The published work presented here relates to evaluating the health impacts of housing, regeneration, and transport. Housing and transport are both key socio-economic determinants of health and are also policy priorities within national government and globally with respect to tackling health inequalities.<sup>7 17 26</sup> From the papers and knowledge translation work presented here, I have demonstrated that my work has gone some way to meet the knowledge needs of decision makers involved in promoting healthy housing and healthy transport policy.

The published work is presented in three themes to represent the three important elements of research activity required to develop evidence informed policy noted earlier:

- Theme I:            Systematic reviews & synthesis of existing evidence**
- Theme II:          Evaluation & generation of new evidence**
- Theme III:        Knowledge transfer**

## **Theme I: Systematic reviews & synthesis of existing evidence**

Syntheses of existing research are required to provide summaries of the empirical support for policy and to inform policy making. These syntheses need to be developed to answer policy relevant questions, but also need to be rigorously conducted to minimise the potential bias when interpreting evidence. Systematic review provides a scientific approach for identification, appraisal and synthesis of empirical data. Each step of the review is required to be transparent and replicable with the intention of minimising the introduction of bias and providing a synthesis that reflects the best available evidence.<sup>27</sup>

Systematic reviews have been carried out across a range of topic areas, including medicine, psychology, criminology, and education; and some of the methodological principles have been used long before the phrase itself was coined.<sup>28</sup> In 2000, when I embarked on the review of housing improvement, I was not aware of any other systematic review which had addressed the health impacts of a social intervention. While reviews of the effectiveness of some public health and social interventions had been done, i.e. examining direct or primary outcomes of an intervention; there had been no published systematic reviews assessing the health impacts of social interventions, i.e. secondary or indirect impacts. Moreover, the review methods were undeveloped and the suitability of this body of evidence for systematic review was contested. The three reviews presented here therefore represent a novel application of systematic review methods within the field of healthy public policy.

**Paper I Thomson H, Petticrew M, Morrison D. Health effects of housing improvement: systematic review of intervention studies. *BMJ* 2001; 323 (7306):187-190.**

The purpose of this paper<sup>29</sup> was to systematically review available data on the health impacts of housing improvement. Extensive searches in electronic bibliographic databases were conducted and beyond. The approach for this review was based on the guidance produced by NHS Centre for Reviews & Dissemination (University of York).<sup>30</sup> While useful, the NHS guidance was developed for reviews of the effectiveness of healthcare interventions, where randomised controlled trials would be expected to be the

predominant source of evidence. This review had very wide inclusion criteria, and included intervention studies of any design, any language or date, and data on any health or health related outcome. Conventional systematic review methods had to be adapted to be more appropriate to the broad and heterogeneous nature of the evidence being reviewed.

The searches had to be very sensitive to detect the diverse range of terms used to describe the intervention and also to reflect the broad scope of the review with respect to the included outcomes, and included study types, as well as the non-restrictive date and language coverage. Extensive searching beyond electronic bibliographic databases proved invaluable; 10 of the 18 included studies were identified from hand-searches of bibliographies, conference abstracts, or contact with experts.

The critical appraisal tool had to be adapted to reflect variations in study quality across the broad range of study designs included in the review, from randomised controlled trials to retrospective uncontrolled studies. The appraisal methods had to be sensitive to reflect variations in study quality across both experimental and non-experimental study designs. The heterogeneity of the included studies and relevant data inevitably limited the possibilities to for data synthesis. Nevertheless, the data were tabulated and a narrative synthesis was conducted to provide evidence users with a useful, albeit broad overview of the available data in this field.

Given the inclusive nature of the review the number of studies identified (n=18) was perhaps somewhat surprisingly small. However, I am confident that the included studies do represent almost all the research on this topic available at the time. Following the publication of the review findings, which received international attention (as indicated by subsequent correspondence I received from around the world) I was only made aware of one study published in the grey literature which I would have included in the review had I known of it.<sup>31</sup>



Not only did this review draw attention to the dearth of research validating the hypothesis that improvements in housing quality will lead to health improvement, but it also established the poor quality of much of the available research evidence. The knowledge gap made undeniable through this review, was subsequently used as leverage for funding proposals of housing improvements and also to inform the design and research questions; for example Scotland's Health And Regeneration Project (SHARP), a randomised controlled trial of housing improvement in New Zealand, and GoWell (an evaluation of the health and social impacts of neighbourhood regeneration in Glasgow). The lack of rigorous studies prevented us from drawing clear conclusions. We concluded that housing improvements have the potential to improve health, in particular mental health, but there is the potential for adverse health impacts and adverse socio-economic impacts associated with housing improvement, such as increased housing costs, cannot be ignored.

**Paper II** Thomson H, Atkinson R, Petticrew M, Kearns A. Do urban regeneration programmes improve public health and reduce health inequalities? A synthesis of the evidence from UK policy and practice (1980-2004). *Journal of Epidemiology & Community Health* 2006; 60 (2):108-115.

Programmes of area based urban regeneration have been an important component of UK urban policy for the past few decades and invest large amounts of public money (estimated at £500-700 million per year). These programmes have included investment to improve housing, employment, and education and as such they represent significant public investment to tackle many of the socio-economic determinants of health. The review reported in **Paper II** was designed to cover a broader area than the housing review (**Paper I**), looking at the socio-economic and health impacts of regeneration investment which has often incorporated area-based programmes of housing-led neighbourhood renewal.

Although many of the programmes of interest have been evaluated, the findings of these evaluations are not typically published in the academic literature; rather the findings are more likely to have been published in 'grey' literature, such as government reports. Only two (n=2/19) of the identified evaluations in this review were from journal publications.

I devised and conducted extensive and specialised searches to identify and locate the grey literature for this review. Identification and retrieval of the grey literature has rarely been done, and our aim to identify and include grey literature enabled valuable, but hitherto untapped, policy-relevant data from evaluations to be synthesised. In addition to synthesising data on health outcomes, we extracted and synthesised impact data for socio-economic determinants of health, such as employment and educational impacts; these are more likely to have been assessed by an evaluation of regeneration, and may also be a useful proxy for longer term health impacts.<sup>11</sup>

Nineteen evaluations of the impacts of regeneration programmes were identified (1980-2004), yet within these evaluations very few actual impact data were reported. Three evaluations reported data on health impacts, and ten evaluations reported socio-economic impacts supporting the inclusion of impacts on both health and socio-economic determinants of health. Where impacts were reported these were often small and a mix of positive and negative impacts.

At the time this review was carried out policy evaluations published in the grey literature were rarely included in systematic reviews. The topic and search strategy of this systematic review was developed to be as policy relevant as possible, drawing on data from policy evaluations. The lack of health impact data was not surprising. What was more alarming was the dearth of knowledge of direct impacts of the regeneration investment, such as employment. This draws attention to the ways in which previous policy experience has or has not been used to refine future policies, as well as the purpose and use of the evaluations that have accompanied large-scale investment of public money.

**Paper II** was selected for “Faculty of 1000 Medicine” (a service where independent academic peers select recent journal publications and rate its importance within a specific field) as a “recommended” paper.

**Paper III Thomson H,** Thomas S, Sellstrom E, Petticrew M. The health impacts of housing improvement: a systematic review of intervention studies from 1887 to 2007. *American Journal of Public Health* 2009;99(S3):S681-S692.

In the earlier review of housing improvement and health<sup>29</sup> a further 13 ongoing but as yet unfinished studies relevant to the review were identified. With this in mind we made plans to update the earlier housing review when a new body of additional evidence had accumulated. **Paper III**<sup>32</sup> reports the main findings of this updated systematic review of the health impacts of housing improvement. Following peer review the protocol for this review was accepted by the Campbell Collaboration.<sup>33</sup>

This review took a similarly broad approach to the 2001 review,<sup>29</sup> however, in this review housing interventions to support those with specific medical or mobility requirements were excluded. Research on the housing people with medical or mobility needs had increased substantially since 2001 and it was decided that these data should be reviewed separately. Compared to the 2001 review, the search strategy, methods of appraisal and synthesis developed for this review were considerably improved and recent developments in systematic review methods were incorporated, particularly in relation to inclusion of non-experimental studies. The critical appraisal was based on a tool developed in Canada specifically to assess evaluations of public health interventions.<sup>34</sup> I amended this tool to identify relevant methodological issues relevant to controlled and uncontrolled studies of housing improvement, most notably relevant confounders such as housing condition and health status at baseline. In addition to study design, the critical appraisal involved a detailed assessment for possible sources of bias through sample selection, control for confounding, blinding, data collection methods and tools, and levels of sample attrition at follow-up. I also assessed the level of intervention heterogeneity within each study, i.e. variation in the extent of intervention delivered, and the extent of improvement in housing conditions actually experienced by residents, i.e. did installation of central heating result in warmer homes. This is related to intervention integrity and implementation, which is subsequently related to exposure to the intervention. Levels of heterogeneity were rarely reported. Where data were reported, it appeared that there was considerable variation *within* studies in the type and extent of housing improvement

delivered to individual households. Variation in the levels of exposure to the intervention may be an important source of bias.<sup>35</sup> It may lead to an underestimate of the health effect which could be expected from exposure to the full intervention, and may also introduce Type II error, falsely implying a negative or null effect following the intervention.<sup>35</sup>

The extreme levels of heterogeneity in this review presented a challenge to data synthesis. Compared to the previous reviews (**Paper I & Paper II**) I made considerable improvements to the synthesis and presentation of data for this review; calculating standardised effect sizes where possible, tabulating data from 45 studies into a two-page summary table, and improving the transparency of the narrative synthesis process. Only 13 of the 45 included studies reported sufficient data to calculate standardised effect sizes. Although it has been argued that heterogeneity alone should not preclude meta-analysis,<sup>36</sup> the studies varied widely on many levels, such as study design and quality, study population, outcomes assessed, and the intervention delivered. The data were therefore synthesised narratively according to the then recently published ESRC guidance on narrative synthesis.<sup>37</sup> Presenting a visual summary of the data is a valuable element of narrative synthesis to improve the transparency of the synthesis. The summary table included an indication of impacts on four key health categories (general health, respiratory health, mental health, and illness/symptoms) and incorporated an indication of study methods, overall methodological quality, sample size and intervention integrity, length of follow-up and changes in housing condition. (N.B. Due to formatting restrictions the journal was unable to publish this version of the table alongside the paper and replaced the visual representation of reported impacts with text. The visual interpretation was published as a supplement on the journal's website.)

Compared to the 2001 review<sup>29</sup> there was a substantial increase in the quantity and improvement in the quality of studies which had assessed the health impacts of housing improvement, and this added more weight to our conclusions around the potential for health improvement. In addition, the increased number of studies facilitated more in-depth examination of differences between studies, and specific study or intervention

characteristics and context which may be related to health effects; this updated review could therefore be said to have taken a realist approach.<sup>38 39</sup> In particular, there were contrasting findings reported from studies of similar interventions in New Zealand and the UK.

The conclusions of this review were that housing improvements, in particular warmth improvements can lead to significant improvements in health. The comparison of the UK and New Zealand studies added helpful qualification to this conclusion, adding that the potential for health benefit may depend on baseline housing conditions and careful targeting of the intervention to those with existing poor health living in poor housing. In addition to the increase in both quantity and quality of available evidence included in this housing review, this review illustrates how I, in discussion with my colleagues at MRC SPHSU, have developed and improved methods for synthesising complex and heterogeneous data.

## **SUMMARY**

The three systematic reviews presented here have been conducted over a period of nine years. At the start of this period, reviews of the health impacts of social interventions had rarely been conducted and this required me to develop methods appropriate to the nature of the available data. The ways in which I have developed and refined the review methods over this period are evident by comparing these three reviews. In addition to the increased number and improved quality of housing studies adding weight to the synthesis<sup>32</sup>; the review methods themselves have incorporated what has recently been described as a realist approach<sup>38 39</sup> and were developed to ensure a more intensive scrutiny and improved visual and tabulated summaries of the data.

The reviews presented here challenge many of the preconceptions about the limitations of systematic reviews,<sup>40</sup> and have also been challenging to conduct. Owing to the lack of intervention evidence for healthy public policy, it was necessary for the reviews to have a broad coverage to ensure inclusion of ‘best available’ evidence. This required the adaptation of conventional systematic review methodology at each step of the review;

identification, appraisal and synthesis. Grey literature sources were searched to ensure valuable evidence was not overlooked. While considering methodological quality, evidence was not excluded on study design alone; studies of any design which had assessed outcomes after a relevant intervention were included. Consequently the assessment of study quality had to be adapted to be sensitive to a range of possible sources of bias across all study designs. The lack of standardised data across studies prevented meta-analysis and I used new guidance on narrative synthesis<sup>37</sup> as well as synthesising data and an indication of study size and quality from 45 studies into a two page summary for the potential audience.

It is true that these reviews were resource intensive and the amount of evidence identified remains small and of variable quality. However, identifying what is known and as well as what remains unknown is important for both academics and policy decision-makers. These reviews have established beyond doubt important knowledge gaps, and the lack of good quality evidence to support healthy policies on housing and regeneration investment. The identification of studies which have successfully used rigorous designs to evaluate housing improvement challenges scepticism that such designs can be used for social interventions. The methodological overview provided by these reviews has been used to make recommendations for future research and reflections on the potential for obtaining experimental or quasi-experimental data to inform housing policy.<sup>29 32 41</sup>

The breadth and related heterogeneity of the reviews may also be a fair criticism. However, scrutiny of the differences between the studies helped refine the hypothesis that housing improvement may lead to health improvement. For example, comparing the impacts of warmth improvements in New Zealand and the UK underlines the importance of targeting housing improvement to those most in need.

Despite the lack of good quality evidence identified, the value of these reviews to the academic community is evident; **Paper I** has been cited over 66 times in other journal publications (ISI Web of Knowledge 11/6/09). In addition, in response to interest from evidence-users in the reviews the work has been translated for evidence use in policy and

practice (see Theme III) and I have been invited to present this work to numerous policy and practitioner audiences.

From this work it is clear that there is insufficient good quality data from intervention studies to provide a solid evidence base with which to support healthy housing and regeneration investment. Moreover, even large well conducted studies are unlikely to provide the conclusive evidence ideally wished for. Nevertheless, best available evidence from well conducted studies will continue to be valuable. The emerging growth of studies across different contexts has already helped explain some of the differential impacts, and identification of adverse impacts is essential to prevent future harm. Qualitative work examining the potential range of and mechanisms for health impacts following housing improvement is needed to inform future areas of investigation. This together with syntheses of cross-sectional data on the links between health and specific housing characteristics may also be a useful evidence resource to inform policy decisions.

## **Theme II: Evaluation & generation of new evidence**

Single primary studies assessing the health impacts of social interventions are required to validate predictions about the actual impacts of an intervention. This may include both immediate direct impacts on socio-economic determinants of health, such as income or housing condition, as well as longer term health impacts. Data from these single studies are also required to contribute to an evidence base which can be applied to future decisions to promote healthy public policy.

The serious lack of intervention research assessing the health impacts of both social and public health interventions is now well established.<sup>42 43</sup> The relatively recent emergence of an interest amongst policymakers in evidence of ‘what works’, as well as lack of evaluation capacity, may partly explain the historical lack of intervention research. In addition, there has been widespread scepticism about the feasibility, ethics, and appropriateness of applying experimental designs to evaluate social interventions.<sup>44</sup> The lack of research evidence and hence knowledge of the possibility of health impacts following social interventions has implications for the type of research enquiry required. Quantitative methods are useful to assess pre-determined outcomes but in many cases it is difficult to specify the types of expected health impacts, and there is much still to be explored around the existence and nature of health impacts following a specific intervention. Qualitative investigation can make a valuable contribution to exploring the nature of and mechanisms for possible health impacts.

This section presents two primary studies assessing the health impacts of neighbourhood investment. A further two papers are presented which comment on methodological issues arising in such evaluations, and the prospects to develop an evidence base for healthy public policy.



**Paper IV Thomson H, Kearns A, Petticrew M. Assessing the health impact of local amenities: a qualitative study of contrasting experiences of local swimming pool and leisure provision in two areas of Glasgow. *Journal of Epidemiology & Community Health* 2003;57(9):663-667.**

Paper IV, and a related Gallery piece (also appearing in *Journal of Epidemiology & Community Health*),<sup>45</sup> reports the findings of a qualitative study investigating the possible impacts of local amenity provision.<sup>45 46</sup> I was initially alerted to the recent closure of an Edwardian public bath-house and swimming pool in a deprived Glasgow neighbourhood, and I was interested in investigating possible health impacts on those living in the local neighbourhood. A number of possible data sources and target populations were considered, including a postal questionnaire to the whole neighbourhood, recruiting members of a local swimming club. Issues of poor response to postal questionnaires, especially in areas of socio-economic deprivation such as this neighbourhood,<sup>47</sup> made this option unattractive, and members of a local swimming club would not necessarily be local residents. In addition, the dearth of previous research investigating the possible impacts or pathways to impacts of local amenities pointed to a more exploratory investigation using open-ended qualitative data.

I conducted focus groups with local residents selected to represent different age groups were conducted. I also identified a suitable comparison area where a new swimming and leisure facility had opened; I conducted a similar collection of focus groups in both areas. The qualitative approach facilitated an open discussion of health and social impacts perceived by local residents. While there was some mention about the possible link between swimming and physical fitness, it emerged that the swimming pool, and other local amenities, provided supervised public space where local residents could meet and where children could play and 'let off steam' safely. It was these social impacts which residents linked to health impacts, in particular improved mental health which was seen as essential to cope with the day-to-day management life on a low-income.

The findings of this study were published in **Paper IV**, and a more accessible report outlining the study and its findings was written and disseminated to the participating community groups and the local authority.<sup>48</sup>

**Paper V** Thomson H, Morrison D, Petticrew M. The health impacts of housing-led regeneration: a prospective controlled study. *Journal of Epidemiology & Community Health* 2007;61(3):211-214.

Paper V,<sup>49</sup> and its accompanying Gallery piece (also appearing in *Journal of Epidemiology & Community Health*),<sup>50</sup> reports the findings of a prospective controlled study of housing improvement. The study was carried out in a post-industrial village in the West of Scotland and in collaboration with the social housing agency which was carrying out a programme of housing-led neighbourhood regeneration. One year after rehousing there was little change in health outcomes among either the intervention or control group. The findings of this study were published in **Paper V**, a more accessible report and a supplementary short leaflet outlining the study and its findings were produced and disseminated study participants and the local housing providers.<sup>51</sup>

This study was quasi-experimental, selecting a control group from a neighbouring area of similar social housing, rather than an experimental design, and the final samples were small (Intervention/Control n=50/50). Nevertheless, the study demonstrates that rigorous but uncomplicated evaluations of health impacts can be applied in the real world to generate best available evidence which can be used to contribute to the evidence base within the field. The data from this study was included in the synthesis reported in **Paper III**, and was one of only three studies that achieved a Grade A for study quality studies of rehousing/refurbishment (Overall study quality of rehousing studies A n=3, B n=4, C=5), as assessed by two independent reviewers.

**Paper VI Thomson H, Hoskins R, Petticrew M, Ogilvie D, Craig N, Quinn T, Lindsay G. Evaluating the health effects of social interventions. *BMJ* 2004; 328 (7434):282-285.**

In 2001 I became interested in assessing the health impacts of increased income among low-income groups.<sup>52</sup> A colleague (R Hoskins) at the Department of Nursing Studies, University of Glasgow had recently investigated the potential for primary care teams and welfare officers to promote uptake of welfare benefit amongst the elderly.<sup>53</sup> Further qualitative research suggested that this increased income could lead to substantial improvements in quality of life, independent living and sense of wellbeing amongst this group.

I convened a group to set up an evaluation of the health impacts of a primary care based initiative to promote uptake of Attendance Allowance amongst the elderly. **Paper VI** reports the group's attempts to design a controlled study and some of the issues which emerged, in particular identification of a suitable control group.

Identification of a suitable control group is a common problem when evaluating social interventions (not just for health impacts). In particular this is difficult where the intervention is already underway and there is universal access for those eligible. **Paper VI** was intended to illustrate this issue with a real case study, and also argue that where 'ideal' study designs are not feasible 'best available' may be justified, i.e. uncontrolled studies. Indeed, knowledge of the health impacts of complex social interventions such as this is so limited that small uncontrolled studies exploring the existence and nature of health impacts may be required to precede more rigorous and expensive study designs.<sup>54</sup> This paper provided a timely example of some issues pertinent to the pursuit of evidence to support healthy public policy, being cited immediately after publication by the Wanless Report.<sup>55</sup>

**Paper VII Thomson H.** A dose of realism for healthy urban policy: lessons from area-based initiatives in the UK. *Journal of Epidemiology & Community Health* 2008; 62 (10):932-936.

Through the systematic reviews and developing evaluations of the health impacts of social interventions, in particular housing and urban renewal, I have accrued an in-depth knowledge and understanding of the issues around the pursuit of evidence which can shape healthy public policy. Drawing on this experience I wrote **Paper VII**<sup>56</sup> as a reflection and commentary on the existing evidence available to inform healthy urban policy and the potential to generate new and improved evidence to inform healthy urban policy. The paper focuses on area-based initiatives, such as area based neighbourhood regeneration, and draws heavily on my own systematic reviews on this topic (**Paper I & II**). However, many of the issues discussed in the paper have a broader relevance to the use of evidence to inform healthy public policy. Broadly, there is a need for more considered and realistic expectations to be set for both, what a single policy or investment can achieve, and also what evaluation evidence will be able to shed light on in terms of attributing impacts to a specific intervention.

In addition, **Paper VII** was selected for “Faculty of 1000 Medicine” (a service where independent academic peers select recent journal publications and rate its importance within a specific field) as a “must read” paper.

## **SUMMARY**

The evaluation work presented here represents my own efforts to pursue best available evidence for healthy public policy. The evaluations presented in **Paper IV & Paper V** were small and exploratory, yet these studies were relatively novel within their field and demonstrate how complex social interventions can be evaluated for health impacts. The findings of these two evaluations and methodological lessons from both these evaluations, and our unsuccessful attempt to obtain funding to evaluate the welfare intervention have used to inform the underpinning theory and methods in future larger evaluations, for

example SHARP (Scotland's Housing & Regeneration Project), and GoWell <sup>1</sup>. Indeed, **Paper VI & Paper VII** illustrate how I have used my experience in developing evaluations and building the evidence base to support health urban policy to provide constructive reflections on the pursuit of evidence for health public policy.

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<sup>1</sup> GoWell is a research programme that aims to investigate the impact of investment in housing, regeneration and neighbourhood renewal across Glasgow on the health and wellbeing of individuals, families and communities over a ten-year period

### **Theme III: Knowledge Transfer**

The third component of my work has been to provide summaries of research evidence which are tailored and presented in an accessible format to meet the needs of policy makers and practitioners involved in promoting healthy public policy. I have developed close links with the public health practitioner and policy making community and the work presented below has been prepared in collaboration with the Scottish Health Impact Assessment Network and the World Health Organisation.

**Paper VIII Thomson H, Petticrew M, Douglas M. Health Impact Assessment of housing improvements: incorporating research evidence. *Journal of Epidemiology & Community Health* 2003; 57:11-16.**

The MRC SPHSU Evaluation programme was originally set-up, in part, to develop support for Health Impact Assessment (HIA). In line with this I represented the programme at the newly formed Scottish Health Impact Assessment Network (SHIAN). SHIAN is a national network of policy makers from local and central government and public health practitioners interested in applying HIA. The SHIAN wanted to develop topic specific guidance for HIA drawing on available research evidence and I was invited to prepare a synthesis on the health impacts of housing improvement.

The synthesis was based on the systematic review of housing improvement (**Paper I**),<sup>29</sup> but a number of steps were required to tailor this to the needs of potential evidence-users. The synthesis had to be prepared in a format that was accessible to potential evidence-users, interpreting research terminology and replacing it with language more widely understood by non-academics. The data from the housing review were further tabulated to provide a one page visual summary of the reported impacts. In response to frustration about the limited amount of evidence on housing improvement and health I extended the scope of this synthesis considerably in relation to the interventions included, the outcomes reported, and the type of research evidence. Adding to the evidence on the effectiveness of housing interventions from my own systematic review, I included additional housing improvement types excluded from my own review, for example

measures to prevent accidents, fires and reduce exposure to house dust mite. I extended the synthesis to include cross-sectional data reporting the links between specific housing characteristics. In addition, I included a review of socio-economic impacts associated with housing improvement which may have implications for longer term health impacts. I also attempted to illustrate how the synthesis could be applied in practice. Informed by the synthesis I developed a list of key questions intended to help shape discussions and questions included in an HIA of housing improvement.

The full synthesis plus an overview of housing policy, and an outline of HIA was published in a peer-reviewed report disseminated to policy makers and practitioners.<sup>57</sup> **Paper VIII**<sup>58</sup> used this work as a case study of how academics and practitioners can collaborate to prepare accessible but rigorous syntheses of research evidence which can be used in practice.

Both the guide<sup>57</sup> and the paper<sup>58</sup> were well received by their respective target audiences. I received correspondence from the editor of the *Journal of Epidemiology & Community Health* informing me that the paper had been ranked as in the top ten for that year.

**Paper IX** Thomson H, Petticrew M. Is housing improvement a potential health improvement strategy? (peer-reviewed report for European policy makers) ([http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214\\_2](http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214_2)). WHO Health Evidence Network. Copenhagen, 2005.

The 2001 housing review (**Paper I**<sup>29</sup>) received considerable international attention and I was commissioned by the Health Evidence Network (HEN) of the World Health Organisation (WHO) to prepare an evidence synthesis on the potential for housing improvement to improve health. This synthesis was very similar to the work prepared for SHIAN (**Paper VIII**),<sup>57 58</sup> however the searches were updated and the resulting synthesis was more comprehensive than the synthesis reported in **Paper VIII**. This peer-reviewed report was prepared for an audience of European policymakers and was made available in English and Russian.

**Paper X** Thomson H, Jepson R, Hurley F, Douglas M. Assessing the unintended health impacts of road transport policies and interventions: translating research evidence for use in policy and practice. *BMC Public Health* 2008; 8 (339): (<http://www.biomedcentral.com/1471-2458/8/339>).

The evidence synthesis on housing improvements (see **Paper VIII**<sup>58</sup> and its accompanying report<sup>57</sup>) that I prepared in collaboration with SHIAN was very well received by SHIAN members and beyond. SHIAN was keen to produce further guides for its members and to promote the use of research evidence in HIA. Transport was considered to be a key area of interest for HIA and I was commissioned to prepare a synthesis of research evidence on the health impacts of transport interventions.

This synthesis adopted a similar approach to the synthesis of housing research: applying the principles of systematic review to limit bias and incorporating evidence of health impacts following interventions and data on associations between transport and health outcomes. It is worth noting that this synthesis proved to be far broader and therefore more involved than the synthesis of housing evidence (**Paper VIII**), and some of the emerging complexities were reflected on in **Paper X**. The synthesis drew on the systematic reviews of transport interventions conducted within the Evaluation programme<sup>23 59 60</sup> (I was a co-author on one of these reviews), and additional relevant systematic reviews of the health impacts of transport interventions were also included.

The evidence synthesis was published in a peer reviewed report<sup>61</sup> which included sections on transport policy in Scotland and the key elements of an HIA. As in the Housing HIA guide, I prepared a list of questions to help HIA practitioners determine the important issues emerging from the evidence which an HIA of transport needs to consider. **Paper X**<sup>62</sup> was prepared for the wider academic community as an illustration of how academic public health can contribute to knowledge transfer activity and promote the use of research evidence in practice. In addition, **Paper X** was used as a case study to illustrate some of the inherent difficulties of assessing the health impacts of multi-faceted interventions such as transport. The key difficulties emerging include, the uncertainty associated with the lack of evidence from intervention studies; the emergence of conflicting outcomes preventing an assessment of overall benefit or harm among and



between defined populations; the multiple steps and mediating factors affecting the nature and extent of a hypothesised health impact.

## **SUMMARY**

These academic papers use specific knowledge transfer work as case studies to illustrate how collaborations between academics and evidence-users can be used to promote the availability of high quality syntheses of research evidence tailored to meet the policy and practice evidence needs. The key principles involved in each of these examples are: close collaboration with the end-users; maintaining the principles of systematic review to provide transparent synthesis and to minimise bias; inclusion of best available evidence, i.e. not only evidence from intervention studies; further distillation of research, and removal of academic jargon; and application of evidence in the ways most likely to be relevant to evidence-users.

Each of these papers and the related reports disseminated to policymakers and practitioners have been well received (**Paper VIII** has been cited 21 times in journal publications, ISI Web of Knowledge 11/6/09). Although it is hoped that this work has promoted the use of evidence, it may be naïve to assume that provision of accessible and tailored evidence will directly shape decision making in policy and practice. Such a rational-linear model fails to acknowledge the multiple influences on decision-making and complexity of the relationship between research, policy and practice.<sup>63</sup> Further evaluation investigation of the possible impacts of this work would be valuable. Unfortunately, despite attempts to evaluate the Housing HIA guidance, we were unable to pursue the lengthy ethical procedures required for such an investigation.

In addition to providing accessible written work, knowledge transfer activity can and should involve collaborative engagement with evidence users, as well as dissemination of research findings to study participants and the public. I have produced articles and research summaries for a range of non-academic audiences,<sup>48 51 64 65</sup> and have regularly presented my work at conferences aimed at policy makers and practitioners.<sup>66-90</sup>

### **Concluding remarks**

This thesis has presented peer reviewed publications from high impact international journals for each of the three themes outlined at the start of the thesis (*I Synthesis of existing evidence; II Generation of new evidence; III Knowledge transfer from research to policy & practice*). The lack of good quality data validating hypotheses about health impacts following interventions expected to tackle socio-economic determinants of health is both disappointing and frustrating. In addition, it seems unlikely that evidence attributing health impacts to complex social interventions will ever attain the level of causality observed for some clinical interventions. Nevertheless, this does not provide grounds to abandon efforts to develop public policies which maximise the potential for health benefit. More research effort is required to produce good quality policy relevant evidence.

A key theme of the work presented here has been to use best available evidence rather than only acknowledging what may be regarded as ideal standards of experimental evidence. Developing best available evidence for healthy public policy provides a constructive response to the dearth of experimental evidence, and to the pursuit of evidence in a field where experimental studies are often difficult and sometimes not possible to conduct. Furthermore, use of non-experimental study designs may be more appropriate to the stage of knowledge within the field where knowledge of the existence and nature of health impacts is still extremely limited. As illustrated in my own work, such an approach has required adapting conventional methods of evidence synthesis, and innovative evaluations to generate evidence which furthers understanding of the extent, nature and mechanisms for health impacts following social interventions.

The collection of work presented here demonstrates clearly that I have made a substantial contribution to developing evidence to inform healthy public policy. Although focussing largely on housing and neighbourhood investment, much of this work also has a wider application to the development of evidence to inform healthy public policy. The academic publications have been well received as indicated by the citations and other accolades received. In addition, my work has extended beyond academia, working with

evidence-users at a national and international level to promote the use of evidence in policy and practice.

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## The submitted work: Paper I-Paper X

### **Theme I: Systematic Review**

- Paper I** Thomson H, Petticrew M, Morrison D. Health effects of housing improvement: systematic review of intervention studies. *BMJ* 2001;323(7306):187-190.
- Paper II** Thomson H, Atkinson R, Petticrew M, Kearns A. Do urban regeneration programmes improve public health and reduce health inequalities? A synthesis of the evidence from UK policy and practice (1980-2004). *Journal of Epidemiology & Community Health* 2006; 60 (2):108-115.
- Paper III** Thomson H, Thomas S, Sellstrom E, Petticrew M. The health impacts of housing improvement: a systematic review of intervention studies from 1887 to 2007. *American Journal of Public Health* 2009;99(S3):S681-S692.

### **Theme II: Evaluation & generation of new evidence**

- Paper IV** Thomson H, Kearns A, Petticrew M. Assessing the health impact of local amenities: a qualitative study of contrasting experiences of local swimming pool and leisure provision in two areas of Glasgow. *Journal of Epidemiology & Community Health* 2003;57(9):663-667.
- Paper V** Thomson H, Morrison D, Petticrew M. The health impacts of housing-led regeneration: a prospective controlled study. *Journal of Epidemiology & Community Health* 2007;61(3):211-214.
- Paper VI** Thomson H, Hoskins R, Petticrew M, Ogilvie D, Craig N, Quinn T, Lindsay G. Evaluating the health effects of social interventions. *BMJ* 2004; 328 (7434):282-285.
- Paper VII** Thomson H. A dose of realism for healthy urban policy: lessons from area-based initiatives in the UK. *Journal of Epidemiology & Community Health* 2008; 62 (10):932-936.

### **Theme III: Knowledge Transfer**

- Paper VIII** Thomson H, Petticrew M, Douglas M. Health Impact Assessment of housing improvements: incorporating research evidence. *Journal of Epidemiology & Community Health* 2003;57:11-16.
- Paper IX** Thomson H, Petticrew M. Is housing improvement a potential health improvement strategy? (commissioned report for European policy makers) ([http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214\\_2](http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214_2)). WHO Health Evidence Network. Copenhagen, 2005.
- Paper X** Thomson H, Jepson R, Hurley F, Douglas M. Assessing the unintended health impacts of road transport policies and interventions: translating research evidence for use in policy and practice. *BMC Public Health* 2008; 8 (339): (<http://www.biomedcentral.com/1471-2458/8/339>).

**Theme I: Systematic Review**

**Paper I** Thomson H, Petticrew M, Morrison D. Health effects of housing improvement: systematic review of intervention studies. *BMJ* 2001;323(7306):187-190.

*With web supplements*



## Health effects of housing improvement: systematic review of intervention studies

Hilary Thomson, Mark Petticrew and David Morrison

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## Health effects of housing improvement: systematic review of intervention studies

Hilary Thomson, Mark Petticrew, David Morrison

### Abstract

**Objective** To review the evidence on the effects of interventions to improve housing on health.

**Design** Systematic review of experimental and non-experimental housing intervention studies that measured quantitative health outcomes.

**Data sources** Studies dating from 1887, in any language or format, identified from clinical, social science, and grey literature databases, personal collections, expert consultation, and reference lists.

**Main outcome measures** Socioeconomic change and health, illness, and social measures.

**Results** 18 completed primary intervention studies were identified. 11 studies were prospective, of which six had control groups. Three of the seven retrospective studies used a control group. The interventions included rehousing, refurbishment, and energy efficiency measures. Many studies showed health gains after the intervention, but the small study populations and lack of controlling for confounders limit the generalisability of these findings.

**Conclusions** The lack of evidence linking housing and health may be attributable to pragmatic difficulties with housing studies as well as the political climate in the United Kingdom. A holistic approach is needed that recognises the multifactorial and complex nature of poor housing and deprivation. Large scale studies that investigate the wider social context of housing interventions are required.

### Introduction

Poor housing has been used both as an indicator of poverty and as a target for interventions to improve public health and reduce inequalities in health.<sup>1</sup> Although housing still has a prime place on the health inequalities agenda, it also has wider importance because small health effects can have a large impact at the population level.

Policy makers are also increasingly interested in measuring the health effects of social interventions (such as social housing) and in gathering evidence to shape policy.<sup>2,3</sup> Much of the research investigating the links between housing and health has been cross sectional, and these studies have shown strong independent associations between housing conditions and health. However, results of studies in small areas are difficult to generalise to other contexts. Observational studies have

also shown strong independent associations between poor housing and poor health, but their results remain open to debate and interpretation.<sup>4</sup>

Experimental studies of the health impacts of housing would provide stronger evidence. The randomised controlled trial has been regarded as the gold standard experimental model to show the effects of interventions in medicine. Such trials, however, are less common in housing research, where there is less of a history of experimentation.<sup>5</sup> We carried out a systematic review of intervention studies of the health effects of housing improvement.

### Methods

#### Search strategy

We searched the following databases: ASSIA (Applied Social Science Index and Abstracts, 1987-2000), CAB Health (1973-2000), DHSS-DATA (1983-2000), Embase (1974-2000), HealthSTAR (1975-2000), Medline (1966-2000), PAIS (Public Affairs Information Service, 1976-2000), PsycINFO (1887-2000), SIGLE (System for Information on Grey Literature in Europe, 1980-2000), Social SciSearch (1972-2000), Sociological Abstracts (1963-2000), Social Science Citation Index (1981-2000), Urbanisc, Cochrane Controlled Trials Database 2000 Issue 2, IBSS (International Bibliography of the Social Sciences), SPECTR (Social, Psychological, Educational, and Criminological Controlled Trials Register, searched December 2000), and the world wide web. Full details of the search strategy are available from the authors.

We hand searched the bibliographies of all reports, papers, and text books that we reviewed. We also requested information on unpublished and ongoing studies from subscribers to the Housing Studies Association newsletter and email list and the Health Action Zone discussion group. HT contacted health authority housing departments, academic departments in the United Kingdom, local authorities, and housing associations. We also asked delegates at an international housing conference for details of suitable studies, either completed or ongoing.

#### Selection

We sought primary studies in any language that used experimental or quasi-experimental approaches to examine the effects of housing improvements. These included randomised controlled trials and observational studies that used prospective or retrospective

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BMJ 2001;323:187-90

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*Tables giving full details of the included and ongoing studies are available on the BMJ's website*

**Criteria for assessing strength of evidence (adapted from NHS Centre for Reviews and Dissemination method)<sup>6</sup>**

**Level A: prospective study, follow up rate >80% and for ≥6 months**

Randomised controlled trial, or controlled study with comparable control group  
Objective assessment of health outcome(s)

**Level B: prospective study with control group**

Limited control of confounding  
Appropriate assessment of health outcomes

**Level C: prospective and retrospective studies that did not adjust for confounding factors**

Studies with biased assessment of health outcomes

measures of health. Our outcome measures were based on a social model of health and included socio-economic changes and illness based outcomes. Housing interventions were defined as rehousing, and all physical changes to housing were defined as infrastructure—for example installation of heating, insulation, double glazing, and general refurbishment.

We excluded cross sectional studies that did not investigate the effects of housing improvement before and after the intervention. We did not include interventions to improve the indoor environment through furniture or indoor equipment (such as vacuuming, mattresses, and air purifiers) unless the evaluation measured changes in residents' health and the measures were part of a package of interventions that included improvements to the house itself. Environmental studies of the adverse effects of lead, urea formaldehyde foam, poor air quality, allergens, or radon were not included. At least two reviewers independently screened all abstracts identified by the searches.

**Assessment of validity assessment and data abstraction**

Three reviewers critically appraised the included studies according to the criteria (box). Studies graded as C were not considered in the final assessment of the evidence. When reviewers' conclusions differed, the study was reviewed jointly by three reviewers. Data were abstracted by one reviewer (HT) and checked by a second reviewer (MP). When data on the group of interest were not given in the publication, we calculated them if possible—for example, new P values were calculated using the relevant sample sizes.

**Results**

We identified 18 completed intervention studies (see *BMJ's* website for details),<sup>7-29</sup> the earliest dating from 1936.<sup>15</sup> Six studies were identified from electronic databases (figure). Three studies examined the health impacts of rehousing based on medical need,<sup>7-10</sup> 11 examined the health effects of rehousing or refurbishment and renovation,<sup>11-23</sup> and four assessed energy efficiency measures.<sup>24-29</sup> Seven studies assessed housing improvement in the context of area or community regeneration.<sup>11 12 15-17 19-21</sup>

Eleven studies were prospective, of which six used control groups.<sup>7 8 11-15 26 27</sup> Three of the seven retrospective studies used a control group.<sup>20 21 28 29</sup>

We also identified 14 ongoing housing intervention studies based in the United Kingdom (see *BMJ's* website for details). These are investigating similar interventions to the completed studies. Seven of these ongoing studies are prospective and controlled; one is using a randomised stepped wedge design.<sup>30</sup>

**Medical priority rehousing**

All three studies of rehousing on the basis of medical need found improvements in self reported physical and mental health. However, the only prospective study was small,<sup>7 8</sup> and no study controlled for the effects of possible confounding variables. One study examined the effects on use of health services and found no clear pattern.<sup>9</sup>

**Rehousing, refurbishment and relocation or community regeneration**

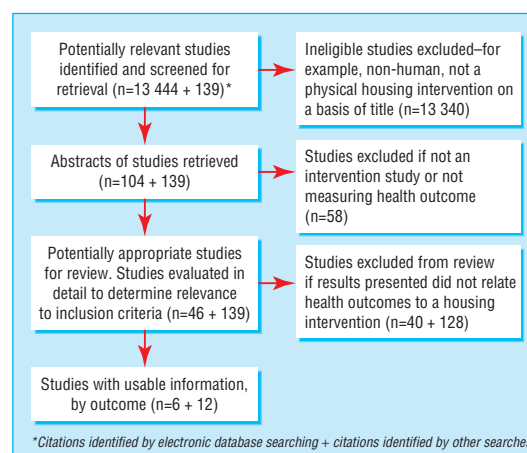
Two prospective controlled studies reported beneficial effects of rehousing or refurbishment on health outcomes, including improvements in mental health.<sup>11-14</sup> Only one study had controlled for confounding. This study showed an initial increase in illness episodes in the intervention group at 9 months. At 18 months, however, the intervention group showed a larger reduction in illness episodes compared with the control group, although the absolute difference was small (29 episodes/1000 people) and the rate of follow up was not stated.<sup>11 12</sup> The other prospective controlled study reported improvements in mental and physical health, but the study was small and the comparability of the control group is unclear.<sup>13 14</sup>

**Energy efficiency measures**

Although the four studies that we identified all found that energy efficiency measures improve respiratory and other symptoms, only one study adjusted for potential confounding variables.<sup>27</sup> High rates of attrition in this and most other studies limit the generalisability of these findings.

**Use of health services and social effects**

Some studies assessed the effects of improving housing on use of health services; decreased visits to the general practitioner, reduced likelihood of inpatient and outpatient use of health services, and reduced prescribing of hypnotic and respiratory drugs were reported. None of the evidence for these effects came from methodologically robust prospective controlled studies.



Trial flow

Broader social impacts of housing improvement were reported in some studies, including improvements in social outcomes, such as perceptions of safety and social and community participation.<sup>16 17 19 23</sup> One small study reported a small increase in social support after the intervention.<sup>19</sup> Two studies that examined the effects of housing improvement in the context of area regeneration, reported that residents' concerns about local crime were reduced.<sup>17 23</sup> Another small study reported that fewer days were lost from school because of asthma after heating improvements.<sup>25</sup>

## Discussion

We found few studies examining the effects of housing improvements on health, and the quality of the studies identified was generally poor. Improvements have been reported in overall self reported physical and mental health, as well as reductions in symptoms and use of health services. There is also some evidence of improvements in broad indicators of social inclusion such as neighbourliness and fear of crime. However, because of the methodological limitations of the studies, it is impossible to specify the nature and size of health gain that may result from a specific housing improvement. In particular, there are few large prospective controlled studies, and many studies are now quite old.

The effect of publication bias on our study also needs considering. Given the small positive effect sizes and small sample sizes, any summary of the published studies may overestimate the effects of housing improvements. In addition, the fact that we identified only six out of the 18 included studies using electronic databases suggests that systematic reviews of non-clinical interventions need to develop specially tailored search strategies.

### Difficulties in studying housing and health

Reasons for the lack of studies into the effects of housing on health may include methodological difficulties and political obstacles. There are many methodological difficulties inherent in assessing the health effects of housing interventions. Poor housing conditions often exist alongside other forms of deprivation, and housing interventions rarely occur in isolation. This may affect the sociodemographics of an area and make before and after comparisons problematic.<sup>20</sup> Moreover, response and follow up rates in studies of deprived areas are often low.

More generally, the experimental approach to housing research has been criticised for being reductionist and ignoring the multifactorial nature of causality in housing, deprivation, and health.<sup>31</sup> Nevertheless, broad generalisations about the link between deprivation and ill health can have only a limited role in informing specific policy decisions.<sup>32</sup> Evidence of the effectiveness and cost effectiveness of specific interventions is therefore particularly important. Assembling such evidence requires a holistic approach, combining quantitative and qualitative methods and taking into account a range of possible influences and mechanisms.<sup>33</sup> Although there is a long tradition of this type of evaluation in the United States, it has rarely been attempted in the United Kingdom.<sup>34</sup> In 1989, Smith recommended that housing research should embrace a public health approach and include more multidisciplinary studies.<sup>35</sup> This is now

starting to happen. Of the ongoing studies we identified, eight are collaborations between housing and health agencies and academics.

Political obstacles to conducting housing research may also exist. Traditionally, policy makers in the United Kingdom have not had access to much evidence on the health effects of social interventions. This lack of evidence and the methodological limitations of existing studies may be used by governments to absolve themselves of responsibility for improving housing. However, the current Labour government's interest in identifying "what works," and its emphasis on joined up decision making, may facilitate a less fragmented approach to tackling deprivation. The number of current collaborative housing studies suggests a greater willingness to use such joined up approaches. What is also needed is robust evidence of their effects.

### Other evidence

Sources of evidence other than experimental studies are also important. Longitudinal studies have been recommended as a useful, if expensive, study design in evaluating complex interventions such as housing.<sup>35</sup> For example, recent results from the 33 year follow up from the longitudinal national childhood developmental study show that poor housing adversely affects health in later life. The study found a dose-response relation, with multiple housing deprivation leading to greater risk of disability or severe ill health in later life.<sup>36</sup> Data from the Boyd-Orr cohort also show that childhood housing conditions have an effect on adult health independent of the effects of socioeconomic deprivation.<sup>37</sup>

Further research is also needed into the direction of the relation between health and housing. Previous work has suggested that poor health can negatively affect housing opportunities.<sup>38</sup>

Although our review focused on major housing improvements, good evidence exists from systematic reviews that other interventions to improve health inside the home may be effective. Among these are interventions to reduce house dust mites and to reduce accidents among children and elderly people.<sup>39-41</sup>

### Conclusion

The basic human need for shelter makes the relation between poor housing and poor health seem self evident.<sup>42</sup> Despite, or perhaps because of, this intuitive relation, good research evidence is lacking on the health gains that result from investment in housing. We know little about the mechanisms of interaction of social factors and the effects of poor housing over the lifecourse. There is also a lack of comparative information on the costs and effects of specific housing improvements, such as central heating or major refurbishment. It is this type of evidence that is likely to be most valuable to policy makers and housing providers. Large scale studies that investigate the wider social context of housing improvements and their comparative effectiveness and cost effectiveness are now required.

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Contributors: HT contributed to the search strategy of the review, collection, and analysis of the data, and writing the paper



### What is already known on this topic

Many epidemiological studies have described associations between poor housing and health

### What this study adds

18 studies were reviewed that studied the health effects of housing improvements

Most studies found some health gains

Small populations and lack of control for confounders limits the generalisability of the findings

More large scale, controlled studies of housing interventions are needed to give qualitative and quantitative data

and is the guarantor. MP contributed to the collection and analysis of the data and writing the paper. DM contributed to reviewing the studies and writing the paper.

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**Table 1: Controlled and uncontrolled intervention studies of the health impacts of housing**

Study, country	Study methods, length of follow-up, number of participants (intervention/control)	Intervention	Health and social outcomes	Sample selection	Were potential confounding factors controlled or adjusted for?	Blinded assessment of outcomes	Main results (Response rate/follow-up rate at end point)	Strength of evidence
<b>Medical Priority Rehousing (MPR)</b>								
Elton & Packer (1987) <sup>6,7</sup>  Salford, UK	Prospective controlled observational study (within a randomised controlled trial). Interview and questionnaire before, 6-8 and 52 weeks after (n=28/28)	Prioritised rehousing by council on mental health grounds	Mental health, by Foulds and Bedford Personal Disturbance Inventory and Scales (DSSI/sAD) and Present State Examination (PSE).	Yes	None	No	6-8 weeks after initial interview 23/28 of the intervention group and 6/28 of the control group had been rehoused.  <i>Health outcomes:</i> Greater reduction in anxiety and depression in those rehoused, based on comparison of 11 matched rehoused/non-rehoused pairs (anxiety -6.5 v -0.6, p=0.0003, depression -6.0 v -1.5, p=0.005)  (100% at 1 year))	B
Smith et al. (1997) <sup>8</sup>  North, Midlands, and South of England	Retrospective cross-sectional study. Interviews at 3 sites 1-12 months after application for rehousing. (n=349/189)	Rehousing by council on mental health grounds	Self-reported general health status by Nottingham Health Profile (NHP); health service use	Yes	None	No	<i>Health outcomes:</i> Movers show improved NHP scores compared to those awarded priority but not yet moved (NHP energy: 44.8 v 63.4; pain 30.6 v 44.4; emotion 26.2 v 44.5; 39.2 v 52.2; 21.1 v 31.1, all p<0.05). Of those with mental health problems 56% reported an improvement in their mental health since the move  <i>Health service use:</i> Movers reported GP use was increased for 21% and decreased for 22%; Similar patterns for contact with consultants (14%, 24%), outpatient departments (14%, 22%), and time in hospital (14%, 30%). Improvements in general health were reported by 61% of MPR movers (no control data available).  (76% at 1-12 months)	C



Cole & Farries (1986) <sup>9</sup>  Bolton, UK	Retrospective cross sectional study. Questionnaire survey of 271 households 2-3 years after rehousing	Rehousing by council on mental health grounds	Self-reported health improvement	n/a	None	No	<i>Health outcomes:</i> 57 (37.7%) reported improvements to health since rehousing. The most common reason (56.5%) given by rehoused residents for health gain due to rehousing was 'lack of stairs' (one third of those rehoused had moved due to osteoarthritis).  (59% at 2-3 years)	C
<b>Rehousing/refurbishment plus relocation from slum area or community regeneration</b>								
Wilner et al. (1958, 1960) <sup>10, 11</sup>  Baltimore, USA	Prospective controlled study. Interviews before and 18 months after (n=400/600)	Rehousing from slum area	Self-reported social adjustment, morbidity and mental health	Yes	Controls matched for; quality of housing, family size, income, welfare, education, employment, age	No	<i>Health outcomes:</i> Greater increase in illness episodes in intervention group at 9 months compared to controls (+301.2 v +261.4 episodes per 1000 persons) but greater reduction at 18 months (-129.9 v -100.9). Social adjustment and mental health improved more among the intervention group (sit and talk +11.1% v +1.9%; positive mood: +13.6% v +10.6; satisfaction with status quo: +23.3% v +19.5%). 56% of the control group moved during follow-up; further analyses showed association between extent of housing improvement and amount of psychological improvement.  (unclear follow-up rate at 9-18 months)	B
Carp (1975, 1977) <sup>12, 13</sup>  USA	Prospective controlled study. Interviews with residents before and 8 years after, (n=127/62)	Rehousing from socially isolated, substandard housing	Self-reported health (diaries), physician contact, mortality rate, morale and life satisfaction (interview)	Yes	None	No	<i>Health outcomes:</i> Ratings of 'good' or 'excellent' health fell more in the control group (-13% v -28%, p=0.02). Increase in those reporting low life satisfaction at 8 years was greater in controls (intervention group: 17% v 18%; controls: 10% v 38%).  <i>Health service use:</i> Rates of physician contact in previous year and mortality rate were higher in control group (64% v 79%, p=0.03; 26% v 41%; p=0.045).  (84% at 8 years)	C

McGonigle & Kirby (1936) <sup>14</sup>  Stockton-on-Tees, UK	Prospective controlled study. Analysis of routine data for individuals 5 years before and 5 years after (n=710/1298)	Rehousing from slum area	Crude and standardised quinquennial mortality rates	No	Age and sex controlled for in analysis	Yes	<p><i>Health outcomes:</i> Age-standardised mortality rates increased in the rehoused population (22.91 v 26.10 per 1000) but fell in the slum area (26.1 v 22.78). Death rates increased across all age groups, apart from infants, where infant mortality rates fell in both groups but more in those rehoused (-54.8 vs -39.2).</p> <p><i>Other outcomes:</i> Rent in improved area doubled, and impacted on households' ability to buy food. Quantities of different food groups (first class proteins, total protein) fell short of the BMA Scale of Minimum Diets. These deficiencies were most extreme in the intervention group, especially among the unemployed (90% of households in intervention group).</p> <p>(routine data set for 5 years)</p>	C
Blackman et al (2001) <sup>15</sup>  Newcastle, UK	Prospective uncontrolled study. Structured interviews with 488/791 households before and 5 years after. At 5 years 98 of original households were re-interviewed. Cross-sectional data at 5 years also reported for 230 households (n=166 residents)	Major refurbishment, neighbourhood renewal, security and safety improvements to area	Self-reported health status, respiratory conditions, mental health, smoking health service use, view of area, safety, draughts in house	n/a.	Pre-intervention group data compared with age matched controls post-intervention (children only)	No	<p><i>Health outcomes:</i> Adults ratings of good general health status decreased (53% v 51%, p&lt;0.01), chronic respiratory conditions increased (adults 32% v 44%, p&lt;0.05, children 23% v 26%, p&gt;0.05). Percentage with a self-reported mental health problem decreased (adults 52% v 41%, p&lt;0.05, children 21% v 2%, p&lt;0.05), trouble with nerves (20% v 10%, p&lt;0.05). Percentage of smokers decreased (72% v 28%, p&lt;0.001).</p> <p><i>Health service use:</i> No changes in self-reported use. Percentage prescribed medication for a month or more increased (36% v 47%, p&lt;0.05)</p> <p><i>Other outcomes:</i> View of area as very/quite nice increased (49% v 62%, p&lt;0.05), area seen as very/quite safe (25% v 50%, p&lt;0.001). Percentage reporting seriously draughty house reduced (35% v 20%, p&lt;0.05)</p>	C

<p>Ambrose (2000)<sup>16</sup> London, UK</p>	<p>Prospective uncontrolled study. Interviews with residents before and 1-4 years after intervention (n=70)</p>	<p>Rehousing or housing improvement and area regeneration</p>	<p>Self-reported illness episodes (standardised for days recorded), illness days, use of health services, prescriptions and self-treatment.</p>	<p>n/a</p>	<p>None</p>	<p>No</p>	<p><i>Health outcomes:</i> Illness episodes increased by 56%, (from 0.0036 to 0.0056 per person per day) partly due to flu epidemic. Increase in coughs and colds (42% vs 67%, p&lt;0.0001); no change in dietary and digestive disorders (12% v 15%, p=0.3). Reduction in aches and pains (23% v 12%, p=0.0004), asthmatic and bronchial symptoms (17% v 6%, p=0.0001), stress and depression (6% v 1%, p=0.002).</p> <p><i>Health service use:</i> Reduction in use of general practitioner (74.6% v 59.4%, p&lt;0.0001), prescription use (65.4% v 51.0%, p=0.0002), and use of casualty or outpatients (20% v 5%, p&lt;0.0001); and illness days (per person, per day) decreased (0.37 v 0.05). No difference in purchase of proprietary medicines (25% v 26%, p=0.8).</p> <p><i>Other outcomes:</i> Increases in feeling of safety (46.7% v 72.0%, p&lt;0.0001); also significant improvements in sense of belonging to community and social networks, and significant reductions in concerns about criminal activity and behaviour of young people. Residents also reported significantly decreased access to health and hospital services.</p> <p>(71% at 4 years)</p>	<p>C</p>
<p>Wells (2000)<sup>17</sup> Michigan, USA</p>	<p>Prospective uncontrolled study. Interviews before, 5 months, and 2 and 3 years after (women only) (n=23)</p>	<p>Rehousing</p>	<p>Psychological wellbeing (using Psychiatric Epidemiological Research Instrument, PERI), neighbourhood atmosphere.</p>	<p>n/a</p>	<p>None</p>	<p>No</p>	<p><i>Health outcomes:</i> Reduction in psychological distress at first follow-up (mean PERI score 31 v 22.6, t=4.00, p&lt;0.001). Changes in housing quality contributed 12% of the variance in distress. At 3 years mean PERI score was 23.22, not significantly different to the post-move average of 22.26 but significantly different to the pre-move mean of 31, t(22)=4.19, p&lt;0.001.</p> <p>(74% at 3 years)</p>	<p>C</p>

Halpern (1995) <sup>18</sup> UK	Mixture of cross-sectional and prospective data presented. Structured interview before, & 1 year after (n=55)	Refurbishment and community regeneration	Mental health (Hospital Anxiety & Depression Scale - HADS), self esteem (Rosenberg Scale), neighbourhood involvement	Yes- from neighbouring locality	Age, length of residence, children under 14, employment, income controlled for in analysis	No	<p><i>Health outcomes:</i> Reduction in anxiety and depression at 1 year (8.2 v 5.8, p&lt;0.05; 5.4 v 3.6, p&lt;0.05). Self-esteem rose non-significantly (53.1 v 57.5, p&lt;0.1). Mean total HADS score fell (11.5 v 8.7).</p> <p><i>Other outcomes:</i> Following intervention residents more likely to attend Residents Association meeting (3% v 19%) more likely to recognise neighbours (55% v 74%) Social support score increased over time (4.7 v 5.6, p&lt;0.05).</p> <p><i>(60-70% at 3 years, only 49% of original sample followed up at 3 years)</i></p>	C
Walker & Bradshaw (1999) <sup>19</sup> Gwent, UK	Retrospective controlled study. Comparison of 2 GP practices to matched control area data, 2-7 years after.	Rehousing and area regeneration	Routine prescribing data over 5 years. Health service providers views on local area and health changes. Interviews with service providers.	Yes- control practices from neighbouring locality	Control practices matched for practice population, Townsend score & social class (from census data)	Yes	<p><i>Health outcomes:</i> Hypnotic prescribing was reduced in the practices covering the regeneration area (-10.845 v +1.9). Anxiolytic prescribing fell in one intervention practice compared to reference area (Area A:-0.45, Area B:-25.56 v reference area: +16.22). Mixed results for antidepressants (A:+29.88, B:+53.59 v +55.57). No beneficial effect of housing renewal on respiratory prescribing (A: +4.75, B: +18.11 v 4.4). Factors other than area regeneration may account for these changes.</p> <p><i>(routine data at 2 &amp; 7 years)</i></p>	C
Wamben & Piland (1973) <sup>20</sup> California, USA	Retrospective controlled study. Routine data 18 months before and 12 months after (n=81/86)	Rehousing from slum area	Hospital out-patient visits	No	None	Yes	<p><i>Health service use:</i> Among children (0-9 years) greater reduction in outpatient visits in those rehoused (all causes, -1.667 v -0.130, p=0.03; housing related visits, -0.963 v +0.0204 p=0.05), no significant differences among other age groups. Significantly greater reduction in housing related visits among rehoused women (-0.538 v +0.120 p=0.02) (though the groups differed significantly at baseline) but not men.</p> <p><i>(%age follow-up not reported at 1 year)</i></p>	C

<p>Baba et al. (1996)<sup>21</sup></p> <p>Tokyo, Japan</p>	<p>Retrospective uncontrolled study Survey 6-24 months after housing improvement (n=375)</p>	<p>Improvement to housing conditions (ranging from new bed to major renovation)</p>	<p>Change in daily activities, need for home care and hospital based care, by questionnaire</p>	<p>n/a</p>	<p>None</p>	<p>No</p>	<p><i>Health outcomes:</i> 34% of users became more active after house improvement (42% no change, 7% worse). Workload for carer declined in 39% of cases (36% no change, 3% increased). 33.8% of respondents reported an increase in activity levels.</p> <p><i>Health service use:</i> Decreased need for home care reported by 39%, reduced likelihood of hospitalisation by 40.3% (no details on reported increased need for care). Changes in entrances and approaches to the residence were most closely associated with improvement in daily activities.</p> <p>(83% at 6-24 months)</p>	<p>C</p>
<p>Woodin et al. (1996)<sup>22</sup></p> <p>London, UK</p>	<p>Retrospective cross sectional study. Survey of households 6-12 months after rehousing (n=160)</p>	<p>Rehousing and area regeneration</p>	<p>Self-reported health service use, experiences of crime and violence, by questionnaire</p>	<p>n/a</p>	<p>None</p>	<p>No</p>	<p><i>Health service use:</i> Decreased visits to GP after rehousing (before v after: 86% v 69%, p=0.003), frequent users (&gt;6 GP visits per year) reduced (38% v 22%, p=0.01).</p> <p><i>Other outcomes:</i> These include: large reductions reported in sense of isolation (19% v 6%), fear of crime (60% v 16%), and problems with traffic (39% v 22%). Increased involvement in community affairs (14% v 21%).</p> <p>(70% at 6-12 months)</p>	<p>C</p>

<i>Energy Efficiency Measures</i>								
Somerville et al. (1999) <sup>23,24</sup> Cornwall, UK	Prospective uncontrolled study. Survey of school age children before and 3 months after (n=72)	Central heating installation	Asthma symptoms, time off school. An economic analysis compared health service use, and prescribing is being carried	n/a	None	No	<i>Health outcomes:</i> Respiratory symptoms reduced (e.g., median frequency of nocturnal cough reduced from “most days” to “1 or several days” in previous month; p<0.001). School age children lost less time from school from asthma (9.3 days per 100 school days before, vs 2.1 days after, p<0.01), but not for other reasons (1.4 days per 100 school days before and 3.2 after, p>0.05).  (68% at 3 months)	C
Hopton & Hunt (1996) <sup>25</sup> Glasgow, UK	Prospective controlled study. Survey of children under 16 years-before, 6 and 12 months after (n=254 households)	Installation of ‘Heat with Rent’ system	Self-reported symptoms	Yes	Smoking, unemployment, changes in other housing conditions, perceived financial situation controlled for in analysis	No	<i>Health outcomes:</i> No group differences in overall mean number of symptoms reported, or in each of 14/15 symptoms reported; significant increase in reporting of aches and pains in intervention group after installation (9.1 v 25.5, p<0.05) but not in control group (9.1 v 18.2, p=0.1). Change in reported level of dampness was the only significant predictor of change in reporting of runny nose (t=2.41; p<0.01).  (30% at 1 year. Not clear of response rate in control group. At follow-up control group differences in smoking and employment disappeared.)	C
Iversen et al. (1986) <sup>26</sup> Copenhagen, Aalberg, Esberg, Herning and Vejle, Denmark	Prospective controlled study. Survey of residents in private housing before and up to 3-9 months after (n=106/535)	Replacement of windows	Self reported symptom list	Yes	Age, smoking & colds controlled for in analysis- no reported data	No	<i>Health outcomes:</i> Some symptoms significantly reduced in the intervention group; joint pains (OR=0.28), headache (OR=0.72), neck or back pain (OR=0.18) (all p<0.01). Odds Ratio normalised for month when baseline measures were taken. Also adjusted for age, smoking and colds; no data reported. No confidence intervals given or calculable.  (31% at 3-9 months- but owing to changes in refurbishment plans only 641 (19%) used in analysis.)	B

Green & Gilbertson (1999) <sup>27,28</sup> Sheffield, UK	Retrospective controlled study. Survey of residents after housing renewal (n=135/140)	Energy efficiency improvements to tower blocks	Health status (SF36)	Yes- but intervention group more likely to be employed (28.2% v 15.7%)	Control group matched for income, housing and area	No	<i>Health outcomes:</i> Residents of improved housing had higher SF36 scores on 2 of the 8 dimensions; 'physical role' (mean 87.7 v 73.9, p=0.003), 'energy and vitality' (mean 59.9 v 51.9, p=0.014). No significant differences on physical function, emotional role, social function, mental health, pain, or general health perception.  <i>(response rate not clear)</i>	C
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**Key:**

**Sample selection:** Were intervention and control groups from the same population?

**Blinded assessment of outcomes (e.g. Self-report):** Were those assessing health outcomes blind to housing status of interviewees?

**Table 2: Ongoing studies of health impacts of housing**

<b>Author, and/or study location</b>	<b>Method</b>	<b>Intervention</b>	<b>Outcomes</b>	<b>Expected Completion date</b>
Eastleigh HA, Hampshire, UK	Investigate local authority practice and health gains from rehousing for health reasons	Rehousing from Medical Priority Rehousing list	Health gains, local authority practice and procedures, collaborative working with health providers	2002
Gwent & Caerphilly, UK	Prospective controlled study before 3 & 9 months after (n=40/40)	Mould eradication	Respiratory health	2003
Fife Kingdom HA, UK	Retrospective questionnaire/interview of households relocated to sustainable homes (n=15)	Sustainable and energy efficient homes	Energy measures, housing survey, indoor environmental measures, health measures, health service use, economic analyses	2001
Sandwell HAZ, Birmingham, UK	Prospective questionnaire to households before and 12 months after	Prescribing central heating and an insulation package to the elderly and children with asthma	SF12, asthma symptom diary, quality of life, health service use, prescriptions, days lost from school	2002
Torbay Healthy Housing Project Torbay, UK <sup>28</sup>	Randomised stepped wedge of rehousing for residents from 142 local authority houses (n=580)	Housing refurbishment	Respiratory, health diaries, health service use, environmental measures	2002
“Warm Homes” study, Glasgow, UK	Prospective controlled questionnaire and housing survey of households (n=300/200)	Major housing refurbishment	Fuel costs, indoor temperature, physical and environmental living conditions, health service use. Also economic analysis	2001
Liverpool Housing Action Trust, Liverpool, UK	Prospective controlled study following residents for 2 years following move (n=225/225)	Moving from hi-rise to low rise flats. Control group matched for age, type and duration of residence, socio-economic status	Health service use, health status (SF36), energy efficiency, quality of life, income, service use	2001
Cordale HA, West Dunbartonshire, UK	Prospective matched control, structured interview before and 1 year after (n=50/100)	Rehousing	SF36, self-reported symptom list & health service use	2002
Riverside Project, Cardiff, UK	Prospective study. Questionnaire and routine data from households, 4 months before and 6 months after rehousing (n=150)	Housing renovation and community regeneration	Indoor housing conditions, SF36, quality of life, self-reported respiratory symptom diaries	2001



Willow Park HA, Manchester, UK	Prospective controlled questionnaire and interview survey	Rehousing and regeneration	Mental health (GHQ-12), quality of life, self-reported consulting rates	2001
Shepherd's Bush HA London, UK	Prospective controlled questionnaire survey (n=600/300)	House refurbishment, new housing and general area reinvestment	Health and health service use, housing measures	2002
Rhymney Valley, Mid Glamorgan, UK	Prospective questionnaire survey (n=4000)	Area and housing renewal	SF36	2010
Scotswood, Newcastle-upon-Tyne, UK	Prospective structured interview survey (n=600)	Medical Priority Rehousing application	SF36, self-reported health, neighbourhood and housing changes	2002
Lambeth Housing, London, UK	Prospective controlled structured interview survey of elderly tenants (n=400/400)	Central heating, insulation, benefit advice	SF36, self-reported health, health service use, hospital admission data	2003

**Key:** HA: Housing Association  
HAZ: Health Action Zone  
SF12: Short Form 12- Health Survey questionnaire  
SF36: Short Form 36  
GHQ-12: General Health Questionnaire- 12 item

**Theme I: Systematic Review**

**Paper II** Thomson H, Atkinson R, Petticrew M, Kearns A. Do urban regeneration programmes improve public health and reduce health inequalities? A synthesis of the evidence from UK policy and practice (1980-2004). *Journal of Epidemiology & Community Health* 2006; 60 (2):108-115.

*With web supplements*



## Do urban regeneration programmes improve public health and reduce health inequalities? A synthesis of the evidence from UK policy and practice (1980–2004)

Hilary Thomson, Rowland Atkinson, Mark Petticrew and Ade Kearns

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## RESEARCH REPORT

# Do urban regeneration programmes improve public health and reduce health inequalities? A synthesis of the evidence from UK policy and practice (1980–2004)

Hilary Thomson, Rowland Atkinson, Mark Petticrew, Ade Kearns

*J Epidemiol Community Health* 2006;60:108–115. doi: 10.1136/jech.2005.038885

**Objectives:** To synthesise data on the impact on health and key socioeconomic determinants of health and health inequalities reported in evaluations of national UK regeneration programmes.

**Data Sources:** Eight electronic databases were searched from 1980 to 2004 (IBSS, COPAC, HMIC, IDOX, INSIDE, Medline, Urdisc/Accompline, Web of Knowledge). Bibliographies of located documents and relevant web sites were searched. Experts and government departmental libraries were also contacted.

**Review methods:** Evaluations that reported achievements drawing on data from at least two target areas of a national urban regeneration programme in the UK were included. Process evaluations and evaluations reporting only business outcomes were excluded. All methods of evaluation were included. Impact data on direct health outcomes and direct measures of socioeconomic determinants of health were narratively synthesised.

**Results:** 19 evaluations reported impacts on health or socioeconomic determinants of health; data from 10 evaluations were synthesised. Three evaluations reported health impacts; in one evaluation three of four measures of self reported health deteriorated, typically by around 4%. Two other evaluations reported overall reductions in mortality rates. Most socioeconomic outcomes assessed showed an overall improvement after regeneration investment; however, the effect size was often similar to national trends. In addition, some evaluations reported adverse impacts.

**Conclusion:** There is little evidence of the impact of national urban regeneration investment on socioeconomic or health outcomes. Where impacts have been assessed, these are often small and positive but adverse impacts have also occurred. Impact data from future evaluations are required to inform healthy public policy; in the meantime work to exploit and synthesise “best available” data is required.

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Policies and interventions that tackle the root causes of poor health have recently been promoted by the UK and other EU governments as an important component of national strategies to improve health and reduce health inequalities.<sup>1–6</sup> The need to ground these strategies on evidence has also been highlighted.<sup>2, 7–8</sup> Most recently the Wanless report stated that “every opportunity to generate evidence from current policy and practice needs to be realised”, and pointed to the value of systematic review methods in this regard.<sup>2</sup> National programmes of urban regeneration, or area based initiatives (ABIs), are one example of large scale investment tackling urban deprivation and the socioeconomic determinants of health, for example, employment, education, income, and housing; in the UK £11 billion has been spent on these initiatives over the past 20 years. The potential for this significant investment to lead to health improvement may seem obvious and indeed is currently used as a justification of such large scale investment (box 1).<sup>1, 9–11</sup> However a systematic review of the impacts of ABI programmes on health or the socioeconomic determinants of health has not yet been done.

The dearth of data validating links between regeneration<sup>12</sup> or housing investment within regeneration programmes<sup>13</sup> and subsequent health improvement has already been established in both systematic<sup>13</sup> and non-systematic reviews.<sup>12</sup> But these reviews have relied largely on the results of formal research studies. Other relevant data and valuable lessons from previous policy interventions may remain hidden within government reports of policy evaluations. For example, large scale evaluations of ABIs are commissioned by government departments but their findings are

rarely published in academic journals and the public health value of the evaluations' findings seems to have been overlooked. In addition, evaluations of ABI programmes may be more likely to prioritise assessments of socioeconomic outcomes, over health outcomes. Impacts on socioeconomic outcomes have been recommended as a pragmatic and more immediate alternative to assessments of health impacts where health impact data are absent or difficult to obtain.<sup>4</sup> A systematic examination of both the health and the socioeconomic impacts reported in national ABI evaluations may therefore allow exactly the type of synthesis called for by Wanless.<sup>2</sup>

## WHAT IS THE EVIDENCE THAT NATIONAL PROGRAMMES OF URBAN REGENERATION (ABIs) IMPROVE HEALTH?

We carried out a synthesis of evaluations of national ABI programmes in the UK over 24 years (1980–2004) to examine the evidence that such major investments can have an impact on population health, the socioeconomic determinants of health, and health inequalities. We used existing systematic review methods for this synthesis.<sup>14</sup>

## METHODS

### Search strategy

We searched for the original reports of national evaluations of all the UK government's nine national ABI programmes since 1980. (A brief description of each ABI programme's activities, focus, years of implementation, and level of funding in the UK since 1980 is provided in table 1.) Eight

### Box 1 The potential for health improvement is currently an important justification for large scale public investment in ABIs

- "Local neighbourhood renewal and other regeneration initiatives are in a particularly good position to address health inequalities because they have responsibility for dealing with the wider determinants that have impact on people's physical and mental health."<sup>1</sup>
- "The benefits of including health in the strategy of regeneration strategy are twofold. First there are the direct benefits of improving peoples' physical and mental health and wellbeing. Second are the indirect benefits for employment, quality of life, levels of stress and the cost of hospital admissions or medicines."<sup>19</sup>
- "Area regeneration has a key contribution to make to improving health. It tackles the social, economic, and environmental problems of multiple deprivation. And it embodies the concerted approach the government seeks to foster."<sup>10</sup>
- Aims of current national ABI (New Deal for Communities). "Lower worklessness and crime, and better health, skills, housing and physical environment."
- To narrow the gap on these measures between the most deprived neighbourhoods and the rest of the country."<sup>11</sup>
- A tally of available funding for programmes included in our review produced an estimate that over £11bn (16bn euros) of public money has been spent on ABIs in England alone between 1980 and 2002.

INSIDE (1980–2004), Ovid Medline (1980–2004), Urbanisc/ Accompline (1980–2004), Web of Knowledge (1980–2004)). Because of the specific nature of the review topic, the databases were searched for any text containing the programme names or their commonly used abbreviations (for example, SRB for single regeneration budget). Relevant government departmental libraries were contacted for details of archived reports. Bibliographies of located documents and identified relevant web sites were also searched (<http://www.odpm.gov.uk/>, <http://www.landecon.cam.ac.uk/urban/urgrsb.html>). Authors of national ABI evaluations and an author's (AK) own experience in this specialist field were drawn on to identify experts; identified experts were contacted to ask about further documentation available that may not have been identified by our search strategy.

#### Inclusion and exclusion criteria

Evaluations that reported achievements or impacts drawing on data from at least two target areas of a national ABI programme in the UK were included. Evaluations of single target areas or of projects within programme areas were excluded as the review aimed to assess the general impacts of a national programme; we assumed that single area evaluations may be less able than multi-area evaluations to account for local peculiarities that may influence outcomes. Annual reports and routine audits of programme activity were excluded unless they were presented as an evaluation or assessment of the programme's achievements. Where it was clear that the document reported on a process or strategy for delivering urban regeneration rather than on the outcomes of ABI investment these documents were excluded (for example, the use of inter-agency partnership working in the delivery of ABI programmes). All methods of evaluation were included (for example, qualitative, quantitative case study, retrospective or prospective studies). Evaluations reporting only business and enterprise outcomes were not included.

electronic databases were searched (Bath Information and Data Services International Bibliography of the Social Sciences (BIDS IBSS, 1980–2004), COPAC (1980–2004), Health Management Information Consortium (HMIC, 1988–2004), IDOX Information Service (1980–2004),

#### Screening and selection

Titles of identified documents were screened by one reviewer to exclude obviously irrelevant or duplicate documents, after which titles and abstracts were screened independently by two reviewers. Where there was disagreement or uncertainty

**Table 1** Main activities and funding of national ABI programmes in the UK since 1969

ABI programme (ordered by date)+estimated expenditure	Main focus of programme
Urban Programme 1969–1980s about £274m/year	Grant based programme to deal with areas of special social need through supplementation of existing programmes covering economic, environmental, employment and social projects.
Urban Development Corporations (UDC) 1981–1998 £2120m	Property and economic regeneration to attract inward investment.
Estate Action 1985–1995 £1975m	Housing led regeneration, addressing both improvements to physical aspects of housing as well as housing management. <sup>47</sup>
New Life for Urban Scotland (New Life) 1988–1998 £485m	Comprehensive multi-agency regeneration programme to improve housing, environment, service provision, training and employment for local people in four areas. <sup>48</sup>
Small Urban Renewal Initiatives (SURI) 1990–2003 £160m+	Housing led regeneration to widen housing choice, improve quality of housing quality and the local environment, improve economic prospects and lever public and private funding. <sup>27</sup>
City Challenge 1992–1998 £1162.5m	Comprehensive multi-agency regeneration to improve quality of life of residents in run down areas. <sup>35</sup>
Single Regeneration Budget (SRB) 1995–2001 £5703m + £20301m from private sector	Comprehensive multi-agency regeneration through initiatives on employment, training, economic growth, housing, crime, environment, ethnic minorities and quality of life (including health, sport, and cultural opportunities). <sup>32</sup>
Regeneration Partnerships (now known as Social Inclusion Partnerships (SIPs)) 1996 £52m	Coordinated approach to tackle and prevent social exclusion and demonstrate innovative practices. Main activities focus on education and training, and initiatives to reduce poverty, crime, and promote employment, enterprise, empowerment, and health. <sup>34</sup>
New Deal for Communities (NDC) £2000m 1998–2008	Neighbourhood based programme delivered through multi-agency partnerships. Aims: to reduce inequalities in crime, worklessness, education, housing, and health between the 39 target areas and the rest of England. Key characteristics of this programme are: long term commitment to deliver real change, communities in partnership with key agencies, community involvement and ownership, joined up thinking and solutions, and action based on evidence about "what works" and what doesn't. <sup>49</sup>

the full document was obtained and screened independently by two reviewers. Data extraction was carried out by RA and HT.

### Data extraction

Impact data, defined as a measure of change in a given outcome over time, were extracted for health and selected socioeconomic outcomes. Health outcomes were any direct measure of health (quality of life, wellbeing, health, morbidity, mortality) or intermediate measure of health (for example, registration/use/satisfaction with local health services). Socioeconomic outcomes relevant to the determinants of health were defined as outcomes pertaining to housing, education, training, income, or employment. These included both direct measures (for example, household income, housing quality) and intermediate measures (receipt of welfare, satisfaction, with housing). Impacts on crime and neighbourhood outcomes (for example, satisfaction with local shops) were also extracted. Gross output data (reports

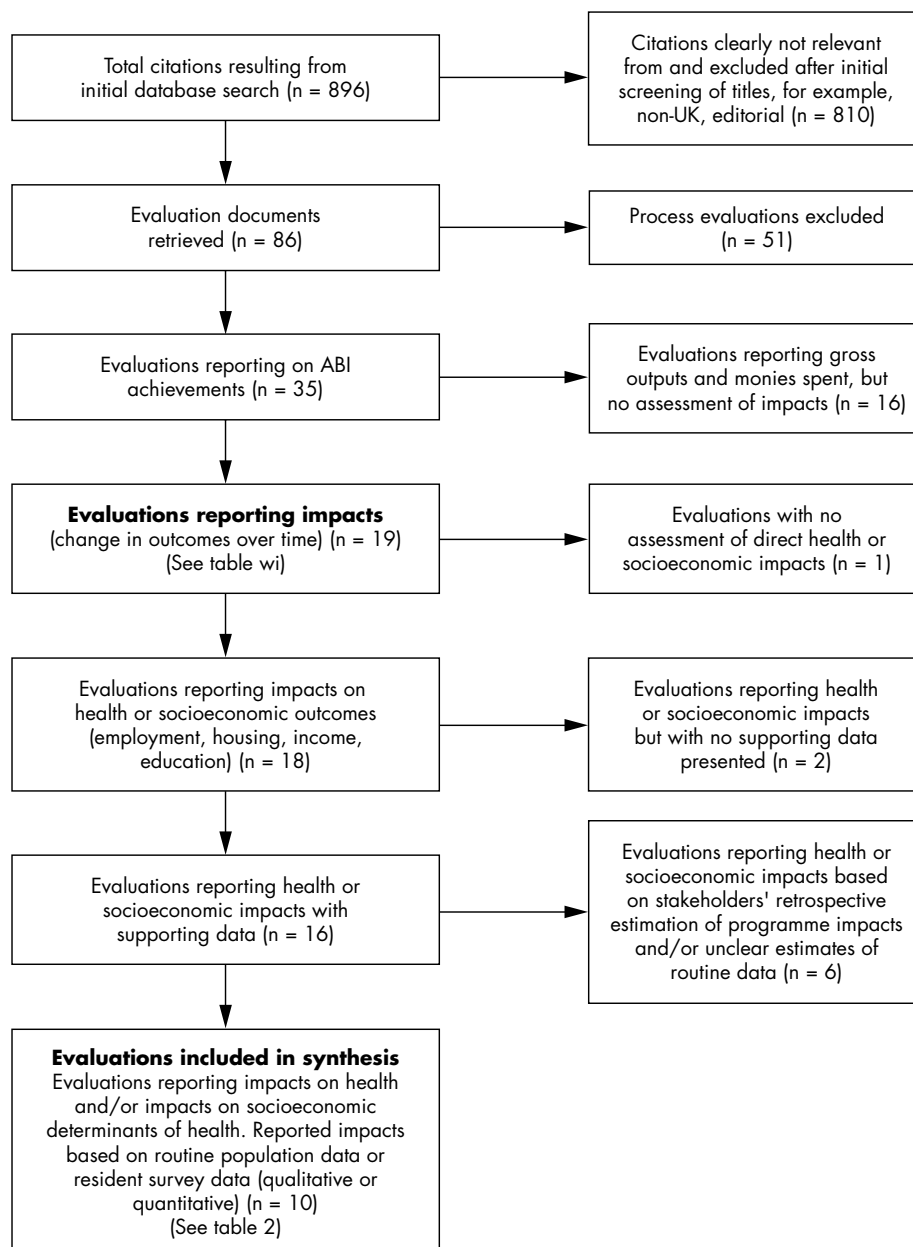
of monies spent and investment activity, for example, number of dwellings built or improved, use of new sports centre) were not extracted.

### Data synthesis

Impact data on direct health outcomes and direct measures of socioeconomic determinants of health were synthesised. Stakeholders' and evaluators' overall assessment of impacts on direct outcomes were not included in the synthesis. Intermediate outcomes were not included in the data synthesis.

### RESULTS

A total of 896 references were identified of which 86 initially appeared relevant; 35 were included in the final review (fig 1). Sixteen evaluations used gross outputs exclusively to report programme achievement. Nineteen evaluations assessed health and social impacts and were included in



**Figure 1** Flow diagram of identifying included evaluations.

the first stage of the review (see table w1 on line <http://www.jech.com/supplemental>).<sup>15-34</sup>

### Impact evaluations: methods, data quality and choice of outcome measures

Nine evaluations were carried out prospectively.<sup>23 24 26-28 30 31 34</sup> All but two<sup>20 26</sup> of the impact evaluations used a case study approach, where the evaluators selected a few sites to represent the national programme. Detailed reporting of evaluation methods, data sources, and sample sizes was poor; in two evaluations some impacts were reported without any supporting data.<sup>23 24</sup> Furthermore, evaluators frequently reported that data on included outcomes were unavailable, resulting in non-reporting<sup>17 23 24 29</sup> or presentation of incomplete data in the final document.<sup>16 19 28 34</sup>

Evaluations assessing impacts relied heavily on routine statistics collected by the UK government as well as stakeholders' perceptions or the evaluators' overall estimates of impacts. Six evaluations included a prospective survey of residents,<sup>23 24 26 28 32 34</sup> one of which was a panel survey of the same residents at both time points.<sup>32</sup> Ten of the 19 impact evaluations reported impacts on direct health or socioeconomic outcomes (table 2).<sup>18 22 25-28 30-32 34</sup>

### Data synthesis of direct impacts on health and socioeconomic status

Impacts on direct health and socioeconomic outcomes reported in the evaluations were self reported health status, mortality rates, employment (long term unemployment, employment, unemployment), household income, educational attainment, housing quality, and housing costs (rent) (table 2). A narrative synthesis of these impacts is presented below.

#### Impacts on self reported health and mortality rates

Impacts on self reported health or mortality rates were reported in three evaluations.<sup>26 31 32</sup> In one evaluation that surveyed the same residents before and after the programme, three of four measures of self reported health deteriorated, typically by  $\pm 3.8\%$ .<sup>32</sup> Two other evaluations reported overall improvements in mortality rates (standardised mortality rate 131 v 114<sup>26</sup> and 122 v 118,<sup>31</sup> crude mortality rate  $-0.6\%$ <sup>31</sup>) although standardised mortality rates increased in some case study areas in one of these evaluations.<sup>26</sup>

#### Impacts on employment and unemployment

Employment measures were the most frequently included outcome measure and data were reported in nine evaluations.<sup>18 25-28 30 31 32 34</sup> Improvements were reported in all but one evaluation.<sup>18</sup> However, this simple tally of positive impacts conceals the specifics of type of outcome assessed, negative effects, and missing data.

Three evaluations reported improvements in employment (% working age in employment  $+6\%$ <sup>26</sup>  $+4\%$ <sup>32</sup> and number of households with at least one person economically active  $+9\%$ <sup>27</sup>), but in one of these evaluations employment rate fell in two of the four case study areas<sup>26</sup> and in another evaluation there was no additional improvement when compared with the national trend in employment rates.<sup>32</sup>

Eight evaluations reported impacts on unemployment outcomes; in six of these positive impacts were reported (% unemployed  $-1.3\%$ ,<sup>31</sup> unemployment rate  $-3.8\%$ ,<sup>34</sup>  $-10.8\%$ <sup>30</sup> numbers of unemployment claimants  $-32\%$ ,<sup>34</sup>  $-29.5\%$ ,<sup>25</sup> and % working age economically inactive  $-5.3\%$ ,<sup>26</sup>  $-4\%$ ,<sup>32</sup>). In two evaluations overall impact on employment outcomes were negative (unemployment rate  $+0.3\%$ ,<sup>28</sup> % unemployed  $+3.35\%$ <sup>18</sup>). While improvements in unemployment measures were regularly reported, in two evaluations a mix of negative and positive impacts on unemployment measures were

reported across case study areas<sup>26 28</sup> and in a further three evaluations the improvements reported were similar to national or regional trends over the same time period.<sup>25 31 34</sup>

Impact on long term unemployment was reported in three evaluations (% of unemployed who have been unemployed  $>12$  months,<sup>28 30</sup> and % of (unemployed + employed population) who have been unemployed  $>12$  months<sup>31</sup>). In two evaluations of the SRB long term unemployment fell ( $-1.6\%$ <sup>31</sup> and  $-17\%$ <sup>30</sup>), although in one of these evaluations rates of long term unemployment increased relative to standardised English rates.<sup>31</sup> In one evaluation of City Challenge an overall increase in long term unemployment was reported, although both increases and decreases were reported within individual case study areas (range  $-4.1\%$  to  $+5.8\%$ ).<sup>28</sup>

#### Impacts on educational attainment

Five evaluations (1988-1999) reported impacts on school achievement. Improvements in proportions of "pupils obtaining  $>4$  GCSEs" or " $>2$  standard grades" (Scotland) were consistently reported in the four evaluations that included this outcome (mean impact  $+6.25\%$ ).<sup>26 28 30 31</sup> However, similar improvements in the proportion of "pupils obtaining  $>4$  GCSEs" were also reported across England over this time and two evaluations reported little or no improvement when the findings were compared with national data.<sup>30 31</sup> Despite overall improvements, both negative and positive impacts on the proportion of respondents reporting "any member of household with CSE/GCSE/O level"<sup>32</sup> or "school leavers with no GCSEs"<sup>28</sup> were reported across case study areas in two evaluations.

#### Impacts on household income

The number of households with incomes below £100 per week was assessed in two evaluations<sup>26 32</sup> and an overall improvement was reported. However, in one of these evaluations a range of negative and positive impacts on this outcome were reported across the four case study areas ( $-34\%$  to  $+3\%$ ).<sup>26</sup>

#### Impacts on housing quality and rent

The proportion of original residents living in improved housing after ABI investment was only reported in one evaluation (42.5%).<sup>22</sup> Another evaluation assessed changes in housing costs; average social housing rent doubled over the period of investment, seven to eight years.<sup>25</sup>

## DISCUSSION

This review is a direct response to Wanless's call to tap "every opportunity to generate evidence from current policy and practice".<sup>2</sup> The use of conventional systematic review methods to synthesise impact data for both socioeconomic outcomes as well as health outcomes is a novel attempt to present evidence tailored to inform healthy public policy. The data synthesis suggests that previous ABIs may have small positive impacts (median size of positive impact reported  $\pm 5.5\%$ , range 1.0% to 32.0%, for example, unemployment rate  $-3.8\%$ ,<sup>34</sup> households with income of less than £100  $-4\%$ <sup>32</sup>) across a range of key socioeconomic determinants of health, although these impacts may mirror national trends. Small positive health impacts are also reported, but adverse health impacts remain a real possibility.

However, reports of impacts in the evaluations of ABIs are rare. In the UK, evaluation of ABI achievement has relied heavily on reports of gross outputs and monies spent (for example, number of new houses built), rather than reports of the actual impacts effected by the investment (for example, change in the proportion of residents living in poor quality housing). Even when an impact evaluation has been







Table 2 Continued

Programme (dates of data collection) Number of case study areas included in evaluation/total number of target areas included in programme	Outcome measure used (number of case study areas where data reported/ no of case study areas included in evaluation)	Overall impact and range across case study areas	Direction of overall impact	Range of effects across case study areas includes zero	Improvement reported over and above national or regional trends over *same time period *
SRB <sup>30</sup> (1994 v 1997) Three target areas	pupils achieving >4 GCSEs grade A-C (one area)	41.6% v 45.8%, +4.2% (English data 43.3% v 45.1%, +1.8%)	Improvement	Yes	Yes
SRB <sup>31</sup> (1994 v 1999)	pupils achieving >4 GCSEs (one area)	50.3% v 56.1%, +5.8% (range +4.3% to +7.3%)	Improvement	No	No
Two target areas	standardised rate where England = 100 (one area)	116 v 117 (range -2 to +3)	Little or no improvement	Yes	No
SRB <sup>32</sup> (1996 v 1999)	any member of household with CSE/GCSE/O level taken part in training in past three years	53% v 54%, +1% (range -10% to +3%) 22% v 29%, +7%	Small improvement Improvement	Yes	Yes
Panel survey in three target areas					
Impacts on household income	households with incomes below £100/week	65.3% v 48.8%, -16.5% (range -34% to +3%)	Improvement	Yes	Yes
All four target areas	households with incomes below £100/week	30% v 26%, -4% (range -10% to -3%) England data 19% v 16%, -4%	Improvement	No	No
SRB <sup>32</sup> (1996 v 1999)					
Panel survey in three target areas	% of residents from local target areas now living in new/ improved housing (two areas)	42.5%	Improvement		
Impacts on housing quality and rent	Average weekly rent in LA housing 1990/1-1997/8 (areas)	+99.3% (range +8.9% to +324%)	Increased housing costs	No	No
UDCs <sup>22</sup>	Average housing association weekly rent compared with previous local authority (four areas)	+116.8% (range +83.7% to +162.5%)	Increased housing costs	No	No
3 of 11 target areas					
Estateaction <sup>22</sup> (1990/91 v 1997/98)					
Seven case study areas					

\*Where data provided in the evaluation report.

## What this paper adds

### What is already known on this subject?

Strong links between socioeconomic circumstances and health are currently used to support large scale investment in national programmes of urban regeneration. Yet the potential for this investment to contribute to a health improvement strategy remains unknown. Evaluations of national urban regeneration programmes may harbour valuable data of the health and socioeconomic impacts of this large scale investment, but these data have not been systematically reviewed.

### What does this study add?

- Regeneration programmes may lead to some small positive impacts on health and socioeconomic circumstances, but adverse impacts are also a possibility. To date evaluations of national regeneration investment have rarely assessed impacts on health or impacts on the socioeconomic determinants of health; far less is reported on the social distribution of these impacts.
- Impact evaluations that can be used to inform both public policy and healthy public policy are urgently required. In addition, innovative approaches to exploiting "best available evidence" can be used to inform the development of healthy public policy now.

## Policy implications

Impact evaluations that can be used to inform both public policy and healthy public policy are urgently required. In addition, innovative approaches to exploiting "best available evidence" can be used to inform the development of healthy public policy now.

attempted this has often been unsuccessful. Evaluators frequently reported difficulties with data collection, preventing clear conclusions around impacts. This made identifying relevant evidence to synthesise for this review difficult. Common problems reported by evaluators included a lack of baseline data, lack of routine data that conform to target area boundaries, incomparable data between case study areas and a limited time scale in which to observe change in key outcomes.<sup>19 27-29 34-37</sup> Data were often collected at an area level rather than an individual level, and panel surveys to assess impacts on the original residents before and after the ABI investment were used in only one evaluation.<sup>32</sup> The potential, therefore, for this significant public investment to ameliorate deprivation and improve health and reduce inequalities remains unknown. Moreover, the possibility of adverse impacts of ABI investment on residents is also largely unknown.

### Implications for evidence based healthy public policy

The dearth of health impact data to inform the development of healthy public policy has already been established across a number of policy areas.<sup>13 38-40</sup> In this review, the lack of socioeconomic impact data questions assumptions that ABI investment will reduce socioeconomic deprivation. In addition, the lack of data on both health impacts and socioeconomic impacts may undermine the rhetoric that links such investment to health gains and reductions in health inequalities.<sup>1 9-11 42 43</sup> However, the absence of impact data does not provide grounds for inaction,<sup>8 41</sup> and it would be

wrong to conclude that there is no research evidence to support hypothetical links between ABI investment and health impact. For example, in the UK both the Black Report and the Acheson Report presented data from a wealth of cross sectional and longitudinal studies to establish clear links between socioeconomic circumstances and poor health.<sup>42-43</sup>

### Improving the evidence base for healthy urban regeneration policy

Evaluations of ABIs need improving if they are to be used to inform the development of healthy public policy or to inform prospective health impact assessments of regeneration programmes. Detailed descriptions of variations in programme delivery and contextual factors that may account for variations in outcomes between areas are essential,<sup>44</sup> and are already available in most ABI evaluations. In addition, evaluation of complex programmes, like ABIs, requires clear theories or hypotheses specifying pathways through which health and social outcomes might improve.<sup>45</sup> To date these have been missing from both evaluations and programmes, even where health improvement is a key objective.

While health impact data remain on the public health "wish list", "best available" evidence should be exploited.<sup>2</sup> This will typically entail rigorous syntheses of socioeconomic impact data as a proxy for health impact data (the approach taken by this review). The extreme heterogeneity of interventions, contexts, methods, and outcomes is an inherent characteristic of this type of systematic review and synthesis will be methodologically challenging as well as producing findings that may often draw attention to uncertainty rather than offering tangible policy recommendations; however, establishing what is not known is essential to good practice.<sup>46</sup> In the face of such uncertainty alternative sources of data can also provide evidence to direct policy and practice. Systematic reviews of cross sectional research evidence may help prioritise interventions and develop research informed theories for possible health impacts of policies which can then be tested through evaluation.

### CONCLUSION

Despite significant public investment in national ABI programmes there is still little evidence to demonstrate the impacts on socioeconomic or health outcomes. Where impacts have been assessed, a small overall positive impact is suggested though adverse impacts are also possible. The few impacts reported rarely related to the original residents of target areas, thus the potential for ABI investment to improve the health or socioeconomic status of people or impact on inequalities remains uncertain.

Future evaluations need to incorporate clear theories of change informed by existing research evidence. In addition, an assessment of the actual impacts on original residents of target areas is required if the potential of such programmes to improve health and reduce health inequalities is to be confirmed. In the meantime, evidence syntheses that exploit best available data may be the best way to develop healthy public policy which is evidence informed.

### CONTRIBUTORS

HT and RA were the principal reviewers, carrying out searches, screening, selection, and data extraction. HT and MP prepared the data synthesis. All authors contributed to planning the review and writing the paper. HT is the guarantor for this paper.



A table giving details of specific health or social impacts included and reported in national evaluation is available on line (<http://www.jech.com/supplemental>).

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## APHORISM OF THE MONTH .....

**“It is necessary to distinguish between health promotion and promoting health.”**

The promotion of health is an activity that must engage society at large and must infiltrate all policy areas. Health promotion too often is seen as a proper noun, denoting a new group of public health workers competing for turf with others. In its worst form, health promotion is driven into a corner where only lifestyle change is to be found, and often with this worst form that depends on victim blaming for its currency (see the Ottawa Charter).<sup>1</sup>

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**Table wi: Details of specific health or social impacts included and reported in national evaluation**

<b>ABI programme</b> <b>Years of programme</b>	<b>Description of evaluation (estimated year(s) of evaluation): methods used to evaluate impacts, data sources and impacts on health and social determinants of health reported</b>
<b>Urban Programme</b> <b>1969-1980s</b>	<p><b>174 projects located in 5 areas and representing 6 categories of environmental improvement (1985):</b> retrospective evaluation of impacts based on residents perceptions of impacts of various environmental improvement projects (structured interviews with residents) <sup>[15]</sup></p> <p><b>Landscaping projects (n=162, 38/38 projects):</b> 28% residents reported 'increased use of public space', 53.3% residents reported 'improved view of area as a place to live'</p> <p><b>Improved and new recreational spaces and walkways (18/40 projects):</b> %age of residents reporting 'improved view of area as a place to live' across 3 project categories- (i) improved recreational space 58% (n=59), (ii) new recreational space 68% (n=193), (iii) new walkways 70% (n=27)</p> <p><b>General environmental improvement (17/17 projects):</b> %age residents reporting 'increased use of public space' 70% (n=36, 9/17 projects), 'improved view of area as a place to live' 52.3% (n=59, 17/17 projects), 'perceived visual improvement' 52.6% (n=59, 17/17 projects)</p> <p><b>10/212 industrial and commercial improvement areas initiated from 1979 onwards (1983/4):</b> retrospective evaluation of impacts based on local project reports and discussion with key stakeholders. <sup>[16]</sup></p> <p><b>Employment:</b> analysis of available documentation from Department of Environment and local authorities found mixed reports of effects, claims around employment gains in half of case study areas outweigh losses in other half. No clear comparison before and after. One survey was carried out but findings were withheld from evaluation consultants.</p> <p><b>Residents' perceptions of neighbourhood</b> (structured interviews with residents, n=59, 6/10 case study areas): value of improvements 'great' 7 (12%), 'some' 19 (32%), 'none' 30 (51%) (missing=3), area as a place to live and shop 'better' 11 (17%), 'same' 34 (58%), 'worse' 12 (20%) (missing=2)</p> <p><b>41(16 industrial, 9 business expansion, 16 commercial development)/113 Urban Development Grant funded projects (1986):</b> retrospective evaluation of impacts drawing on project monitoring documentation. <sup>[17]</sup></p> <p><b>Employment:</b> Reported modest positive impacts on permanent employment opportunities in the local area but less than expected. No actual impact data available, reported estimates of 1,543 jobs attributable to investment compared to 4,281 attributable jobs originally anticipated by policy makers and funders.</p> <p><b>2 target areas in inner London (1981-1991):</b> retrospective evaluation of employment impacts of assistance to small businesses drawing on questionnaire to 82 local managers of ABI programmes, examination of project documentation and routine employment data. <sup>[18]</sup></p> <p><b>Employment:</b> %age unemployed 1981/82 v 1991 8.25% v 11.5% compared to London 7% v 7.5% and UK 10.5% v 7.5%</p>

<p>Urban Developm ent Corporatio ns 1981-1998</p>	<p><b>8/11 target areas (1997/8):</b> retrospective evaluation of impacts based on estimates of key outputs e.g. jobs created, routine data and views of stakeholders and community groups. Evaluation authors were unable to draw conclusions about impacts due to limitations of the data. <sup>[19]</sup></p> <p><b>Employment:</b> 'UDCs may have reduced local unemployment, but on too small a scale to register given the crude level of analysis and the impact of external factors'. <sup>[19]</sup></p> <p><b>11/11 target areas (1988/9):</b> retrospective evaluation of impacts based on routine data and key stakeholder assessments of impacts. <sup>[20]</sup></p> <p><b>Employment:</b> mixed impacts reported by local authority stakeholders.</p> <p><b>2/11 target areas (1988):</b> retrospective evaluation of employment impacts using oral and written evidence presented to House of Commons Employment Committee. <sup>[21]</sup></p> <p><b>Employment:</b> unemployment 1986 v 1988 London Docklands 5000 v 4065, Merseyside estimated 1700 jobs created plus 1000 jobs safeguarded, stakeholders perceive increased employment.</p> <p><b>3/11 target areas (unclear):</b> retrospective evaluation of impacts drawing on house purchase data, programme monitoring data, semi-structured interviews with regeneration policy makers (n=90), and questionnaire survey of local businesses (n=211), employees and householders. Authors report very limited interest from UDC stakeholders in housing, employment or training benefits for residents of deprived areas bordering the commercial UDC areas. <sup>[22]</sup></p> <p><b>Employment:</b> new companies supported by UDC investment provide employment for residents in target area assessed by %age of employees drawn from 'local deprived' areas (assessed by post-code district area) amongst new v pre-existing companies in target UDC area 39.7% v 31.9%.</p> <p><b>Housing:</b> (2/3*) 42.5% of residents from local target areas now living in new/improved housing supported by UDC investment.</p>
<p>Estate Action 1985-1995</p>	<p><b>6/7 target areas (1989-1993):</b> prospective evaluation of impact using routine data, area surveys, resident survey, interviews with residents panels, local authorities, local agencies and government department officials. <sup>[23]</sup> **</p> <p><b>Crime:</b> (4/6*) crime reduction -5.2% (range -8% to 0%) * (estimated from various outcomes, stakeholders and residents views, and routine data)</p> <p><b>Economic:</b> residents' economic circumstances- improved in 2/6 areas *</p> <p><b>Housing &amp; neighbourhood:</b> housing satisfaction (5 point scale) (before v after) 3.6 v 3.9, +0.3 (range -0.37 to +0.6), estate satisfaction (5 point scale) 3.3 v 3.8, +0.5 (range +0.2 to +1.2), residential quality- improved (range +7% to +29%) * (estimated from various outcomes, stakeholders and residents views, and routine data)</p> <p><b>Other:</b> homelessness- reduced in 3/6 areas *, empowerment- improved in 2/6 areas *</p> <p><b>5/7 target areas (1989-unclear):</b> prospective evaluation of impacts based on various indicators included in residents survey before and 12 months after regeneration activity completed. <sup>[24]</sup> **</p> <p><b>Health:</b> self-reported health &amp; health service use- no effect.*</p> <p><b>Crime &amp; incivility:</b> reduced crime- no effect,* fear and incidence of crime and incivilities- partial positive effect.*</p> <p><b>Social fabric &amp; community control:</b> social control- partial positive effect,* sense of community- partial negative effect.*</p> <p><b>Upbringing &amp; control of children:</b> parental control &amp; awareness- no effect.*</p> <p><b>Neighbourhood:</b> neighbourhood satisfaction partial positive effect,* satisfaction with local environment- partial positive effect.*</p> <p><b>Housing:</b> housing management unimproved,* housing satisfaction partial positive effect. *</p> <p><b>7 case study areas in north east England (1998):</b> retrospective evaluation of impacts using range of routine data and monitoring data from local housing providers. <sup>[25]</sup></p> <p><b>Employment:</b> Change in number of unemployment claimants in target area between v changes in local district areas (1991-1997/98) (6/7*), -29.5% (range -11% to -48%) v -36.9% (range -22% to -42.2%)</p> <p><b>Housing:</b> 1990/91-1997/8 Changes in average weekly rent for Local Authority housing, (6/7*) +99.3% (range +8.9% to +324%) Housing association average weekly rent compared to previous LA average weekly rent (4/7*) +116.8% (range +83.7% to +162.5%). Various measures reported across case study areas to assess changes in desirability of residential area- typical measures used were requests for transfers, rent arrears, difficult to let houses. However, set in the context of large stock transfer from local authority to housing association it is difficult to interpret these data. Baseline data for the housing association was unavailable and the transfer resulted in substantial change in socio-demographic composition of remaining local authority tenants.</p> <p><b>Crime:</b> (1/7*) 1994-1997 Change in total reported crime (beat area v district) -20% v -28%, change in number of 'other incidents' requiring police involvement (beat area v district) 0% v -6%</p> <p><b>Other:</b> (1/7*) Reports by tenancy enforcement officers of incidents involving vandalism, threatening and anti-social behaviour fell (1995-1997)</p>

<p>New Life for Urban Scotland 1988-1998</p>	<p><b>All 4 target areas (1988-1998):</b> prospective evaluation of impacts based on routine data (education, health board, police) and before (1988), during (1994) and after (1998) household questionnaire survey (1988 v 1998, n=3400 v 2004).<sup>[26]</sup> No indication of response rates, absolute numbers or missing data in findings.</p> <p><b>Quality of life indicators</b> (as defined by project) <b>1988 v 1994:</b> <b>Poverty-</b> social tenants receiving housing benefit 63.5% v 57.2%, -6.3% (range -24% to +12%), households with incomes below £100/week 65.3% v 48.8%, -16.5% (range -34% to +3%) <b>Health-</b> working age reported to be permanently sick 10.5% v 8.8%, -1.7% (range -5% to +1%), standardised mortality rates (3/4<sup>+</sup>) 131 v 114, -17 (range -29 to +12), satisfied with health service provision 59% v 85.5%, +26.5% (range +23% to +29%) <b>Education-</b> attendance rates at secondary school (2/4<sup>+</sup>) 74% v 82.5%, +9% &amp; +14%, obtaining 3+ standard grades (2/4<sup>+</sup>) 69% v 79%, (+4% &amp; +16%), obtaining 1+ highers (2/4<sup>+</sup>) 12.5% v 15% (+2% &amp; +3%), school leavers entering employment (1/4<sup>+</sup>) 38% v 42%, +4% <b>Crime-</b> recorded crime per 1000 population (1/4<sup>+</sup>) 118 v 107, -11%, afraid of leaving home at night (3/4<sup>+</sup>) 40.3% v 52.3%, +12% (range +7% to +21%) <b>Shopping-</b> satisfied with local corner shops 48.2% v 54.2%, +6% (range -5% to +23%), satisfied with local shopping centre (3/4<sup>+</sup>) 45.6% v 66.6%, +21% (range -6% to +39%) <b>Transport-</b> using buses 5+ days per week 33.5% v 27.2%, -6.3% (range -13% to +3%) <b>Leisure-</b> residents who go swimming in local area 9.5% v 15.8%, +6.3% (range -3% to +11%) <b>Community-</b> attendance at a community group/meeting 29.5% v 20.5%, -9% (range -13% to -3%), very satisfied with area 10.5% v 24.8%, +14.3% (range +8% to +19%), very dissatisfied with area 18% v 6%, -12% (range -8% to -17%) <b>Employment:</b> % of working age registered unemployed or economically inactive 1988 v 1998, 58.5% v 53.2%, -5.3% (range -20% to +9%), %age of working age in employment 1988 v 1998, 41% v 47%, +6% (range -9% to +20%) <b>Housing:</b> very dissatisfied with housing 1988 v 1998, 11% v 10%, (range -9% to 0%), %age of housing rented from local authority 96.5% v 53%, -43.5% (range -53% to -33%) <b>Population:</b> rate of population change in past 10 years 1988 v 1998, -38% v -23% (range of rate change -17% to -8%)</p>
<p>Small Urban Renewal Initiatives 1990-2003</p>	<p><b>6/15 target areas included in evaluation (1993-1998) findings of additional data collection in 2003 not yet reported:</b><sup>[27]</sup> prospective evaluation of impacts using routine and housing association data sources</p> <p><b>Employment</b> (routine data from Scottish Continuous Recording based on housing association data on new tenants): No of households with at least one person economically active (1993/94 v 1997/98), SURI area 23% v 32%, non-SURI area 32% v 27%</p> <p><b>Income:</b> mean household income of new housing association tenants (1993/4 v 1997/8) SURI area £95 v £120 non-SURI area £89 v £107</p>
<p>City Challenge 1992-1998</p>	<p><b>14/31 target areas (1993-1995):</b> prospective evaluation of impacts based on changes in routine data before and during programme activity and retrospective evaluation of perceived changes among stakeholders in partner agencies using postal questionnaire. Small number of CC areas conducted residents' survey-range of incomparable measures used prevented presentation of findings.<sup>[28]</sup></p> <p><b>Quality of life:</b> perceived changes reported by stakeholders in partner agencies- overall 'a lot of improvement' reported across areas including housing, jobs, sports/leisure opportunities, &gt;50% of respondents attributed 'quite a lot' or 'all' improvement to CC investment. Mixed views on amount of improvement in crime/fear of crime, educational provision and attainment, opportunities for young people and health care.</p> <p><b>Routine data</b></p> <p><b>Crime</b> (1991 v 1994): all reported crime range of change (3/14<sup>+</sup>) -36.1% to +28.5%</p> <p><b>Welfare:</b> children receiving free school meals (2/14<sup>+</sup>) +3%, recipients of housing benefit (1/14<sup>+</sup>) +1.8%, income support data not available.</p> <p><b>Education</b> (1992 v 1994): (4/14<sup>+</sup>- overlap in data from neighbouring areas) pupils achieving &gt;4 GCSE pass grade A-C 16.3% v 20.8%, +4.5% (range +1.6% to +10.4%), school leavers with no GCSEs 14.8% v 14.2%, +0.6% (range -8.3% to +3.8%)</p> <p><b>Employment</b> (1992 v 1994): unemployment rates (7/14<sup>+</sup>) 21.9% v 21.6%, -0.3% (range -2.4% to +3.0%), long term unemployed (5/14<sup>+</sup>) 40.9% v 42.8%, +2.9% (range -4.1% to +5.8)</p> <p><b>Housing:</b> owner occupiers (1/14<sup>+</sup>, unclear if includes new residents) +0.7%</p> <p><b>16/31 target areas plus 219 individual projects from 31 areas (1997-1998):</b> retrospective evaluation with limited analysis of routine data before and after (1992-1998). Evaluator's assessments of impacts draw on range of data sources, including beneficiaries' perceptions of primary impacts of individual projects, project monitoring data, discussions with key stakeholders- data presented unclear.<sup>[29]</sup></p> <p><b>Health project:</b> overall assessment one of positive impact *</p> <p><b>Training &amp; education project:</b> improvement in relations with parents and pupils, confidence in school.</p> <p><b>Community &amp; Social project:</b> little or no improvement in childcare provision, shops, leisure &amp; community facilities, crime and youth activities</p> <p><b>Crime project:</b> conflicting assessment of impact on perceptions of crime, recorded burglary and car crime decreased *</p> <p><b>Environment project:</b> improvements in local area</p> <p><b>Transport project:</b> improvements in public transport and accessibility</p>

Single  
Regenerati  
on Budget  
1995-2001

**Three SRB target areas:** <sup>[30]</sup> \*\* prospective evaluation of impacts on national and local routine data and a survey of local residents before and after.

**Brent & Harrow**

**Education** (1994-1997): pupils achieving >4 GCSEs grade A-C 41.6% v 45.8%, +5% & +3.4%, (English data 43.3% v 45.1%)

**Limes Farm** (baseline v end of scheme of 4 year duration, dates of data collection not stated)

**Crime & safety:** total reported crime 155 v 114, -26.5%, residents views- estate lighting inadequate 49% v 69%, +20%, security inadequate 22% v 62% +40%, feel unsafe in stairwell of multi-storey 74% v 16%, -58%

**Employment:** unemployment rate -10.8%, unemployed >12 months -17%

**Housing:** no of local authority dwelling in need of improvement (absolute numbers) 275 v 94, -65%

**Northumbria Community Safety**

**Crime** (1995-1997): total recorded crime 171.6 v 127.2, -44.4%

**Two SRB target areas (1994-1999):** <sup>[31]</sup> \*\* prospective evaluation of impacts on national and local routine data.

**West Cornwall** (changes in standardised rates are relative to standardised English rates, unless stated, where England=100 at both points)

**Health** (1994 v 1998): crude mortality rates (%per 1000) 12.5% v 13.1%, -0.6% (range -1% to -0.2%). Standardised rates 122 v 118 (range -7 to -1) compared to all Cornwall 116 v 111

**Crime & community safety** (1994-1999): total reported crime- figures unclear, reported crime relative to all Cornwall (where Cornwall=100) 127 v 105 (range -15 to -8)

**Welfare** (1993 v 1999): % of total population receiving income support 17% v 10.7%, -6.3% (range -7% to -6%), standardised rates 113 v 118 (range -2 to +17) standardised rates for all Cornwall 116 v 111

**Education** (1994 v 1999): obtaining 5 GCSEs 50.3% v 56.1%, +5.8% (range +4.3% to +7.3%) standardised rate 116 v 117 (range -2 to +3) standardised rates for all Cornwall 106 v 108

**Employment** (1995 v 1997): % of population unemployed 4.5% v 3.2%, -1.3% (range -1.5% to -1.2%) standardised rate 120 v 133 (range +6 to +23) standardised rates for all Cornwall 108 v 112, %age of unemployed + employed who are unemployed > 12 months 4.4% v 2.8%, -1.6% (range -2.3% to -1.3%), standardised rate 129 v 167 (range +15 to +71) standardised rates for all Cornwall 112 v 124

**Engineering in education**

**Education** (1995/6-1997): 16yr olds entering full-time education or training 67% v 73%, +6% (range -1.2% to 18.1%)

**Three SRB target areas (1996-1999):** prospective evaluation using structured interview panel survey of residents before and after investment (n= 1329 v 527). Due to sample attrition at time-point II further recruitment was undertaken to gather additional cross-sectional data- these data did not substantially alter the findings from the panel survey. <sup>[32]</sup><sup>[33]</sup> Data reported below from panel survey, no indication given of missing data for specific variables.

**Health** (1996 v 1999): Self-reported good health 44% v 40%, -4% (range -6% to +2%) (overall fall attributed to ageing) (improvement, +2%, in cross-sectional sample), those reported health 'not good' 26% v 28%, +2% (range -7% to +8%), health improved in past 3 years 7% v 10%, +3% (range +2% to +4%) health worse in past 3 years 29% v 35%, +6% (range 0% to +13%)

**Community** (1996 v 1999): feel closely involved in community 28% v 31%, +3% (range -2% to +8%), satisfied with local area 72% v 70%, +2% (range -4% to +1%, England data 1996-1999 87% v 87%), area a bad place to bring up children (*cross sectional data*) 30% v 21% -9% (range -19% to -2%, England data 1996-1999 14% v 12%)

**Crime** (1996 v 1999): area safe to walk alone at night 37% v 40%, +3% (range 0% to +7%, England data 1996-1999 68% v 68%), more safe than 3 years ago 16% v 14%, -4% (range -15% to +14%) \*\*

**Income & welfare** (1996 v 1999): income below £100/wk 30% v 26%, -4% (range -10% to -3%, England data 1996-1999 19% v 16%), receiving income support 26% v 19%, -7% (range -11% to -3%, England data 1996-1999 19% v 17%),

**Education** (1996 v 1999): taken part in training in last 3 years 22% v 29%, +7% (range- not reported), any member of household with CSE/GCSE/O'level 53% v 54%, +1% (range -10% to +3%)

**Employment** (1996 v 1999): working age economically inactive 29% v 25%, -4% (range-7% to -4%, England data 1996-1999 10% v 10%), employment rate 56% v 60%, +4% (range +3% to +5%, England data 1996-1999 78% v 82%)



<p>Regeneration Partnerships (now known as Social Inclusion Partnerships-SIPs) 1996-ongoing</p>	<p><b>All nine target SIP areas:</b> evaluation of impacts drawing on changes in outcomes collected from various sources at two time points (1996 v 1999). Data sources include residents' survey, SIP monitoring data and routine data. <sup>[34]</sup></p> <p>Overall assessment of impact on key indicators and the contribution of SIP activities on these. Inconsistent data availability and data type presented for each case study area. Final assessment made by authors based on available data (fully detailed in evaluation document) and includes consideration of wider area trends for similar indicators. (1996-1999)</p> <p><b>Population &amp; households:</b> (6/9<sup>+</sup>) 4 SIP area populations fell relative to wider area. Unable to assess contribution of SIP in context of housing renewal in wider area.</p> <p><b>Health:</b> (3/9<sup>+</sup>) compulsory health indicators included limiting long term illness, low birth weight babies, coronary heart disease, cancer, stroke, smokers, access to health services but insufficient data available to assess trends. Examples of impacts reported in absolute numbers from individual projects: teenage pregnancies 2 v 2, deaths from coronary heart disease 13 v 10, suicides and self inflicted deaths 3 v 2, babies with mothers who smoke 41 v 16, registered with a GP +8%, limiting long term illness +14% (data from single SIPs). Contribution of SIP judged to be low.</p> <p><b>Community:</b> community involvement: no quantitative trend data available, but thought to be some improvements in local participation with SIP organisation.</p> <p><b>Crime:</b> (5/9<sup>+</sup>) in 3 areas where crime reduction prioritised by SIP, crime rates fell faster than in the wider area. SIP activities thought to contribute to this.</p> <p><b>Poverty:</b> no trend data available.</p> <p><b>Access to information:</b> no trend data available.</p> <p><b>Physical transformation:</b> no baseline data available. Minimal contribution by SIP.</p> <p><b>Employment &amp; training:</b> (6/9<sup>+</sup>) Positive impact on short term and long term unemployment. SIP made important contribution to reduced employment often in context of enhanced economic conditions.</p> <p><b>Education:</b> (4/9<sup>+</sup>) Some improvements in secondary education attainment, data not reported in comparable format. Unable to assess contribution of SIP due to lack of trend data and other educational initiatives coinciding with SIP activities. SIP activities more likely to impact on lifelong learning but no impact data on this is available.</p> <p><b>Housing:</b> (6/9<sup>+</sup>) Some improvement in satisfaction. SIPs not directly involved in housing improvement so unlikely to contribute to improvements in housing satisfaction.</p>
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\* no data presented to support reported findings

\*\* summary of main impacts reported here, other similar outcomes assessed and reported in evaluation document

\* number of areas in evaluation which presented data/total number of case study areas included in evaluation



**Theme I: Systematic Review**

**Paper III Thomson H, Thomas S, Sellstrom E, Petticrew M.** The health impacts of housing improvement: a systematic review of intervention studies from 1887 to 2007. *American Journal of Public Health* 2009;99(S3):S681-S692.

*With web supplements*

The journal has not given permission for this paper to be included in the e-thesis version of this thesis. The abstract of the paper is provided. For a copy of this paper and its supplements please access the journal online or contact Hilary Thomson (hilary@sphsu.mrc.ac.uk).

## **Abstract**

**Objectives:** To conduct a systematic review of the health impacts of housing improvement.

**Methods:** Forty two bibliographic databases were searched for housing intervention studies (1887-2007). Studies were appraised independently by two reviewers for sources of bias. The data were tabulated, and synthesised narratively taking into account study quality.

**Results:** Forty five relevant studies were identified. Improvements in general, respiratory and mental were reported following warmth improvements, but these varied across studies. Mixed health impacts were reported following housing-led neighbourhood renewal. Studies from the developing world suggest that provision of basic housing amenities may lead to reduced illness. There were few reports of adverse health impacts following housing improvement. Some studies reported that the housing improvement was associated with positive impacts on socio-economic determinants of health.

**Conclusions:** Housing improvements, in particular warmth improvements, can lead to tangible improvements in health; but the potential for health benefit may depend on baseline housing conditions and careful targeting of the intervention. There is little to suggest that housing improvement is detrimental to health. Investigation of socio-economic impacts associated with housing improvement is needed to investigate the potential for longer term health impacts.

## **Theme II: Evaluation & generation of new evidence**

**Paper IV** Thomson H, Kearns A, Petticrew M. Assessing the health impact of local amenities: a qualitative study of contrasting experiences of local swimming pool and leisure provision in two areas of Glasgow. *Journal of Epidemiology & Community Health* 2003;57(9):663-667.

*With accompanying photo:* Thomson H. Community amenities - a neglected health resource? (gallery). *Journal of Epidemiology & Community Health*, 2002:81.



## Assessing the health impact of local amenities: a qualitative study of contrasting experiences of local swimming pool and leisure provision in two areas of Glasgow

H Thomson, A Kearns and M Petticrew

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## EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

# Assessing the health impact of local amenities: a qualitative study of contrasting experiences of local swimming pool and leisure provision in two areas of Glasgow

H Thomson, A Kearns, M Petticrew

*J Epidemiol Community Health* 2003;**57**:663–667

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**Study objective:** To assess the health impacts of local public swimming pool and leisure provision.

**Design:** Retrospective qualitative study using focus groups. Reports from two areas with contrasting experience of provision of a public swimming pool (opening and closure) were compared within the context of general reports about health and neighbourhood.

**Setting:** Two deprived neighbourhoods in south Glasgow.

**Participants:** Local adult residents of mixed ages, accessed through local community groups.

**Main results:** In both areas the swimming pool was reported as an important amenity that was linked to health and wellbeing. However, few residents reported regular use of the pool for physical activity. Use of the pool facility for social contact was directly linked to reports of relief of stress and isolation, and improved mental health. Pool closure was one in a series of amenity closures and area decline and was used to represent other area changes. Health impacts were strongly linked to the pool closure. The pool opening was associated with local area regeneration, similar but less prominent links between swimming pool provision and health were reported. Health benefits of social contact were diffuse and linked to other local amenities as well as the new pool facility.

**Conclusions:** Although theoretically linked to increased physical activity, the health benefits conveyed by the swimming pool may be more closely linked to the facilitation of social contact, and a supervised facility for young children. The use of qualitative work to investigate area based change provides rich contextual data to strengthen and explain the reported health impacts.

Observational studies have consistently reported a residual health effect that is attributed to area or contextual effects.<sup>1</sup> Yet, the nature of the relation between health and place remains poorly understood. As a result there has been a call to "move beyond the macro statistical relations" with a need to link investigation of area effects and social capital.<sup>2</sup> Qualitative analysis of lay reports has been recommended as one approach to further understanding of area effects, lay perceptions, and possible mechanisms around health and place.<sup>1,3</sup> Such empirical work could be used to inform health impact assessments of area based change as well as contributing to academic understanding of health and place.

We carried out a qualitative study in two areas of south Glasgow (three miles apart) to assess the health impacts of neighbourhood swimming pool and leisure facilities. We designed the study to examine reports of contrasting experiences of a specific area change in two similar areas. Comparison of these reports was thought to enable validation of the findings in the two areas by considering separately the immediate and possibly reactionary response from the situated nature of the psycho-social and perceived health impacts of the place of swimming pool provision within a community narrative. Analysis of narratives as they are embedded within the local historical context has been recommended to provide richer and more valid interpretations.<sup>4</sup> This paper presents a comparative analysis of local residents' reports of the health and social impacts of a local, public amenity, namely a swimming pool.

The study of the health impacts of a swimming pool facility is a good example for this case study of local amenities and health. Swimming is considered to be an inclusive sport and

leisure activity,<sup>5</sup> which is less gendered or socially patterned than many other sports, for example, tennis, golf, squash,<sup>6</sup> and can be continued into old age. Swimming is now the UK's most popular physical sporting activity,<sup>5</sup> and as a form of exercise has an obvious link to health. Although an attractive facility to invest in, the expense of maintaining aging swimming pools is considerable. Recent government inquiries in the UK<sup>7,8</sup> and high profile local pool closures add to the topicality of this case study.

## METHODS

In January 2000 a modern swimming pool and leisure complex was opened in one case study area (Riverside\*), while in December 1999 in the other case study area (Parkview\*) the swimming pool was closed. The closed swimming pool was originally opened in 1927; the reason given by the local council for closure was the expense of repair and upgrading. In both areas the pool buildings are located within a residential neighbourhood and included gym and spa facilities. The two case study areas are sociodemographically similar and are classified as deprived according to the Carstairs deprivation categories (Riverside 7, Parkview 6<sup>9</sup>). In the past decade Riverside has been part of an £80 million housing led regeneration programme and the area has Social Inclusion Partnership status. While in Parkview there has been no similar investment or prioritising. The contrasting levels of area investment and amenity provision were confirmed by focus group data and contact with the local authority.

\* Area names have been changed.

Fourteen focus groups were carried out 14–18 months after the pool opening and pool closure. The aim of the focus group data collection was to gather a collective community narrative of health, neighbourhood, local amenities, and contextual change rather than individual stories. Focus groups have been recommended as a method for focusing on a specific issue and exploring shared norms and meanings that underlie the collective assessments of a situation.<sup>10</sup> Ethical approval for the study was obtained from the University of Glasgow Ethics Committee.

The sample was recruited from the area immediately around the pool, defined by the local authority ward (n=7500–8000).<sup>11</sup> A field visit was carried out by the researcher to obtain contact details of local community groups in the areas. Local community groups of mixed gender were selected to provide a range of adult age groups. Groups were written to and long term (>4 years) residents were invited to take part. These groups were theoretically sampled according to age group and sampling in Riverside was carried out to mirror the sample in Parkview (see appendix). Posters and information leaflets describing the study were enclosed with the letter of invitation. A semi-structured schedule was drawn up beginning with discussion of what the area was like to live in and what local amenities were available. Relevant newspaper headlines and local photographs were used to stimulate discussion and introduce the concept of health and place. Focus groups lasted around one hour and participants were paid £10 (£15) for participating. The issue of the swimming pool was not raised specifically by the researcher until the end of the discussion unless it had already been raised spontaneously by participants. When the issue of the pool was raised by the participants they were asked to elaborate on their use and views of the pool rather than asking explicitly whether they linked it to health. Group members were given the opportunity after the group to speak individually with the moderator and stationery was distributed to allow for additional private feedback. Focus groups were audio-recorded in toto and transcribed verbatim. The tapes were listened to immediately following the group to allow for documentation of group dynamics and subtleties of emphasis.

Data analysis examined the place of the swimming pools in the local context and was facilitated by the use of NVivo software using inductive analysis and constant comparison in accordance with the principles of grounded theory.<sup>12</sup> The focus groups and preliminary analysis were carried out sequentially to allow for interim analysis to inform subsequent data collection. Transcripts were read repeatedly and coded into themes of health, place, and person. Further themes for coding emerged during this process, for example, “amenities” and “swimming pool”. Data analysis and interpretation was carried out by HT; validation of the thematic analysis was carried out by AK.<sup>13</sup>

## FINDINGS

All seven groups approached in Parkview agreed to take part, while in Riverside 10 groups were approached; three groups declined to participate. A total of 81 residents (male;female 11:70) took part with an average of six in each group (range 2–10). Three feedback forms were received but did not change the findings of the group discussion.

The main emergent themes are presented below with quotations (m=male, f=female voices) selected to represent the data and provide clear illustrations of the complex relationships of place, person, and health reported.

## REPORTS OF NEIGHBOURHOOD AND LOCAL CONTEXT

Reports of the local neighbourhood comprised a number of key features: people, location, length of residence, public space, amenities, private space, and housing. Changes in these

key features were reported throughout the data reflecting the contrasting levels of area investment and suggesting that there was a perceived change in the fundamental nature of the neighbourhood in both areas. People or other residents were the most prominent area influence and change reported.

The dynamics of the area changes and their impacts were reported to be complex in both areas. Change in a specific area feature influencing a chain of secondary changes in seemingly unrelated area features. For example, the pool closure was reported to have an impact on perceptions of safety in public space, other amenity closures, appearance of the area, and whether people are attracted to the area.

*M1: And it wisnae that it [the pool building] brought life into that bit of the area because it was lit up, the huge big dome the whole place had an aura about it but now you go up there, you've nae light, the building is dim the weans have smashed whatever lights hanging about, it's dreary, it's frightening, that's how the shops are shutting because naebody is there at night whereas when the baths were opened at night it lit the whole area up*

*F: Aye till about 10 o'clock even, even like you could park up next to it*

*M1: People were coming backward and forwards but now there's nae reason for anybody to go up there.*

### Parkview: middle aged men and women, (P4)

## THE PLACE OF THE POOL

The pool was an important change in both areas. In Parkview the closure of the swimming pool was presented spontaneously by each group as a significant change in the area. The swimming pool building occupied a large site in the centre of the neighbourhood and its closure was reported as one of the most recent in a long line of amenity closures. Reports of the pool closure were used to emphasise the scale of the reported under-investment in the area and, as such, were symbolic of wider area decline.

*F1: When we moved in, it was a high amenity area because you had the baths, the library, the station, the buses, the steamie [laundrette] everything was handy, now it's a deprived area.*

*HT: Right, so have these things been shut down then?*

*F2: Yeah, there are several shops that have closed completely.*

*HT: Right and so what is left for you to use?*

*F1: The library [laughing]*

*F2: That's all*

*F3: And thanks to the powers that be they made this one of the biggest ghettos on the south side the day they closed the swimming baths, it was the only thing that the kids had to go and do here, there's no other amenities other than the church and any other church groups round about have to use so that was thanks to them this place became . . . it's overnight they made it into a ghetto practically.*

### Parkview: elderly women (P3)

Residents in Parkview reported having little control over the pool closure. Lack of control and choice was an issue that was reported throughout the data. The closure of the pool was used to represent the powerlessness of the residents regarding decisions made that had an impact on the local environment and their living conditions. [see above quote]

Reports of the pool were markedly less prominent in Riverside, the pool was not always mentioned spontaneously. Other changes, such as new housing and new owner occupiers were reported to be more influential in the area. There were mixed reports of the adequacy of amenities in Riverside. There had been a number of new facilities provided and small shops had been replaced with an attractive mainstream shopping area.

*HT: And you've sort of said that there've been a lot of changes in Riverside over the past few years, what have been the main changes?*

*F1: Oh, housing is one.*

F2: Sports Centre.

F1: The Sports Centre. That's made a big difference.

HT: Has it?

F1: It took quite a lot off the street. The ones that want to go off the street, it took them off the street, you know.

F2: It made a big difference.

#### Riverside: mothers of pre-school children (G7)

#### USE AND BENEFITS OF THE POOL

In both areas the pool was reported to be an important amenity; use and benefits linked to the pool were similar in both areas, although more prominent in Parkview. Links were made between health and the physical exercise facilitated by the swimming pool and the associated leisure facilities. However, there were few reports of regular use of the facility for this purpose. The pool was reported to be important for facilitating social contact with friends and neighbours across all age groups and this was directly linked to mental health; this was striking throughout the data. The health benefits of social contact were reported to be stress relief and reducing isolation.

F1: Well we used to go to the keep-fit [held in the swimming pool building] every Tuesday night and that was a women's night from 6 o'clock to 10 o'clock at night and that was stowed every night of the week so I mean that was keeping us healthy. I mean although we smoke and everything else but we were still going there, keeping healthy, keeping fit, going for a swim and then going home. It was £3.20 we paid for the whole night and we had a swim, all the aerobics and everything else that they were teaching us.

F2: You can go to any of the big health centres . . . . .

F1: But we felt better for going there at least once a week, we felt good within ourselves going down the road with a chippy [everybody laughing]

F2: You worked it off before you ate your chippy . . . . .

#### Parkview: mothers of pre-school children (P6)

Further analysis suggested that the lack of the swimming pool compounded other stresses associated with personal and area disadvantage. Mothers of young children, those living alone, and elderly people were frequently reported as especially in need of amenities like the swimming pool and its associated benefits. In particular mothers of young children reported using the pool as a stress reliever to cope with lively young children in circumstances where there was not much secure public space accessible and where housing was not spacious; and reported benefits to children of being able to participate in safe, spacious, and energetic play. Mothers also used the pool as an opportunity to escape their domestic duties and socialise with other adults.

HT: Do you think this is an exercise thing do you think the negative thing of it closing is just that folk . . .

M1: Well, everything, social

F1: For some it was social and for some it was exercise some it was a hobby. It depends on how you look at it. Some of maybe of the younger kids, you took them you sort of monitored them but it let them release a lot of tension meant like when you got home they were exhausted and right bed and you would get peace and quiet for an hour [laughs] so it let you unwind. Whereas now they are totally about your feet your are hyper and they are hyper and you are [flop sound as if exhausted/exasperated].

F2: That's another thing, they are not allowed to play in the corridors, they can't play there, you can't let them out you can't let them play in the corridor so they are stuck in the house so they get bored stiff as well.

#### Parkview: middle aged men and women (P5)

In addition to highlighting groups most vulnerable to the impacts of the pool closure, there were also reports of widespread vulnerability in the local neighbourhood compared with neighbouring areas that were more affluent and where car ownership was high.

M: I'm not trying to bring this place down because I stay in it, but I know fine well that is how it is. If you have got money you can afford to send them, that baths being shut that won't affect a lot of people in Newton\* [neighbouring affluent area to Parkview] or whatever it is, you have got a car and you have got all of these things.

F: For instance they close that [the swimming pool] and then expect you to go to Riverside which to me in a winters night I would... go along and walk all along to Riverside? You just don't do it. A car at the door yeah that helps, but she eats healthy right enough

#### Parkview: middle aged parents (male and female) (P5)

#### GENERAL AMENITY PROVISION

Although the place of the pool in Riverside was less central to reports than in Parkview, similar use and benefits of the facility were reported. However, in Riverside reports of the use and benefits of other local amenities were similar to those that were reported in Parkview as being directly linked to the pool. These benefits, social contact, stress relief of individual disadvantage and isolation, were subsequently linked to mental health. It was also reported that a range of amenities was required to meet the needs of different groups.

F1: You feel happier here then you are healthier.

F2: And some days they are dealing with all sorts of problems when they leave their front door you know, one of the biggest ones maybe their giro didn't bounce on the carpet that morning, that is stress to somebody and they will still go out in the street and talk to you. The morale is always there. Maybe they don't know any better I don't know.

F3: It's human nature like you speak to a baby like anybody that speaks to you it brings up your self esteem, its like you are a person, you are there, you are alive, whatever.

#### Riverside: middle aged women (G2)

F1: You cant just take like certain groups of people like where I'm saying about the bookies [betting shop], the older men maybe have been out of work for a long time and they've no got anywhere to go to, they're still in the house, so you know, they're just in the house. That gets them out for that wee while, to get to meet people and everything about it is getting out and meeting people. I think gives you a bit of a . . . you know, a lift.

F: Well you'll no go in to a depression so much. Especially a man living on his own. You take away the bookies [betting shop], he's no just going to keep walking about the streets and stand and blather [chat] to somebody, whereas you always blather to somebody when you are watching the racing. There's a difference there, isn't there.

#### Riverside: middle aged women (G6)

#### DISCUSSION

##### Amenities and health

The pool was a valued amenity in both areas. Benefits of the pool included the health benefits of swimming and other physical activity. However, a greater emphasis was placed on the mental health benefits associated with the secondary functions facilitated by the pool, in particular social contact. This was reported to alleviate the stress of disadvantaged living circumstances and isolation. Reported benefits were similar across all ages with parents appreciating access to a safe play area for their children. The emphasis on social contact and mental health throughout the data is an important finding. However, the nature of our sample may have introduced bias against those residents with less interest in social interaction and who choose not to be part of a community group. This may or may not be related to the gender bias in the data owing to the lack of male participants, although similar impacts were reported for men.

The contrasting prominence of the pool in these areas raises important issues and supports the rationale for our study design. Analysis of the wider context was essential to explain the contrasting meanings and weight of impact attributed to



the pool; withdrawal of an amenity giving rise to more tangible reports and impacts compared with the diffuse impacts reported around the new facility. Pool closure was symbolic of abandonment by the council and was reported to compound both area and personal disadvantage. Added to this was an implicit lack of control over the pool closure and general living circumstances. In Riverside, the place of the pool was less obvious but benefits of the pool were reported along with general benefits of other amenity provision and improved housing following area regeneration. Despite different levels of emphasis and appropriation of the use and benefits of amenities, the reported benefits of amenity provision were similar in both areas. This provides empirical support to link general amenity provision with health effects, in particular mental health.

Higher rates of participation and better amenity and service provision have been associated with a positive area effect on self reported health.<sup>14-15</sup> Structural conditions, such as amenities, have been proposed as a forerunner to social ties and networks<sup>16</sup> and these, in turn, have well documented links to health.<sup>17</sup> Reports in this study add to the knowledge of these links by providing accounts of *how* local amenities may facilitate social networks, and how changes in amenity provision might influence residents' perceived health through a contextual effect. The collective narrative provided by the focus group method also implies that people may be affected by changes in this type of neighbourhood amenity despite not participating directly in it. Reported impacts, not related to pool use, included neighbourhood aesthetics, perceptions of safety in public space as well as linking the pool closure to further area decline and closures. The positive relation between health and context, independent of participation has been reported elsewhere and suggests a collective benefit.<sup>14</sup> Although not linked to health, similar feelings of loss, abandonment and lack of control have been reported elsewhere by residents following closures of local amenities and heritage buildings.<sup>18</sup>

### Assessing health impacts of area based change

Although the methods used in this study may not resemble some readers' ideas of health impact assessment, this study has assessed community reports of the health impact of a specific intervention. Health impact assessment has been described as providing a structured framework for "taking into account the opinions and expectations of those who may be affected by a proposed policy".<sup>19</sup> In a recent review of completed health impact assessments gathering community views was a common method used with some relying exclusively on community views to inform predictions of the health impact.<sup>20</sup> Because of the retrospective nature of this study it has also been possible to investigate reported impacts rather than rely on predicted impacts. This, together with prospective evaluations of area based interventions, may provide ways of strengthening the validity of health impact assessment.<sup>20</sup>

Assessing the health impacts of interventions and policies is a commendable idea and is a logical response to the independent contextual area effects reported in epidemiological studies.<sup>1</sup> However, area interventions or changes are typically complex, having the potential for multiple and diffuse secondary impacts that in turn may influence and be influenced by unique local factors, making evaluation difficult. The methods used for this study demonstrate the potential for qualitative methods in evaluation, in particular identifying mechanisms, investigating complex local networks and providing more in depth explanations.<sup>21</sup> More specifically, they highlight the need to examine structures and practices or behaviours to provide explanations of neighbourhood effects on health.<sup>22</sup> In addition, area based interventions often evoke strong emotions; care needs to be taken if more than reactionary responses are to be assessed and separated from possible longer term impacts. Our study design enabled

us to interpret the data and the meanings attached to the pool in light of the contrasting local contexts.

### Conclusions

Findings from this study suggest that the obvious health impacts of a public swimming pool and leisure facility, such as physical activity, may not be the health impacts that have the most profound impact on the local neighbourhood. Secondary functions, in particular the facilitation of social contact, of amenities, may convey health related benefits to local residents. These findings are important given that investment in leisure facilities are regarded as a high but neglected priority by residents.<sup>23</sup>

This study has also provided a case study of the health impacts of a specific area change using lay reports. The examination of the relevant context strengthens the findings of this study and adds to the generalisability of the findings to the issue of wider amenity provision. Similar qualitative work may contribute to an improved understanding of health impacts of area and area based change and could be used to inform future health impact assessments.

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### Appendix Focus group characteristics (n=number of focus groups)

	Parkview	Riverside
Parents of pre-school children	2	2
Middle aged adults	2	2
Elderly people	3	3

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# IN THIS ISSUE

**John R Ashton, CBE**  
*Joint Editor*

## POSTMODERN PUBLIC HEALTH

Public health challenges are complex, programmatic and context dependent, and so are the interventions required to address them and the research methods sufficient to the task of throwing light on the most effective solutions. It has been said that practitioners and researchers should first of all define the problem and then make use of the most appropriate methods in the tool bag. In this postmodern world diversity is the keynote, and in this issue there should be something for everybody.

There is a strong flavour of the arguments about evidence, and in our Theory and Methods section there is an a la carte of useful ideas and experiences for researchers and practitioners alike. This month's research reports throw light on adolescent health and family rituals (eating together is a good idea); stress and suicide in nurses; the benefits of sexual intercourse for cardiovascular health (hooray); and the complexities of the risk factors for HIV infection in women. In a full hand of papers on Public Health Policy and Practice, the debates about evidence and health impact assessment are brought together; a traditional problem of noise, in this case around Heathrow Airport, is given an airing; and valuable reports are presented on genetic screening for familial hypercholesterolaemia; the most effective approaches to controlling the malaria mosquito; and the effectiveness of antiretroviral therapy among HIV-1 infected women.

All in all, we hope that those in the northern hemisphere will find plenty to fill the winter hours, and in the southern hemisphere will be tempted by the offerings despite the attractions of the summer.

## THE JECH GALLERY.....

### Community amenities: a neglected health resource?



This picture shows residents demonstrating against a local swimming pool closure in an area of Glasgow where the chance of dying before the age of 65 is 2.3 times the British average. The pool, built in 1914, is being closed because of the expense of repairs. Residents of high amenity areas have been shown to experience improved health independent of amenity use and social class.

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**Theme II: Evaluation & generation of new evidence**

**Paper V** Thomson H, Morrison D, Petticrew M. The health impacts of housing-led regeneration: a prospective controlled study. *Journal of Epidemiology & Community Health* 2007;61(3):211-214.

*With web supplements & accompanying photo:* Thomson H, Morrison D, Petticrew M. Better homes, better neighbourhoods (gallery). *Journal of Epidemiology & Community Health*, 2007:214.



## The health impacts of housing-led regeneration: a prospective controlled study

Hilary Thomson, David Morrison and Mark Petticrew

*J Epidemiol Community Health* 2007;61;211-214  
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## RESEARCH REPORT

# The health impacts of housing-led regeneration: a prospective controlled study

Hilary Thomson, David Morrison, Mark Petticrew

*J Epidemiol Community Health* 2007;61:211–214. doi: 10.1136/jech.2006.049239

**Study objective:** To evaluate self-reported changes in housing quality and health associated with housing-led area regeneration.

**Design:** A prospective study over 1 year using structured interviews with 50 households who moved to new housing and with 50 matched controls who did not move.

**Setting and participants:** Residents of two social rented housing schemes in the West of Scotland.

**Results:** Small but not statistically significant increases in levels of "excellent" or "good" self-reported health status were found in both groups. Both intervention and control groups experienced reductions in problems related to warmth, but no significant change in how they felt about their house.

**Conclusions:** It is feasible to conduct prospective controlled studies to evaluate the health effects of housing improvement using matched control groups. The absence of marked improvement in health after moving to new housing might be due to the small sample size or to the limited potential to improve health through this intervention alone.

The potential for developing healthy public policy is seriously limited by the dearth of studies which have assessed the impact on health and health inequalities of social interventions, such as housing renewal.<sup>1</sup> Our systematic review of world literature identified only 18 studies (1936–2001) which had assessed the health effects of housing improvement, of which only six were prospective and controlled. Positive effects of housing improvement on mental health were consistently reported across the studies. However, methodological limitations and conflicting results prevented clear conclusions being drawn about the effects on physical and self-reported health.<sup>2</sup>

Calls to improve the quality and quantity of research evidence available to inform healthy public policy have recommended using the implementation of new investments or policies as opportunities to carry out outcome evaluations.<sup>1 3 4</sup> This short paper reports the findings of a prospective controlled study of housing improvement.

## METHODS AND RESULTS

We carried out a prospective controlled study in West Dunbartonshire, Scotland, where the local housing association was carrying out a major programme of housing-led neighbourhood renewal.<sup>5</sup> The investment involved replacing ex-council owned housing stock that was reported to have problems of damp and mould, with newly built housing in the same locality. Control group participants were recruited from a nearby council estate (predominantly social rented housing) where the housing type, age and quality were reported by the council's housing department to be similar to the one under study. In both areas, contact details of residents (all social renters) willing to take part in the study were obtained after the relevant social housing provider had written to each tenant about the study. One adult (the principal householder or his/her nominee) from each household was recruited. Data were collected before the house

move (July 2000–May 2003) and one year after moving (November 2001–June 2004, mean (SD) time since house move = 12 (0.67) months) from the same person where possible; control group participants were interviewed at baseline (May 2001–October 2001) and 1 year afterwards (data collection May 2002–January 2003, mean (SD) time between interviews = 12.36 (1.139) months). At both time points, a 1-hour structured interview using a previously piloted questionnaire<sup>6</sup> asking about health and housing was conducted by a nurse interviewer.

At baseline, 55% (intervention group 59/107: 15 refused, 33 failed to contact) and 45% (control group 84/188: 46 refused, 58 failed to contact) of households approached agreed to participate. At follow-up, 52 of 53 intervention households successfully followed up had moved house, and 53 of 64 control households had not moved house.

Table 1 presents an analysis comparing changes in the intervention and control groups after 1 year, in which the same person was interviewed at both time points (50/52 in the intervention group, 50/53 in the control group).

The intervention and control group participants were well matched at baseline with respect to age (intervention/control mean age 47.91/51.54 years,  $p = 0.308$ ), sex (30%/26% men,  $p = 0.656$ ), housing benefit dependency (57.8%/60.5%,  $p = 0.798$ ), employment status, health status (self-reported and short form 36, version 2 (SF-36v2)), housing quality and occupancy (table 1). The groups were not successfully matched for house type or private garden, but none of these variables was associated with self-reported health at baseline (see supplementary table A available online at <http://jech.com/supplemental>). At baseline, the percentage of houses with dampness and/or condensation (24% householder reported) was greater than that reported in a national survey of social rented housing (up to 16% surveyor reported and 11% householder reported).<sup>8</sup>

At 1 year after moving to a new house, there was a small increase in the percentage of householders reporting "excellent" or "good" health (2.2%) and this percentage also increased among the control group (6%); neither increase was statistically significant. No significant changes were observed in the mean scores of the physical or mental component of the SF-36v2.

Residents in both groups reported fewer problems related to warmth (appendix A), but these improvements were significantly greater for intervention households. The proportion of residents reporting no other housing-related problems (appendix A) increased by similar amounts in both areas.

Some residents provided rent data ( $n = 33$ ). Rent increased in both areas, with a larger increase in the intervention group (intervention/control mean change in rent +£6.65/+£1.31 per week, where mean rent at baseline was £32.24/£31.00 per week). Some residents reported increases in fuel bills (intervention/control 14/5 residents reporting increased fuel bill(s)).

At both time points, there was no significant difference between the intervention and the control group participants regarding how they felt about their house, or in the number of neighbourhood problems reported (appendix B). There was very little change in the intervention group at follow-up.

**Table 1** Comparing intervention and control group percentage change in binary variables between time 1 and time 2 (and mean change in SF-36v2: calculated using UK norms<sup>†</sup>)

	Intervention group (before) n=50	Control group (before) n=50	Statistics	Intervention group change at 1 year* n=50	Control group change at 1 year* n=50	Statistics*
<b>Economically active</b>						
Yes	11 (23.4%)	8 (16.0%)	$\chi^2=0.843$ , p=0.358, missing=3	-1.4%	-2%	z=0.22 (95% CI -4.56 to +5.76), missing=3
<b>Feel about house</b>						
Happy	24 (48%)	25 (50%)	$\chi^2=0.939$ , p=0.626, missing=0	25 (50%)	21 (42%)	$\chi^2=0.659$ , p=0.719, missing=0
Neither happy nor unhappy	19 (38%)	21 (42%)		21 (42%)	24 (48%)	
Unhappy	7 (14%)	4 (8%)		4 (8%)	5 (10%)	
<b>Type of house</b>						
House	13 (26%)	31 (62%)	$\chi^2=13.149$ , p<0, missing=0	33 (66%)	-	z=4.01 (95% CI 20.46 to 59.54), missing=0
Flat	37 (74%)	19 (38%)		17 (34%)		
<b>Garden</b>						
With private garden	13 (26%)	36 (72%)	$\chi^2=21.168$ , p<0, missing=0	+72%	-	z=7.41 (95% CI 52.97 to 91.03), missing=0
<b>House occupancy</b>						
Persons per room	0.386	0.334	t=1.393 (95% CI -0.022 to 0.126) missing=0	0.309	0.342	Intervention: paired t test=4.409, (95% CI 0.418 to 0.112), missing=0 Control: paired t test=-0.482, (95% CI -0.04 to 0.025), missing=0
<b>Self-rated health over the past year</b>						
Excellent/Good	15 (32.6%)	20 (40%)	$\chi^2=0.368$ , p=0.544, missing=3	+2.2%	+6%	z=0.92 (95% CI -4.21 to 11.81), missing=4
<b>SF-36v2 (Physical Component Score)*</b>	36.322	36.864	t=-0.07 (95% CI -7.082 to 6.598), missing=10	+1.409	-0.317	Intervention: paired t test=1.01, (95% CI -1.418 to 4.236), missing=12 Control: paired t test=-0.238, (95% CI -3.01 to 2.372), missing=6
<b>SF-36v2 (Mental Component Score)*</b>	46.052	46.547	t=-0.201 (95% CI -5.376 to 4.387), missing=10	+2.083	-0.225	Intervention: paired t test=1.094, (95% CI -1.756 to 5.922), missing=6. Control: paired t test=-0.143, (95% CI -3.414 to 2.964), missing=12
<b>Dampness/condensation</b>						
No problem	38 (76%)	43 (86%)	$\chi^2=1.624$ , p=0.202, missing=0	+24%	+2%	z=3.27, (95% CI 8.82 to 35.18), missing=0
<b>Draughts/leaky windows</b>						
No problem	33 (66%)	37 (74%)	$\chi^2=0.762$ , p=0.383, missing=0	+28%	+10%	z=2.29, (95% CI 2.62 to 33.38), missing=0
<b>Keep home warm in winter</b>						
No problem	36 (73.5%)	39 (78%)	$\chi^2=0.277$ , p=0.599, missing=1	+20%	+6%	z=2.08, (95% CI 0.82 to 27.18), missing=0
<b>Heating system</b>						
No problem	36 (72%)	43 (86%)	$\chi^2=2.954$ , p=0.086, missing=0	+22%	+4%	z=2.67, (95% CI 4.82 to 31.18), missing=0
<b>Other housing problems</b>						
No problems†	13 (26%)	7 (14%)	$\chi^2=2.250$ , p=0.134, missing=0	+10%	+12%	z=0.32 (95% CI -10.27 to 14.27), missing=0
<b>Neighbourhood problems</b>						
Average number**	12.84	11.96	t=-0.917, (95% CI -2.785 to +1.025), missing=0	-1.02	+0.14	Intervention: paired t test=1.639, (95% CI -0.231 to 2.271), missing=0 Control: paired t test=-0.279, (95% CI -1.148 to 0.868), missing=0

SF-36v2, short form 36, version 2.\*All reporting and testing differential change between intervention and control at 1 year, with the exception of "feel about house", which compares the two groups at both time points, and SF-36 and neighbourhood problem scores, which compare change between the two groups.  
†See appendices.

### What is already known on this topic

- Although it is often assumed that improved housing will lead to improved health, these assumptions are often based on studies with methodological limitations, and, in particular, on studies without control groups.

### What this paper adds

- The health effects of housing improvement may be smaller than sometimes suggested.
- Prospective studies with matched control groups are a feasible means of assessing the health effect of housing improvement.

### COMMENT

Despite significant improvements in reported housing quality, there was no significant change in the percentage of residents reporting “good” or “excellent” health 1 year after moving to improved housing. Similarly, among the matched control group, there was no significant change in “good” or “excellent” health.

The lack of any positive health effects after housing improvement is perhaps surprising, although the robustness and generalisability of the findings are limited by the study’s low power to detect small effects. Nevertheless, this study shows the feasibility of a prospective controlled design, which is uncommon in housing research. The study also confirms the possibility of other important negative effects of housing improvement—namely, increases in rent.

Housing improvement is a complex intervention that may simultaneously have an effect on wider determinants of health. Such effects reported in previous research include increases in rent, relocation of tenants to a new area and wider neighbourhood changes.<sup>9–12</sup> These secondary effects may counteract the potential for health improvement after housing improvement. However, residents in this study were not relocated to a new area, there was no significant change in the mean number of neighbourhood problems reported, and it is unlikely that the reported rent increases can explain the absence of a positive health impact, as over half of the participants (59.2%) were dependent on housing benefit.

Other possible explanations for the absence of health effects observed are the relatively short follow-up period (1 year), the possible insensitivity to change of the health measures used,<sup>13</sup> and the possibility that the potential for health improvement in the intervention group was limited. Nearly half of the participants reported no problems with dampness, draughts, warmth or heating systems at baseline, and at baseline the association between housing conditions and health status was weak (see supplementary table A available online at <http://www.jech.com/supplemental>). National data from Scotland also suggest that the association between housing quality and health, although statistically significant, may be small.<sup>14</sup> These data, and the data from the current study, question the likelihood of significant health improvements shortly after housing improvement, especially when the multiple deprivations commonly associated with poor housing are not similarly improved. This hypothesis remains to be tested in larger evaluative studies.

This study, albeit small, is one of only a few evaluations assessing the health impacts of major housing improvement,<sup>2 15 16</sup> and larger prospective controlled studies are still needed. In addition, this study raises wider issues about the actual potential for health effects and the mechanisms for health effects after housing improvement. Future studies need to assess the wider context

within which housing improvement occurs and to investigate the processes through which health effects may, or may not, arise.

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Supplementary tables are available at <http://www.jech.bmj.com/supplemental>

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Competing interests: None.

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## APPENDIX

### APPENDIX A: QUESTIONS ABOUT HOUSING PROBLEMS

Looking at the options on the card, to what extent, in your opinion, is each of the following a problem in your home? (options “no problem”, “minor problem”, “serious problem”, “don’t know”)

*Housing problems related to warmth:* Dampness or condensation; draughty/leaky windows, keeping your home warm in winter; the heating system.

*Other housing-related problems:* the level of security; too few rooms; too many rooms; rooms too small; rooms too large; not enough privacy; noise from neighbours; noise from other household members; poor state of repair; hazards inside the home; hazards outside the home

## THE JECH GALLERY .....

### Better homes, better neighbourhoods

Interventions to improve housing are often part of broader area-regeneration activities. A programme of housing-led regeneration in a post-industrial village in West Dunbartonshire, at the foot of Loch Lomond in Scotland, involved housing association tenants moving from ex-council flats reported to have damp problems (fig 1), to newly built houses with private gardens (fig 2). Not only was the fabric of the new houses better, but also the neighbourhood regeneration involved general environmental improvements. These included aesthetic improvements, provision of children’s play areas and better street design. Levels of housing density were reduced by housing people in houses rather than in flats, and although the flats were not overcrowded, there was a small but statistically significant reduction in house occupancy (persons per room) when residents moved to their new house. A paper in this issue of *JECH* reports the findings of a prospective controlled study that evaluated the effects on health 1 year after residents moved to a new house: no marked health effects were reported.<sup>1</sup>

The potential for positive health effects is often used as a rationale for public investment in neighbourhood regeneration.<sup>2,3</sup> However, positive health effects should not be assumed to be the inevitable result of housing improvement.<sup>4</sup> The results from our study raise questions about the complexity of the intervention and about the diverse mechanisms through which housing improvement may affect health.<sup>1</sup>

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### APPENDIX B: NEIGHBOURHOOD SCORE—AGGREGATE OF 21 ITEM QUESTIONNAIRE

Looking at the options on the card, which best describes how much of a problem the following are around where you live? (options “not a problem”, “a minor problem”, “a serious problem”, “don’t know”)

Vandalism; litter and rubbish; smells and fumes; assaults and muggings; burglaries, levels of security of houses; closes and back courts or gardens; disturbance by children or youngsters; speeding traffic; people drinking alcohol in public places; uneven or dangerous pavements; lack of public transport; level of police presences and speed of police response; safe children’s play areas; facilities for teenagers/young people; adequate street lighting; nuisance from dogs; people hanging around; reputation of neighbourhood; drug dealing and drug taking; noise—for example, factories, traffic, shouting; the people around here.



Figure 1 Ex-council flats with reported damp problems.



Figure 2 Newly built houses with private gardens and wider environmental improvements.



**Web table i:** Relationship between self-reported health and housing characteristics at baseline (n=100)

	Excellent/good health	Fair/poor health	Statistics
<b>Type of house</b>			$\chi^2=0.080$
House	17 (47.2%)	27 (44.3%)	$p=0.777$
Flat	19 (52.8%)	34 (55.7%)	missing=3
<b>Garden</b>			$\chi^2=0.526$
With private garden	30 (83.3%)	54 (88.5%)	$p=0.468$
No private garden	6 (16.7%)	7 (11.5%)	missing=3
<b>Dampness/condensation</b>			$\chi^2=0.030$
No problem	29 (80.6%)	50 (82.0%)	$p=0.863$
Problem	7 (19.4%)	11 (18.0%)	missing=3
<b>Draughts/leaky windows</b>			$\chi^2=1.463$
No problem	23 (63.0%)	46 (75.4%)	$p=0.226$
Problem	13 (36.1%)	15 (24.6%)	missing=3
<b>Keep home warm in winter</b>			$\chi^2=9.100$
No problem	21 (60.0%)	53 (86.9%)	$p=0.003$
Problem	14 (40.0%)	8 (13.1%)	missing=4
<b>Heating system</b>			$\chi^2=2.438$
No problem	26 (72.2%)	52 (85.2%)	$p=0.118$
Problem	10 (27.8%)	9 (14.8%)	missing=3
<b>Any problems related to warmth *</b>			$\chi^2=3.077$
No problems	13 (37.1%)	34 (55.7%)	$p=0.079$
Problem	22 (62.0%)	27 (44.3%)	missing=4
<b>Other housing problems</b>			$\chi^2=0.546$
No problems	6 (16.7%)	14 (23.0%)	$p=0.460$
One or more problems	30 (83.3%)	47 (77.0%)	missing=3

\* see appendix 1



## Better homes, better neighbourhoods

Hilary Thomson, Mark Petticrew and David Morrison

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Figure 1 Ex-council flats with reported damp problems.



Figure 2 Newly built houses with private gardens and wider environmental improvements.

**Theme II: Evaluation & generation of new evidence**

**Paper VI** Thomson H, Hoskins R, Petticrew M, Ogilvie D, Craig N, Quinn T, Lindsay G. Evaluating the health effects of social interventions. *BMJ* 2004; 328 (7434):282-285.



## Evaluating the health effects of social interventions

Hilary Thomson, Robert Hoskins, Mark Petticrew, David Ogilvie, Neil Craig, Tony Quinn and Grace Lindsay

BMJ 2004;328:282-285  
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### Summary points

Antiretroviral therapy is becoming more affordable for developing countries

Infrastructure is also essential to deliver the complex and sensitive drug regimen

DOTS has been suggested as a method for delivering antiretroviral therapy, although it has limited success for tuberculosis in much of Africa

Suboptimal adherence to antiretroviral therapy is likely to result in the transmission of drug resistant virus strains within the community

Other methods for ensuring adherence need to be developed and evaluated

prescribing practices and poor monitoring of therapy and adherence.

A rational approach is required in which systematic delivery and proved methods for maximising adherence are as important as procuring the drugs themselves. This should be led by a respected international organisation that has the objectives of overcoming short term suffering as well as preventing a similar disaster in the long run, by insisting that antiretroviral policies incorporate a phase of piloting systems that seek to maximise adherence.

Contributors and sources: WS has worked with the World Bank in predicting the effect of HIV in West Africa, and with the Department for International Development and the London School of Hygiene and Tropical Medicine on the economics of tuberculosis control programmes. SK has worked on monitoring HIV drug resistance in trials of antiretroviral therapy conducted in the United Kingdom and Europe. TC has been in charge of the clinical services provided by the MRC unit in the Gambia since 1986 and has specialised in the care and treatment of patients infected with HIV and tuberculosis.

Competing interests: None declared.

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## Evaluating the health effects of social interventions

Hilary Thomson, Robert Hoskins, Mark Petticrew, David Ogilvie, Neil Craig, Tony Quinn, Grace Lindsay

Is no evidence better than any evidence when controlled studies are unethical?

Rigorous evidence<sup>1 2</sup> on the health effects of social interventions is scarce<sup>1 2</sup> despite calls for more evidence from randomised studies.<sup>3</sup> One reason for the lack of such experimental research on social interventions may be the perception among researchers, policymakers, and others that randomised designs belong to the biomedical world and that their application to social interventions is both unethical and simplistic.<sup>4</sup> Applying experimental designs to social interventions may be problematic but is not always impossible and is a desirable alternative to uncontrolled experimentation.<sup>3</sup> However, even when randomised designs have

been used to evaluate social interventions, opportunities to incorporate health measures have often been missed.<sup>5</sup> For example, income supplementation is thought to be a key part of reducing health inequalities,<sup>6</sup> but rigorous evidence to support this is lacking because most randomised controlled trials of income supplementation have not included health measures.<sup>5</sup> Current moves to increase uptake of benefits offer new opportunities to establish the effects of income supplements on health. In attempting to design such a study, however, we found that randomised or other controlled trials were

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**Box 1 Attendance allowance**

- Attendance allowance is payable to people aged 65 or older who need frequent help or supervision and whose need has existed for at least six months
- The rate payable depends on whether they need help at home or only when going out and whether they need help during the day or the evening, or both

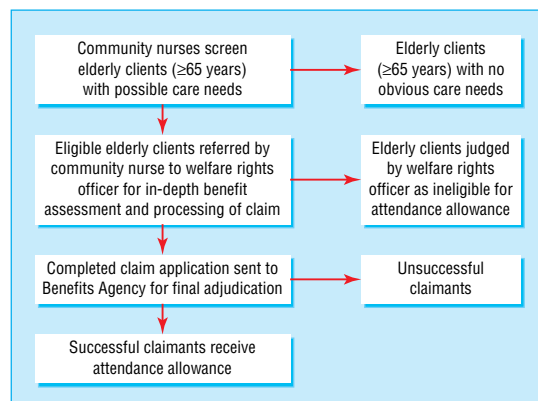
difficult to justify ethically, and our eventual design was rejected by funders.

**Aims of study**

A pilot study carried out by one of us (RH) showed substantial health gains among elderly people after receipt of attendance allowance. We therefore decided to pursue a full scale study of the health effects of income supplementation. The research team comprised a multidisciplinary group of academics and a representative from the Benefits Agency (TQ). Our aim was to construct a robust experimental or quasi-experimental design (in which a control group is included but not randomly allocated) that would be sensitive enough to measure the health and social effects of an attendance allowance award on frail, elderly recipients.

**The intervention**

The intervention involved a primary care based programme that aimed to increase uptake of benefits. In 2001, community nurses, attached to a general practice serving the unhealthiest parliamentary constituency in the United Kingdom,<sup>7</sup> screened their frail elderly clients for unclaimed attendance allowance (box 1). Potential underclaimants were then visited by a welfare rights officer, who carried out a benefit assessment, and the claim was then forwarded to the Benefits Agency (part of the Department of Social Security) for the final adjudication of applications (figure). This resulted in 41 clients receiving additional benefit totalling £112 892 (£160 307; \$200 302), with monthly incomes increasing by £163-£243.<sup>8</sup>



Process of screening to promote uptake of attendance allowance. The groups represented by the boxes on the right would be unsuitable as controls because they would be systematically different from benefit recipients in terms of care needs and health status



Health effects of social intervention can be hard to study

**Outcomes**

We chose change in health status measured by the SF-36 questionnaire as the main outcome variable. Explanatory variables, which recipients had linked to increased income in pilot interviews, were also incorporated. These included diet, stress levels, levels of social participation, and access to services. We intended to assess health status before receipt of the benefit and at six and 12 months afterwards. An economic evaluation was also planned.

**Study design**

We initially considered a randomised controlled trial. However, we encountered problems with the key elements of this design. The study designs considered and the issues raised are outlined below.

**Design 1: randomisation of the intervention**

Under a randomised controlled design successful claimants would be randomised immediately after the adjudication decision by the benefits agency. Those in the control group would have their benefit delayed by one year, and those in the intervention group would receive the benefit immediately. This design would ensure that the health status and benefit eligibility of both groups were comparable at baseline. However, the research group considered this design unethical because of the deliberate withholding of an economic benefit, which would also be unacceptable to participants. This design was therefore abandoned.

**Design 2: randomising to waiting list**

The introduction of a three month waiting list between initial assessment by a nurse and assessment by the welfare rights officer provided an opportunity for random allocation to the control and intervention group. We obtained approval to randomise the clients to a waiting list of a maximum of three months from the Benefits Agency, which provides the welfare rights officer. Thus, elderly clients referred by the nurse to the welfare rights officer could have been randomised to receive the visit either immediately (the intervention group) or after three months (the control group).

This design would have allowed us to compare the groups at the desired time points and provided a directly comparable control group in terms of health

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status and benefit eligibility. However, it randomises the benefit assessment and not the intervention of interest (receipt of the benefit), and a delay of three months would probably not be long enough to detect important health differences between the two groups. More importantly, it is unlikely to be ethically acceptable to request that study participants, already assessed to be in need of an economic benefit, accept a 50% chance of delaying the application process for three months in the interests of research. We therefore rejected this design.

### Design 3: non-randomised controlled trial

A third potential design entailed identifying a non-randomised control group from a nearby area with a similar sociodemographic composition but with no welfare rights officers. In this design, community nurses would have screened potential underclaimants in the control area, who would then have been offered a standard leaflet on how to apply for attendance allowance (a nominal intervention corresponding to "usual care"). This design would have eliminated some of the ethical concerns associated with randomisation and delaying the receipt of benefit, and would have achieved an intermediate level of internal validity by retaining a comparison with a control group. However, recruitment and retention of this control group raises problems.

The success of this design depends on participants in the control group delaying their claim for the duration of the study. Although the effectiveness of the "usual care" intervention, the leaflet, is normally poor, we considered it unlikely that this would be the case after assessment for the study as participants are made aware of their potential eligibility for the benefit. We thought it unacceptable to request that participants delay claiming the additional benefit after drawing attention to their eligibility.

### Design 4: uncontrolled study

A before and after study of a group of benefit recipients would be more ethically acceptable, but it would be more difficult to attribute any observed change in health status to the intervention alone. We applied for research funding for a study based on this design, citing the practical and ethical difficulties in designing a randomised controlled trial, but the application was rejected mainly because of the lack of a control group. We presume that the underlying assumption was that such an uncontrolled study would be so biased as to provide no useful information.

## Discussion

Our initial aim was to design a randomised or controlled study to detect the health effects of income supplementation. Our failure to design such a study and to get funding for a less rigorous study poses the question of what sort of evidence is acceptable in such situations. Social interventions differ from clinical and most complex public health interventions in that changes in health are often an indirect effect rather than a primary aim of the intervention. Investigation of indirect health effects often requires choices to be made between competing values, usually health and social justice, creating a moral problem. When, as in our study, the tangible social and economic gains generated by the social interven-

## Summary points

The health effects of social interventions have rarely been assessed and are poorly understood

Studies are required to identify the possible positive or negative health impacts and the mechanisms for these health impacts

The assessment of indirect health effects of social interventions draws attention to competing values of health and social justice

Randomisation of a social intervention may be possible using natural delays, but adding delays for the sole purpose of health research is often unethical

When randomised or other controlled studies are not ethically possible, uncontrolled studies may have to be regarded as good enough

tions outweigh the theoretical possibility of marginal health effects, the moral issues are clear.

### Randomisation

Although judgments about equipoise have recently been challenged,<sup>9</sup> equipoise around the primary clinical outcome has been the ethical justification for randomising clinical interventions.<sup>10 11</sup> Equipoise implies uncertainty around the distribution of costs and benefits between two interventions. Designing a randomised study may be simple in theory, but in cases where the equipoise is around uncertain indirect health impacts, and the primary economic or social impacts seem certain, true equipoise is unlikely and randomisation may be unethical.

Randomising a control group need not always present ethical hurdles. There may be inherent delays in rolling out a new or reformed programme across an area, or an intervention may require rationing or be subject to long waiting lists. These delays may provide ethical and pragmatic opportunities for randomisation<sup>12</sup>; indeed, randomisation may be the fairest means of rationing an intervention.<sup>13</sup> However, delaying access to a tangible benefit for individuals who are assessed as "in need" may not be justifiable on research grounds.

### Generating evidence for healthy public policy

An urgent need remains for studies of the indirect health effects of social interventions to improve our understanding of the mechanisms by which health effects can be achieved.<sup>14</sup> Attention has already been drawn to the need for careful design of evaluations of complex public health interventions,<sup>15-17</sup> but guidance for evaluating the indirect health impacts of social interventions may require further consideration in light of the issues outlined above. For example, when the direct effects are obvious, randomised controlled trials may be unnecessary and inappropriate.<sup>18</sup> In health technology assessment, other study designs have an important role in development<sup>15 19</sup> and in helping to detect secondary effects.<sup>18</sup> For example, new drugs with established pharmacological mechanisms



are investigated at increasing levels of internal and external validity before being tested in a population level randomised controlled trial. Phase I and II studies are often small and uncontrolled, but they help to establish positive and negative effects, clarify the dose-response relations, and provide the background for larger trials.<sup>15-19</sup> In addition, once approved, drugs are closely monitored at a population level to detect previously unidentified secondary adverse effects that may outweigh the primary positive effects.<sup>18</sup> Our pilot study was similar to a phase II study.

This matching of study designs to the level of development and knowledge of the effects of an intervention could be usefully applied to the study of social interventions. Non-randomised and uncontrolled studies could be used to shed light on the nature and possible size of health effects in practice, to illustrate mechanisms, and to establish plausible outcomes.<sup>18</sup> Such studies may serve as a precursor to experimental studies when these are ethically justifiable and appropriate. However, when randomised studies are not possible, we may have to accept data from uncontrolled studies as good enough, given the huge gaps in our knowledge.<sup>14</sup> We need to reconsider what sort of evidence is required, how this should be assembled and for what purpose, and the trade offs between bias and utility so that study designs that are acceptable to research participants, users, and funders can be agreed.

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Contributors and sources: The initial idea for this study was developed by RH. All authors regularly attended and contributed to meetings of the study team, development of the research proposal, and writing the paper. HT, MP, and DO work on a research programme that evaluates the health impacts of social interventions. RH, GL, and TQ worked on initial pilot work investigating Attendance Allowance uptake and its health impacts. NC is a lecturer in health economics and has an active

research interest in designing economic evaluations of social welfare interventions.

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## Two memorable patients

### Two nil

It is a dull wet Saturday afternoon in Goodison Park. The fans are filing in, and there is a tense excited atmosphere around the ground. It is nearing the end of the season, and everyone is hoping the seemingly inevitable relegation battle can be avoided this year. The Goodison faithful are buzzing with the prospect of taking three points from fellow strugglers. Behind the scenes, the usual band of St John Ambulance volunteers have gathered—doctors, nurses, firemen, policemen, dockers, students, and others from all walks of life.

As the match enters the last five minutes, the only thought echoing around the ground is how to put the ball into the goal. Until, that is, a simple radio message is received: "Code Blue, cardiac arrest in the Lower Bullens stand."

Our team jumps into action. We arrive to find an unresponsive, cyanotic, elderly man stretched out across four seats. Cardiopulmonary resuscitation is already being performed by a dockworker; he's an experienced first aider. Other members of our team and the club doctor arrive with oxygen and an automatic defibrillator. The casualty is in ventricular fibrillation, and the first three shocks are given immediately, but with no effect. We intubate and cannulate him, as slick as any hospital arrest team. A fourth shock is given, and we get a result—the rhythm change that everyone is looking for. A spontaneous circulation is returned.

Just as we all relax, lightning strikes twice: "Code Blue, cardiac arrest in the Gwladys Street stand." Half our team go tearing off to the second incident, with the match now in injury time. A second unresponsive man is found in cardiac arrest, but not for long. We are joined by an ambulance service team and soon once more have a spontaneous output.

The crowd are now filing out, blissfully unaware as two paramedic vehicles arrive. The first man has spat out his endotracheal tube and is conscious, asking what the score is. Two live casualties are taken to hospital. Our team of volunteers returns to the first aid point buzzing, but football and relegation are no longer important. The only score on everyone's mind now is St John 2—Undertakers 0.

Working in a state of the art hospital surrounded by machines that go beep and staff who have trained in their professions for many years can sometimes make us forget the basics. It is humbling to remember that the two lives saved that day weren't due to fancy new techniques or expensive modern technology. They were saved by a group of volunteers, the likes of whom may be found at every major sporting event and public gathering across the country.

Joanne Banks *orthopaedic specialist registrar, Mersey Deanery Rotation*

**Theme II: Evaluation & generation of new evidence**

**Paper VII Thomson H.** A dose of realism for healthy urban policy: lessons from area-based initiatives in the UK. *Journal of Epidemiology & Community Health* 2008; 62 (10):932-936.



## A dose of realism for healthy urban policy: lessons from area-based initiatives in the UK

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# A dose of realism for healthy urban policy: lessons from area-based initiatives in the UK

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## ABSTRACT

Many urban policies aim to improve areas and address socioeconomic deprivation. The resulting investment is often delivered through area-based programmes which incorporate initiatives to improve the physical, social and economic environment. Hypotheses that these investments can contribute to wider public health strategies are based on epidemiological data and used to support the concept of healthy urban policy. However, there is little evidence on their ability to generate positive impacts on socioeconomic or health outcomes. The lack of validating evidence on actual impacts raises two important questions: (1) Is area-based investment an effective strategy to tackle socioeconomic deprivation? (2) What is the prospect for new and improved evaluations to provide stronger evidence? Both the programmes of area investment and their accompanying evaluations have been criticised for being overly ambitious in what can be achieved by the investment and what can be measured by an evaluation. Area-based approaches to tackling deprivation have their advantages but a mix of area and individual-level targeting is likely to be needed. While there is scope to improve the utility of evaluation data there are also inevitable constraints on assessing and attributing impacts from urban investment. The inherent limitations to an area-based approach and the ongoing constraints on impact evaluation will inevitably temper expectations of what healthy urban policy can achieve. However, lack of evidence is not grounds to abandon the concept of healthy urban policy; adoption of more realistic expectations together with improved evaluation data may help to increase its credibility.

Healthy public policy, a term currently popularised by the World Health Organization, has been defined as public policy which improves living conditions; its adequacy measured by consequent health impacts.<sup>4</sup> In the UK and elsewhere, there is now established political interest in using public policy as a health improvement strategy through tackling the socioeconomic roots of poor health and health inequalities.<sup>1–10</sup> Urban policy is a major route through which governments attempt to deliver improvements to living conditions and economic opportunities; commonly through large-scale programmes of urban regeneration or neighbourhood renewal as well as local community-based initiatives. Such investment is often area-based, targeting priority areas, and the various investment activities may be collectively described as area-based initiatives (ABIs). Area-based initiatives are, therefore, potentially central to the pursuit of healthy urban policy and more generally to healthy public policy.

Healthy urban policy is most often discussed conceptually, with little discussion of how it might be realised. This paper draws on recent efforts to exploit available evidence for healthy urban investment and points to important issues which need to be acknowledged if some form of healthy urban policy is to be pursued at an operational level. The paper reflects on the empirical support for ABIs as a strategy to tackle poor health and health inequalities, as well as broader issues of the generation and potential use of research evidence. While some of the issues raised are specific to urban policy, many are also pertinent to the broader topic of evidence-informed healthy public policy.

### Box 1 The potential for health improvement is used to justify government investment in area regeneration and renewal

- ▶ “Local neighbourhood renewal and other regeneration initiatives are in a particularly good position to address health inequalities because they have responsibility for dealing with the wider determinants that have an impact on people’s physical and mental health.”<sup>1</sup>
- ▶ “The benefits of including health in regeneration strategy are twofold. First there are the direct benefits of improving peoples’ physical and mental health and wellbeing. Second are the indirect benefits for employment, quality of life, levels of stress and the cost of hospital admissions or medicines.”<sup>2</sup>
- ▶ “Area regeneration has a key contribution to make to improving health. It tackles the social, economic, and environmental problems of multiple deprivation. And it embodies the concerted approach the government seeks to foster.”<sup>3</sup>

### ABI POLICY LINKS TO HEALTH

Area-based initiatives target geographical areas of deprivation and commonly comprise investment in key socioeconomic determinants of health, for example employment, housing, education, income and welfare. In addition to these substantive material interventions, there will often be accompanying initiatives to promote healthy lifestyles. In the UK, the official links between ABIs and health have historically been limited to specific funding themes around health initiatives, most often involving physical improvement to health service provision or promotion of healthy lifestyles—for example, smoking cessation initiatives. However, over the past 10 years the shift towards joined-up policy has led to clearer and more visible policy links between ABI investment to tackle socioeconomic deprivation and health impacts (box 1). Indeed, in the UK, neighbourhood renewal is



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currently an explicit part of the national strategy to tackle health inequalities.<sup>1 5</sup>

### ABI PROGRAMMES' IMPACTS ON HEALTH AND SOCIOECONOMIC DETERMINANTS OF HEALTH: STATE OF THE EVIDENCE

There is irrefutable evidence from epidemiological research to support the hypothesis that interventions which aim to alleviate socioeconomic deprivation will lead to improved health; impact data following such interventions are needed to confirm this hypothesis. Large-scale ABIs, both in the UK and elsewhere,<sup>11 12</sup> have been evaluated, but much of the arising data are presented in policy reports which are often hidden in poorly catalogued grey literature and difficult to locate. Despite considerable efforts to extract what data are available, it is apparent that empirical data confirming expectations that ABIs will lead to health impacts, or other relevant socioeconomic impacts are seriously lacking.<sup>11-14</sup> Until relatively recently the focus of much evaluation has been on audit; reporting monies spent and gross outputs, such as miles of new road built, or number of training places provided, rather than actual impacts—that is, changes over time compared with baseline. The growing interest in assessment of impacts is illustrated by the emergence and the gradual improvement of impact evaluations over the past 15 years.<sup>11 15 16</sup>

The data generated by the evaluations of national UK ABI programmes have been reviewed to produce an evidence synthesis,<sup>11</sup> (table 1) albeit limited by the quality, quantity and nature of the data available. Health and mortality impacts have been assessed in four evaluations, but conflicting data make it impossible to draw conclusions about the health impacts of previous ABIs. Employment and education impacts are the most commonly reported socioeconomic impact; data are suggestive of a modest positive impact. Impacts on income and housing quality have rarely been assessed, making it difficult to generalise about likely impacts.<sup>11</sup> Notably, the ongoing evaluation of the New Deal for Communities (NDC) ABI programme, includes a panel survey following the same individuals in both NDC areas and a sample from similarly deprived neighbourhoods within the same geographical area but which are not part of the NDC programme.<sup>15 16</sup>

From the scant amount of impact data available there is much uncertainty around whether ABIs do impact positively on health or the socioeconomic determinants of health; with even less known about the social distribution of impacts and the implications for health inequalities. It is important to remember that this uncertainty should be interpreted as absence of evidence rather than evidence of absence.

The lack of evidence and uncertainty about impacts raises two fundamental issues which need to be addressed if ABIs are to be incorporated into a strategy to improve health and reduce health inequalities. Firstly, there is the question of whether

area-based approaches can be effective at targeting socioeconomic deprivation; the use of ABIs as a strategy for health improvement assumes they are. And secondly, to what extent and how can evaluations be improved to provide a stronger evidence resource with which to improve the effectiveness of future urban policy (whether or not as part of a wider health improvement strategy)?

### ARE ABIS AN EFFECTIVE STRATEGY TO TACKLE SOCIOECONOMIC DEPRIVATION?

Area-based initiatives and their approach to targeting small areas are an efficient way to deliver intensive periods of investment to a target population concentrated in a small area, and may also alleviate negative area effects that may be associated with concentrations of multiple deprivations in a small area. There may also be added value in terms of the local agency synergy and partnership when concentrating investment in a small defined area.<sup>17</sup>

However, there have also been some serious criticisms of ABIs and their approach of targeting small areas. At a policy level, ABIs have been criticised for being short-term, unfocused, and overly ambitious given relatively modest funding.<sup>18-22</sup> The continually changing political landscape, local, national and global, inevitably limits the potential impact of any single policy, including relatively short-term ABI investment.<sup>19</sup> A further related criticism is that predictions of positive impacts are made with no clear underlying theory of what type of impacts and how such impacts will be achieved. The diverse range of interventions delivered by ABI programmes, ranging from rehousing, employment initiatives and environmental improvements, to healthy lifestyle initiatives, means that the types of and routes to possible health outcomes and socioeconomic outcomes will be diverse. Some of these interventions may have a direct, observable impact which does not need further elaboration or exploration, for example impact of graffiti removal on neighbourhood aesthetics. However, immediate observable impacts cannot always be relied upon and expectations that the investment will lead to impacts, health or socioeconomic, would benefit from a more explicit theory mapping the types of impacts expected, timeframes, affected populations, and mechanisms for impacts.

The use of an area-based approach to target deprivation is also problematic. Although there are well-defined areas with concentrations of multiple deprivations, it has been repeatedly demonstrated that, in the UK at least, the majority of socioeconomically deprived individuals do not live in these areas. Thus, ABIs have been criticised for missing the majority of the target population.<sup>17 23</sup> Area-based approaches have also been linked to possible stigmatising of an area.<sup>24 25</sup> Identifying a local area as an ABI area publicly labels the area as deprived and may add further to social exclusion of the area and its residents.<sup>24-27</sup> The use of an area-based approach has also been dismissed as being an inadequate sticking plaster to address the roots of socioeconomic deprivation and social exclusion, which do not necessarily stem from the area itself but rather are more deeply rooted at a societal level.<sup>20 28</sup>

Aside from research evidence, other, more casual, observations have noted that despite decades of ABI investment, deprivation persists in many target areas; this brings into question the effectiveness of ABIs.<sup>18 29</sup> A counterargument in support of ABIs is that residents of ABI areas, known to be highly mobile, who are benefiting from improved socioeconomic circumstances, often leave the area and are replaced by

**Table 1** Summary of evidence of impacts on health and socioeconomic determinants of health from national programmes of urban regeneration in the UK (1980–2004)

Health impacts	Rarely assessed - conflicting findings (5 evaluations)
Employment	Modest positive impact (10 evaluations)
Education	Modest positive impact (6 evaluations)
Housing quality	Rarely assessed (1 evaluation)
Income	Rarely assessed (3 evaluations)



individuals experiencing higher levels of socioeconomic deprivation.<sup>17 19</sup> Thus, although individuals are benefiting, the investment may be appearing to fail as the target area remains a ghetto for the most socially excluded.

The above criticisms suggest that expectations of significant socioeconomic impacts following ABI investment may be unrealistic. How much more unrealistic, therefore, is the expectation of substantial health impacts, which is predicated on the effectiveness of ABIs to impact on socioeconomic outcomes?

The alternative to targeting small areas is to target individuals in large areas, nationally or regionally. Such an approach is more likely to reach the majority of the socioeconomically deprived population who will not be reached by ABIs targeting the most deprived small areas. In addition, large-area targeting is more likely to be part of existing mainstream funding rather than short-term grants, and may be less likely to lead to stigmatisation of an area. Inevitably, there are pros and cons to both approaches<sup>17 28</sup>, and appropriate mix targeting small areas and individuals would appear to be desirable.<sup>17 19</sup> There is no doubt about the relative merits of targeting small areas, and the criticisms levied at ABIs do not justify abandoning targeting small areas, but rather it is important to be aware of the strengths and limitations when prospectively assessing the potential impacts.

#### NEW IMPROVED EVALUATIONS: THE ANSWER?

It is well established that little is known about the impacts of ABIs. This dearth of evidence would appear to be largely due to a lack of research, suggesting that there is potential for new primary studies to address this knowledge gap. The past decade has witnessed calls for more evidence to support public policy generally through the use of new and improved impact evaluations.<sup>30 31</sup> In particular, there have been calls for evaluations that use quasi-experimental designs.<sup>32 33</sup>

An examination of previous evaluations in this field points to some obvious areas that need to be improved. Like the programmes themselves, ABI evaluations have been criticised for being over-ambitious in what they expect to be able to assess within the set time and resource constraints.<sup>18 19 34</sup> This is especially relevant where impacts of interest, such as health, cannot be expected in the short term. Other criticisms of previous ABI evaluation include the absence of a theory-based approach to test hypothesised mechanisms for the key impacts being assessed;<sup>11 12 18 19 34 35</sup> an over-reliance on routine data rather than cohort studies to track individuals;<sup>11</sup> and the lack of comparison data to give an indication of additionality (ie what impacts have occurred in addition to those that would have occurred regardless of the investment).<sup>11 34</sup> Moreover, much of the data presented in available evaluations is incomplete and difficult to interpret as the description of methods used is often unclear.<sup>11 36</sup>

Some of the above criticisms can be addressed simply and without much cost; though may require more careful thought in evaluation design. In line with the need for the links between intervention and predicted impacts to be supported by more explicit theory or pathways, evaluations should be designed to test these theories (using their own theory where none have been previously devised).<sup>35</sup> Other ways in which the utility of evaluation data could also be increased relatively inexpensively include improved clarity of reporting of results and methods, and substituting assessments of distal health outcomes with proxy measures of health determinants, using either routine or self-reported measures.<sup>9</sup> Innovative use of routine data has been

recommended as a practical, low-cost resource for evaluation.<sup>37</sup> For example, where routine data are available for small areas, it may be possible to carry out a time-series analysis, comparing projected trends from before the intervention with actual trends observed following the investment.<sup>38</sup> Area-based routine data are unable to report changes among individuals, and this presents an obstacle given the typical mobility of residents in ABI areas.<sup>17 19</sup> However, recent improvements in the availability of small-area data more closely reflect the defined target area or neighbourhood and should provide increased utility of routine data. For example, in the UK, useable routine data on numerous socioeconomic outcomes are now available,<sup>39</sup> and in Scotland much of this is available for small areas of around 750 people.<sup>40</sup> In addition, linking routine individual health service data to individual neighbourhood survey data is now possible.<sup>41</sup> Where routine data are not available for geographies that relate closely enough to the intervention area, there may be no worthwhile alternative to intensive and costly panel surveys of individual residents.

In addition to quantitative assessments, qualitative data can shed light on unforeseen impacts, and can also provide valuable insights into possible pathways for impacts. Assessments from both those delivering and those in receipt of the intervention may provide helpful contrasts in perceptions of the intervention and its impacts, and may also explain unexpected impacts or the distribution of impacts.

Other criticisms of ABI evaluations may be more difficult to address. Conducting community based, quasi-experimental evaluations, which are powered to detect small impacts among individuals over long periods is neither straightforward from a pragmatic point of view,<sup>42 43</sup> nor cheap. Area-based initiatives comprise multiple and varied interventions delivered over a period of time. Typically, it will not be possible for the evaluators to control the allocation or timing of the intervention. Details of the nature, implementation and timing of the interventions can be invaluable to the evaluation but obtaining this information requires time and skills to develop good relationships with key stakeholders. Furthermore, there is the increasing problem of high levels of attrition in deprived areas, which are most likely to be targeted by ABIs.<sup>44</sup>

Aside from the considerable cost implications and difficulties of implementing a rigorous evaluation in the 'real world', even an evaluation which achieves 100% response and follow-up levels at 10 years or longer may well still fail to generate the hoped-for evidence due to the introduction of confounding factors. Even in the short term, impacts are likely to occur in conjunction with other changes which may or may not be associated with the intervention. Extended follow-up inevitably introduces further multiple confounding due to other changes over time, be they at an individual, area or societal level; and intensive, longitudinal studies tracking individuals may themselves need to be quite interventionist and, thus, introduce an additional confounder which is difficult to control for.

Other conceptual problems for these evaluations include definitions of exposure and success, and identifying comparison areas. Area-based initiatives involve multiple interventions, ranging from rehousing, environmental transformation to health promotion initiatives. The different components of the interventions typically target relevant subgroups within the investment area. Yet categories of exposure to the intervention are often reduced to a binary variable which is insensitive to the varying exposures experienced within the target population and its sub-groups. Similarly, any number of diverse outcomes may be used to assess the impact of the various interventions and

### Box 2 A summary of key issues to consider in the realistic pursuit of healthy urban policy

**Realistic aims:** Are the expected impacts and timescales realistic given the level of funding and timescale of the programme and the evaluation?

**Why area-based investment might not be as successful as hoped**

**Area versus individual investment:** Investment targeted at priority areas will not reach the majority of socioeconomically deprived population at a national level.

**Theory:** Mechanisms or routes through which impacts are to be expected need to be made explicit when the programme is being planned (this is aside from visible links to health within the general vision of a programme). This has rarely been done and programmes have been criticised for being unfocused.

**Residential mobility:** Residents whose socioeconomic circumstances improve often leave the area and are replaced by more socioeconomically deprived residents, thus area-based deprivation remains despite apparent benefit for some individuals.

**Stigma:** Areas in receipt of assistance may be stigmatised, thus compounding existing social exclusion for residents.

**Ideological:** Area-based initiatives have been criticised for ignoring the root causes of socioeconomic deprivation and exclusion at wider societal level.

#### Issues when assessing the health impact of area-based investment

**Use of theory:** Evaluations should be designed to test a pre-specified theory mapping a mechanism or route to a measurable outcome (see above).

**Reporting of data/methods:** Improved transparency of evaluation methods and reported results would improve the utility of evaluation data.

**Individual or routine data:** Routine data is inexpensive but is often limited in reporting changes at individual level.

**Small effect size:** Detecting small health effects will require a large study population to detect significant changes at a population level.

**Recruitment of target population:** Response rates in areas of deprivation are falling.

**Comparison areas:** Use of a suitable comparison area is desirable but identification of an area with equal need but not selected for the investment is difficult.

**Defining exposure to intervention:** Individuals within the target area will have widely varying levels of exposure to what are often multiple interventions.

**Time-scale:** Timing of final outcome is unknown but may be many years after the intervention. Aside from resource implications, and attrition, long-term follow-up may have an effect itself, and introduces additional confounding due to the passage of time. An alternative is to use proxy measures which can be measured within 2–3 years, eg socioeconomic determinants of health.

**Defining success:** Slowing the rate of downward trends may be an important success, but this may be wrongly reported as a negative impact; assessing trends before and after the intervention may be required.

may well report a mix of effects, making an overall assessment of success difficult.

Definitions of success may refer to positive impacts for the target area but this alone is unable to reveal whether or not the

### What is already known on this subject

The concept of healthy urban policy is intuitively appealing to both urban policy makers and the public health community. But area-based initiatives and their attendant evaluations are often over-ambitious relative to the funding levels and timescales allowed. With little prospect of obtaining clear empirical support, the pursuit of evidence informed healthy urban policy may be dismissed as idealistic.

### What this study adds

- ▶ Despite the difficulties in gathering evidence of the impacts of area-based investment, the overwhelming epidemiological evidence supporting the hypothesis that alleviating socioeconomic deprivation will generate health improvement suggests that healthy urban policy is still worth pursuing.
- ▶ Policy makers and evaluators need to agree realistic expectations of how urban policy might impact on health and its determinants, and what evidence is obtainable within the resource and conceptual limitations of an evaluation.

impacts would have occurred, and may even have been greater, had the area not received any intervention. Conversely, a negative impact cannot be assumed to indicate failure; without the investment the area may have fared worse. Analysis of trend data and comparison area data can help illuminate additional change, but identifying areas which are similar sociodemographically at a detailed level, as well as being in equal need of the ABI investment, may not be possible.<sup>45</sup>

### CONCLUSION

With little prospect of robust empirical validation, the development of evidence-informed healthy urban policy may be dismissed as an impossible ideal; but this is not grounds for total abandonment of the concept. Aside from health improvement, investment to alleviate socioeconomic deprivation can be justified on grounds of social justice. Support for the concept of healthy urban policy and forecasts of accompanying health improvement relies on the well-established links between socioeconomic deprivation and health;<sup>46</sup> data from outcome evaluations are needed to validate these forecasts, but is currently lacking and may be difficult to obtain.

The continued pursuit of healthy urban policy needs to incorporate a more realistic and pragmatic approach (box 2). Policy makers and evaluators need to set agreed expectations of both area-based investment and its evaluation. This requires a clear acknowledgement of the inevitable uncertainties, while also incorporating scope for improvement using empirical evidence from evaluations. Some practical solutions, discussed earlier, could greatly increase the utility of evaluation data, but expectations still need to be tempered by what evaluation can realistically achieve. In time, evaluation of realistic (both achievable and measurable) impacts should provide 'best available' evidence to inform how best to mitigate possible harms and maximise benefits of future urban investment.

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## Theory and methods

reviews of empirical research in this field as well as the authors own experience of responding to the evidence demands of policy makers and practitioners to develop healthy public policy, in particular within the field of housing and area-based regeneration initiatives.

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### **Theme III: Knowledge Transfer**

**Paper VIII Thomson H, Petticrew M, Douglas M.** Health Impact Assessment of housing improvements: incorporating research evidence. *Journal of Epidemiology & Community Health* 2003;57:11-16.



## Health impact assessment of housing improvements: incorporating research evidence

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## PUBLIC HEALTH POLICY AND PRACTICE

## Health impact assessment of housing improvements: incorporating research evidence

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**Background:** Health impact assessment (HIA) has been widely recommended for future social policies and investment, such as housing improvement. However, concerns have been raised about the utility and predictive value of an HIA. Use of existing research data would add more weight to forecasts by an HIA.

**Methods, results, and conclusions:** A recent systematic review of housing intervention studies found a lack of research. The authors recommended that a broader evidence base would be needed to support HIA. In response to consultation with policymakers and HIA practitioners this paper presents a way in which research can be used to inform HIA. Based on the systematic review, the authors have developed a table of synthesised findings indicating the expected health effects of specific housing improvements. The authors also reviewed observational data of housing associated health risks to highlight the key impacts to consider when doing a housing HIA. The findings are presented and the authors discuss how they should be used to inform evidence based housing HIA. In addition to considering the existing research, HIA must consider the local relevance of research. Consultation with local stakeholders also needs to be incorporated to the final assessment. The lack of data and the difficulties in gathering and reviewing data mean that not all HIAs will be able to be informed by research evidence. Well conducted prospective validation of HIAs would contribute to the development of healthy housing investment by informing future housing HIA.

Health impact assessment (HIA) has been recommended for all new policies.<sup>1</sup> However, HIAs have been criticised for being subjective and failing to account for their use of evidence.<sup>2</sup> Toolkits and guidelines on HIA have been produced but proposals to develop an evidence base for topic specific HIAs have not yet been realised.<sup>3</sup> It is important that a serious attempt is made to locate and provide what evidence is available and to present it in such a format as to maximise its potential for influence.

Research evidence of specific policies or interventions can be gathered and systematically reviewed to produce accessible summaries that can assist those carrying out HIAs in specific areas. We recently carried out a systematic review of the health effects of housing improvements.<sup>4</sup> This review included retrospective, prospective, controlled, and uncontrolled studies from all over the world in any language. Despite broad inclusion criteria the lack of studies, the range of interventions and outcomes used, and the low study quality made synthesising the findings difficult. We concluded that there was a lack of research evidence from intervention studies alone to support improved housing as a means to improve health and that other sources of evidence should be used in addition to help inform current housing HIAs.

In response to consultation with policy makers and HIA practitioners this paper presents the findings of the systematic review highlighting the type of outcomes observed after specific housing improvement (table 1). In addition to the systematic review we have incorporated a broader evidence base of observational research, to produce evidence informed guidance on what health effects to expect and what questions to ask for those carrying out housing HIAs (boxes 2 and 3). This paper tackles the issue of presenting research evidence in a way that can inform prospective HIAs of housing improvement projects or policies.

#### Scope of the review

The literature reviewed here relates to housing conditions and does not specifically include furniture interventions or

interventions to reduce home accidents, falls, or fires or impacts of area regeneration. Four systematic reviews covering these topics and a comprehensive review on homelessness were identified but are outwith the scope of this paper.<sup>5-10</sup> Literature on radon, lead, and carbon monoxide were also excluded as there are already measures in place to protect residents from those hazards.

#### EXISTING EVIDENCE OF HEALTH AND SOCIAL EFFECTS OF HOUSING IMPROVEMENTS

Table 1 shows the main effects of different types of housing improvements on six main broad health and social outcomes. The findings are a synthesis of the data from the intervention studies reviewed and we indicate the strength of evidence for each finding.

#### General physical health and illness episodes

Thirteen studies assessed changes in general health after housing improvement.<sup>11-25</sup> Measures used included self reported wellbeing, activity, symptoms or illness episodes, and health service use. Two studies used a validated general health measurement.<sup>20, 26</sup> Ten studies found some health improvements<sup>11, 13-17, 19, 20, 22-25</sup> and five studies found no difference in some measures. Some studies found mixed effects.<sup>12, 15, 20</sup>

Three studies of rehousing and community regeneration reported adverse effects on general health.<sup>12, 15, 27</sup> One study found increases in reported illness episodes (+56%),<sup>15</sup> though this was in part attributed to a flu epidemic. In a further study, age standardised mortality rates increased for all ages, except infants, five years after rehousing from a slum area.<sup>27</sup>

#### Mental health

Half the studies identified used a measure of mental wellbeing (including the Hospital Anxiety and Depression Scale (HADS), self reported mental health and hypnotic prescribing levels).<sup>12-15, 17, 20, 22, 23, 26, 28-30</sup> These studies assessed the health

**Table 1** Evidence from controlled and uncontrolled intervention studies of specific health impacts of housing

Impact on outcomes measured	General health or wellbeing	Symptoms/illness and health service use	Respiratory	Mental health	Mortality	Social
<i>Rehousing/refurbishment plus relocation from slum area or community regeneration</i>						
	↔ Unclear impact on measures of general health +	↔ Unclear impact on symptoms or illness episodes ++ ↔ Unclear effects on health service use +	↔ Conflicting findings from four studies	↑ Consistent improvements in mental health ++	↓ Increased +	↑ Numbers of smokers reduced +  ↑ Increased community involvement, social support, sense of belonging and feeling of safety. Reduced fear of crime and sense of isolation + ↓ Increased rents led to reduced income to buy adequate diet +
<i>Medical priority rehousing (MPR)</i>						
	↑ Improved objective measure and self-reported health +	↔ Unclear impact on health service use +		↑ Improvement in objective measure and self-reported mental health ++		
<i>Energy efficiency measures</i>						
	↑ Improved objective measure of health +	↔ Unclear impact on general symptoms +	↑ Reduction in respiratory symptoms +	↔ No significant difference in emotion and mental health +		↑ Less school time lost due to asthma, but not other symptoms +

Direction of effect: ↑ improvements to health or reductions in illness; ↔ no clear effect on health or illness indicators; ↓ reductions in health or increases in illness. Strength of evidence: +++ strong association: evidence from prospective controlled studies with good levels of follow up; ++ moderate association: evidence from at least one prospective controlled studies; + weak association: evidence from uncontrolled studies.

impacts of Medical Priority rehousing, energy efficiency improvements, refurbishment, rehousing, and area regeneration. All of these studies, except one study of central heating installation,<sup>17 26</sup> found improvements one month to five years after the housing improvements were completed. In one large, prospective controlled study the degree of improvement in mental health was directly related to the extent of housing improvement, demonstrating a dose-response relation.<sup>23</sup> This consistent pattern of improvements in mental health would suggest that improving housing would generate mental health gains.

### Respiratory health

Four studies looked at changes in respiratory symptoms.<sup>12 15 21 28</sup> Measures used included self reported symptoms and respiratory prescribing. Three of these studies were of rehousing and area regeneration; two of the studies reported increases in respiratory symptoms. One study found an increase in chronic respiratory conditions (+12%) among adults five years after the move<sup>12</sup> while the other study found reductions (-11%) in bronchial and asthmatic symptoms one to four years after the move.<sup>15</sup> The study of routine respiratory prescribing data found no significant changes, though the use of routine data that are not linked to individuals is not easy to interpret.

In the fourth study, children's respiratory symptoms improved and fewer days were lost from school because of asthma three months after installation of central heating.<sup>21</sup>

## OTHER EFFECTS OF HOUSING IMPROVEMENTS

### Social context

Four studies measured changes in a range of social outcomes and each found improvements after the housing improvement. Residents reported a reduced sense of isolation, reduced fear of crime, increased sense of belonging and feelings of safety, increased involvement in community affairs, greater recognition of neighbours, and improved view of the area as a place to live.<sup>12 15 24 30</sup> These are important changes and may effect residents satisfaction with their house, however, it is not

known if improvements in such measures translate into health improvements.

### Increased rents

Two studies of rehousing and area regeneration provide good examples of the potential for unintended adverse effects because of increased rents. One study reported increases in standardised mortality rates in the rehoused residents. This was attributed to a doubling in rents, which in turn affected the households' ability to buy an adequate diet.<sup>27</sup> More recent work in Stepney also reported that rents in the new houses increased by an average of 14.8%, and some residents reported this as a barrier to employment opportunities. Some residents reported economising on food to accommodate the increase in rent.<sup>15</sup>

### Using other sources of evidence on housing and health

The strongest research evidence of health gains generated by housing investment is most likely to come from completed intervention studies. However in the absence of this, it is necessary to consider other data sources. The following sections provide a selective review of observational and qualitative literature that has linked poor housing conditions to health. Where available up to date systematic reviews or comprehensive expert reviews were used to inform this review.

## OBSERVATIONAL EVIDENCE IN HOUSING

There are many housing characteristics that have been strongly associated with poor health using observational data. A comprehensive, expert review of the associated risks and health hazards in domestic buildings identified hygrothermal conditions, radon, falls, house dust mites, environmental tobacco smoke, and fires as the highest health risks.<sup>31</sup> The main housing factors associated with health variation and that are commonly part of or aspects associated with housing improvements are listed in box 1; these should be considered in an HIA of housing improvements.

**Box 1 Main housing factors that have been associated with health variation and targeted as part of common housing improvements**

- Indoor air quality
  - House dust mite and allergens
  - Dampness and hygrothermal conditions
- Temperature and warmth
- Home ownership
- House type and design, for example, flat or house

**Other issues associated with housing improvement**

- Moving and relocation
- Displacement
- Area effects
- Housing costs

### Indoor air quality

In a recent expert review of the health effects of exposure to airborne particles in the home, the findings of observational, human, epidemiological, and toxicological animal studies were reviewed. The most common airborne particles arise from environmental tobacco smoke, cooking, certain heating appliances, and human activity. The level of indoor particles is strongly correlated with outdoor levels and raises personal exposure substantially. Short-term increases in ambient particles are strongly associated with increased mortality and morbidity; acute cardiopulmonary impairment being the predominant impact and vulnerable groups such as the elderly people and people with asthma being most at risk.<sup>32</sup>

### Dampness and hygrothermal conditions

No recent systematic reviews of associations between dampness, mould, and health have been identified. In a review of studies of the associations between damp and mould and respiratory health the authors concluded that if the home was damp or mouldy the increased risk of respiratory symptoms was small, and recommended that new build housing is designed to prevent the proliferation of indoor allergens.<sup>33</sup>

### Allergens

The most important allergen in house dust comes from the house dust mite. A systematic review<sup>9</sup> of the effectiveness of house dust mite control measures in the management of asthma has been carried out. Measures used included vacuuming and acaricidal chemical measures. The authors concluded that current chemical and physical measures to reduce exposure to house dust mite allergens seem to be ineffective in the management of asthma. This is partly because asthma sufferers are often sensitive to other allergens as well as house dust mite.

### Temperature and warmth

There is considerable seasonal variation in mortality in the UK that is strongly related to reductions in outdoor temperatures.<sup>34</sup> Recent analyses suggest that the seasonal variations are related to indoor rather than outdoor temperature, and that this annual variation could be reduced by helping residents protect themselves from cold weather conditions.<sup>35-37</sup>

### Housing tenure

Home ownership has been independently associated with improved health. It is thought that home ownership may generate a degree of security and control, though the direction of the relation needs further investigation.<sup>38</sup> However, home ownership is not always health promoting. Nettleton and Burrows' study of the health impacts of mortgage arrears suggested that those living on the margins of home ownership suffer increased insecurity and detrimental mental health

impacts.<sup>39</sup> In addition, cultural variations in rates and meaning of home ownership may give rise to international variation.

### Housing design

Flat dwelling has been linked to factors associated with stressful living conditions such as increased social isolation, crime, reduced privacy, and opportunities for safe play for children.<sup>40</sup> However, there are many factors related to flat dwelling that may confound findings of surveys and there are no conclusive data that height of home from ground level is associated with reduced health or satisfaction with housing.<sup>41-43</sup> A recent review<sup>44</sup> of epidemiological surveys showed a consistent pattern of decreased levels of mental health associated with housing height and multiunit dwelling. It is unclear how these studies were selected for review and the authors point out that they are unable to draw conclusions of a causal link because of the poor quality of research in this area.

### OTHER CONSIDERATIONS IN HOUSING IMPROVEMENT PROGRAMMES

In addition to factors associated with housing fabric and housing conditions there are some other associated factors that may be of relevance to a housing improvement programme.

#### Moving and relocation

Moving house is considered to be a stressful, health damaging life event.<sup>45</sup> In the field of social housing this has been attributed to lack of opportunity to negotiate with the housing authority regarding control around the move.<sup>46</sup> Housing relocation has also been associated with loss of community, uprooting of social networks,<sup>47</sup> and unsatisfied social aspiration<sup>48</sup> that may counteract satisfaction with improved housing. The meaning and context of housing varies between people and it may not be possible to detect tangible or consistent health effects of moving and relocation.<sup>49-51</sup>

Residents' satisfaction with their neighbourhood and dwellings has also been used as an indicator of quality of life and as an ad hoc measure of the success of housing investment. However, prioritising improvements in factors associated with high dissatisfaction may not maximise the incremental well being of residents; residents who are dissatisfied with the local neighbourhood may prioritise housing improvements before neighbourhood improvements.<sup>52</sup> Consultation with residents included in proposed housing improvements is important.

#### Displacement

Some area and housing regeneration projects can lead to displacement of original residents.<sup>28</sup> This may result in misleading shifts in routine social and health statistics that will not be identified unless a more detailed analysis of individual data is performed. It is therefore necessary to identify reasons and potential for displacement in advance.

#### Area effects

The socioeconomic characteristics of a neighbourhood may have an effect on a person's health status.<sup>53</sup> Work ongoing in five large cities in the USA is looking at the health effects of relocation from areas of deprivation to improved housing in middle income areas. After 13 years employment opportunities, education, and social integration were improved. The suburban movers attributed increased employment to increased job vacancies, increased neighbourhood security, and less local gang activity.<sup>54 55</sup> The most recent report from a similar project demonstrated that households in the intervention groups experienced improved health among household heads, and children in the experimental group were less likely than the control group children to experience an asthma attack.<sup>55a</sup>

**Key points**

- To improve the predictive value of health impact assessment it is necessary to provide supporting research evidence.
- Using the example of housing, there is little research evidence of the health effects of improved housing; examination of a broader evidence base is required.
- Incorporating research evidence is only one part of HIA; balancing local knowledge and conflicting views is also required.
- Evaluation of the health impacts of future housing investment is required to inform HIAs of housing improvement and the development of healthy housing policy.

**Housing costs**

Research done in the USA supports the potential for rents to impact on residents' lives. In the USA housing or rent subsidies have been used as a way of offering public housing tenants more control and choice in where they live and of promoting more integrated public housing tenancy. This is done by means of housing vouchers that can be used in privately rented accommodation and allow low income families to consume more housing and free up funds to be spent on other work related expenses<sup>56 57</sup> as well as increasing employment opportunities and earnings.<sup>58</sup> In one survey of child growth and nutrition, children whose family were on the waiting list for housing subsidy were over eight times more likely to have low growth indicators than similar children whose families already received a housing subsidy (OR 8.2,95% CI 2.2 to 30.4).<sup>59</sup> However, voucher programmes are affected by and themselves affect other important and inter-related factors such as housing supply and demand levels<sup>60</sup> and quality of new build subsidised housing.<sup>61</sup>

**USING EVIDENCE TO INFORM HEALTH IMPACT ASSESSMENTS OF HOUSING IMPROVEMENTS**

The purpose of health impact assessment of proposed housing interventions may be to recommend changes to maximise the health benefits arising, or to prioritise areas of housing investment. The summary of research evidence presented in this paper is a response to calls for usable evidence to inform future HIAs and policy decisions. By acting on these findings and considering both the potential positive and negative impacts of housing improvements, the health benefits of housing can be maximised.

In the current absence of intervention studies it is necessary to incorporate other sources of evidence. Data from qualitative studies can be used to identify possible mechanisms for unpredicted negative or positive impacts and inform adaptations to a proposed intervention. Longitudinal life course data can examine the long term health effects of exposure to poor housing.<sup>62 63</sup> Cross sectional epidemiological data can be used to inform and prioritise proposed interventions based on the strength of observed associations. Strength of observed associations can be ranked and applied to populations taking account of local population subgroups, for example, vulnerable groups. A locally responsive set of associated risks could then be used to prioritise vulnerable groups and the type of housing improvement. Risk estimates may also be used to predict and trade off the positive and negative impacts of the interventions between and within a population. However, it cannot be assumed that by reducing the exposure to a known housing risk the adverse effects of poor housing can be reversed. There are several well known examples of potentially effective interventions identified from observational research that fail to have the desired effect in practice.<sup>64 65</sup> This means that although evidence of associated risk is important, it should be interpreted with caution as regards cause and effect.

**Box 2 Evidence for health impacts after housing improvement derived from a systematic review of intervention studies**

- Mental health likely to show some improvements.
- Possible small improvements in general physical health and wellbeing—though three studies of rehousing and regeneration showed adverse effects.

**Box 3 Questions to ask in a housing HIA, informed by evidence from intervention studies, observational, and qualitative data reviewed**

What are the specific housing changes/improvements that are proposed?  
 Are there other housing changes not detailed in the proposals that may occur?  
 What is the evidence that these changes will affect health and any specific symptoms?  
 Are there vulnerable groups (for example, elderly, asthmatic people) who may benefit particularly from the proposed changes?  
 When can health gains be realistically expected?  
 Will the improvement be too marginal to detect?  
 Are there going to be any changes in housing costs?  
 Is there any other change that may affect living costs—transport, food, access to amenities?  
 Was there sufficient consultation about the housing improvements?  
 What is residents' baseline satisfaction level with their housing?  
 What levels of displacement can be predicted over the period of improvement?  
 What explanations might there be for displacement?

Incorporating best evidence into the process of HIA is essential but not straightforward. Locating and synthesising available research findings requires time and availability of specialised resources. In addition, there are problems with generalising research findings from one area to another. HIA has been described as "the use of the best available evidence to assess the likely impact of a specific policy in a specific situation . . . the evidence must be weighed for its local relevance as well as its robustness".<sup>66</sup> The review of research evidence provided here is only one aspect of an HIA and there will be many other aspects to consider. Consultation with experts and local stakeholders may predict additional, wider impacts, and may help explore the relative, local importance of predicted impacts. For example, the effects of the timescale of seeking funding to being rehoused, of accompanying regeneration rather than only rehousing, how other amenities may be affected. However, the views of stakeholders may conflict with the existing research findings. In these situations, decisions will need to be made on the balance of available evidence and local influences.

The difficulties in developing and using an evidence base for HIA has been recognised and a framework for different levels of HIA has been advocated. These levels range from a desktop exercise reliant on readily available information, to detailed assessment that included synthesis of existing research.<sup>2 67</sup> Currently there is insufficient evidence to fully support a detailed HIA to predict the health impacts of housing improvement. The relative lack of evidence may seem to question the value of housing as a public health investment. However, it is important that absence of evidence is not confused with evidence of absence.

Validation of well designed HIAs has also been recommended.<sup>2 68</sup> If this validation incorporated follow up after completion of the intervention to determine whether



identified impacts actually took place it could contribute to the evaluation of housing improvements. Prospective validation of HIA predictions is now a priority. Well conducted validations will, hopefully be carried out and be able, in future, to inform the development of an evidence base for housing HIA and the development of healthy housing policy.

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### **Theme III: Knowledge Transfer**

**Paper IX**      **Thomson H**, Petticrew M. Is housing improvement a potential health improvement strategy? (commissioned report for European policy makers)  
([http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214\\_2](http://www.euro.who.int/HEN/Syntheses/housinghealth/20050214_2)).  
*WHO Health Evidence Network*. Copenhagen, 2005.



# Is housing improvement a potential health improvement strategy?

February 2005



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## Summary

### The issue

The well-established links between poor health, poor housing and poverty suggest that housing improvements in disadvantaged areas or social housing may provide a population-based strategy to improve health and reduce health inequalities. Housing improvements that reduce exposure to specific hazards may lead to health improvements for current residents and prevent harmful exposure by future generations.

### Findings

In countries where the hazards of carbon monoxide, lead, poor sanitation and unsafe access have been minimized through the enforcement of strict building regulations, the most serious hazards linked to adverse health are poor air quality, inadequate heat, dampness, radon, trips and falls, noise, house dust mites, tobacco smoke and fires. Few studies have actually evaluated the health impact of interventions to reduce exposure to these hazards, or the health impact of general housing improvement. However, available research suggests that general housing improvement appears to have the potential to improve health, especially mental health.

Housing improvements that ensure the provision of affordable warmth may have the greatest potential to reduce the adverse effects of poor housing. Optimal temperature is an essential component of domestic heating provision and may also affect levels of dampness and allergen growth. Energy efficiency improvements have led to improvements in general health and respiratory health among asthmatic children. The elderly and very young are particularly at risk from both low and high indoor temperatures. Sudden increases in air pollutants are also most detrimental to the health of the elderly and asthmatics.

The most common sources of domestic infestation that pose potential health hazards are lice, bedbugs, fleas, cockroaches, mites, rats and mice. Such infestations can be prevented through careful food and waste storage and good hygiene. Faecal pellets from house dust mites and mould spores are the most common domestic allergens. Well-ventilated, damp-free housing and household dust control are recommended to minimize growth of domestic allergens.

Poisoning, falls and fires in the home are preventable causes of death and injury, particularly among children and the elderly. Effective prevention measures for elderly people at risk include customized safety devices, exercise, balance training and hazard removal. Educational outreach and home visits are also essential if the potential for injury reduction is to be fully realized.

### Policy considerations

Improvements in mental health are reported consistently following housing improvements, and the degree of mental health improvement may be linked to the extent of the housing improvements. Increased housing satisfaction following housing improvements has been strongly linked to improvements in mental health. General housing improvements may also result in improvements in physical health and general well-being.

However, the potential that housing improvement has to generate health improvement cannot be considered separately from other changes that residents may experience as part of housing improvement, such as increased housing costs, relocation and more general neighbourhood changes. Some of these may have additional health impacts, either negative or positive.

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## Introduction

This comprehensive review aims to answer the question *Is housing improvement a potentially effective health improvement strategy?* From this question there follow a number of other questions that this review also tries to shed light on.

- Which housing characteristics pose the greatest health risks?
- Which available interventions are effective in minimizing the adverse health effects of housing hazards?
- Can better housing improve health?
- What sorts of housing improvements are most likely to improve health?
- What kind of health effects have been reported following housing improvements?
- Are there other factors associated with housing improvement programmes that might also affect the health of those who receive new or improved housing?

The link between poor housing and poor health is well established. Many, possibly hundreds, of cross-sectional studies have reported consistent and statistically significant associations between poor housing conditions and poor health. Many countries utilize strict building regulations to control exposure to identified housing hazards, particularly carbon monoxide, lead, poor construction and poor sanitation. In countries that enforce such regulations, the hazards believed to have the most significant adverse health effects have been ranked, with the most important being poor air quality; inadequate warmth or excessive humidity (poor hygrothermal conditions); radon; slips, trips and falls; noise; house dust mites; tobacco smoke; and fires (1). Many less wealthy countries do not have or do not enforce strict building regulations; as a result, the adverse effects of specific housing hazards may be more pronounced in these countries, especially among vulnerable groups.

The identification of individual housing hazards and efforts to limit exposure to them has led to some reductions in the mortality and morbidity associated with housing hazards. Nevertheless, the relationship between poor housing and poor health persists, and the independent effect of poor housing on health remains unknown due to the many confounding factors that are inextricably linked to poor housing. Major confounding factors include the degree of individual and neighbourhood deprivation, the presence of multiple domestic hazards and the amount of time spent in the home. More general

factors in the local social context and the national political and cultural context may also influence housing conditions and housing-related factors. An ecological approach to housing and health research – one that acknowledges the many factors that affect health in addition to concrete physical housing conditions – has been recommended (2,3). Such an approach is also essential for those attempting to describe and predict the potential health effects, whether mental or physical, positive or negative, of housing improvement. (See Annex 1 for more information on and examples of social, economic and cultural factors that increase the complexity of the relationship between housing and health.)

## Sources for this review

This review has drawn on a range of research sources, including both cross-sectional studies and, where available, evaluative studies of housing improvement. Systematic or comprehensive expert reviews of the research have also been identified and included at appropriate points. A description of the sources of evidence and their role in this synthesis is provided in Annex 2. All of the work used for this review comes from countries in the developed world; housing conditions peculiar to the developing world are beyond its scope. The literature on the health effects of radon and carbon monoxide in the home was not included in this synthesis.

## Findings

### Housing-related health determinants and available interventions for limiting exposure

This section reviews specific housing characteristics that have been linked to poor health and includes a review of health links to housing tenure, housing design and housing satisfaction, in addition to identified physical biohazards. In many instances, there exist housing improvements that target the specific hazards, such as house dust mites; these are identified, and any research on the health effects of such improvements is, when available, reviewed. It should be noted, however, that these studies generally do not detail how much an individual intervention reduces exposure to the relevant hazard.

#### *Indoor air quality*

Over half of the airborne particles indoors arise from outdoor sources, while their most common indoor sources are ambient tobacco smoke, house dust mites, cooking, certain heating appliances and other human activity (4,5). Allergenic biological indoor air pollutants arise most commonly from house dust mites, cockroaches and pets such as cats and dogs (4). (See below for more information on house dust mite allergens.)

Short-term elevations in ambient particle levels are strongly associated with increased mortality and morbidity, with acute cardiopulmonary impairment being the predominant health impact, and vulnerable groups such as the elderly and asthmatics being the groups most at risk (4). Increased levels of domestic allergens have been linked to an increased risk of asthma among children (6), and exposure to domestic allergens has been established as a secondary cause of asthma, triggering attacks among asthmatics (7,8). However, there is insufficient research evidence to suggest that allergen exposure is a primary cause or major risk factor in the development of asthma (9).

<b>Overall assessment: indoor air quality</b>
<ul style="list-style-type: none"><li>• Indoor air quality is determined by levels of both outdoor and indoor pollutants.</li><li>• Sudden increases in air pollutants are most detrimental to the elderly and asthmatics.</li><li>• Optimal levels of ventilation, allowing air replacement while minimizing heat loss, are recommended.</li><li>• The health impact of improved indoor air quality has not been fully assessed.</li></ul>

### *Dampness and hygrothermal conditions*

Dampness and hygrothermal conditions are of particular concern in European countries with a temperate, damp climate. The number of people and animals; activities such as cooking, laundering and bathing; the use of certain fuels for heating and cooking; the indoor temperature; and ventilation also affect the amount of water vapour in indoor air. Water leakage due to structural damage may contribute to dampness too. An optimal level of ventilation will reduce internal water vapour, as well as expel noxious odours and gases. However, if too much warm indoor air is exchanged for cooler outdoor air, the lost heat increases the likelihood of condensation (10).

The health risks of dampness are due to the fact that damp, warm conditions are ideal for the proliferation of allergens (especially moulds and house dust mites) and viruses, as well as to the cooling effect of damp air. While condensation is an indication of a damp environment, condensation on windows is unlikely to be harmful to health, since glass surfaces cannot support mould growth, and condensation itself is pure water (10). Condensation on walls is more likely to encourage mould growth than structural dampness is, as the salts that emerge with penetrating or rising damp tend to inhibit moulds (2).

<b>Overall assessment: dampness and hygrothermal conditions</b>
<ul style="list-style-type: none"><li>• A warm, damp indoor environment encourages the growth of allergens and microbes that may be harmful to the health.</li><li>• Levels of ventilation that allow air replacement while minimizing heat loss are recommended.</li><li>• The health impact of reducing dampness in the home has not been assessed.</li></ul>



### *Mould and house dust mite allergens*

The pores released by moulds and the faecal pellets of house dust mites are the most common domestic allergens (11). Although the symptoms of exposure to house dust mites are poorly defined, reductions in levels of house dust mites are recommended (5). Methods of reducing house dust mites include vacuuming and chemical measures, which are used in the management of asthma. However, achieving significant reductions in allergens is difficult, requiring a high level of commitment from residents, and current measures are ineffective in managing asthma. This may be partly because asthma sufferers are often sensitive to allergens other than house dust mites, but it may also be due to the failure of vacuuming and chemical measures to achieve significant reductions in house dust mite levels when used in domestic settings (12).

Moulds thrive on the organic material of plaster and wallpaper and, once established, spread easily to furnishings and clothing. Exposure to mould spores can have toxic effects and cause infections or allergies. An association between mould growth and health status has been reported frequently, though there is debate about the strength of the relationship owing to the wide variety of moulds, differences in hazardous exposure levels and measurement difficulties, as well as the perennial problem of multiple confounding factors (11). In reviewing studies of the associations between damp, mould and respiratory health, the authors concluded that a damp or mouldy home carries a small increased risk of respiratory symptoms. It is recommended that new housing be designed to prevent the proliferation of indoor allergens (13).



**Overall assessment: mould and house dust mite allergens**

- Mould spores and the faecal pellets from house dust mites are the most common domestic allergens.
- Although the health effects of mould and house dust mites are poorly defined, limiting exposure to and proliferation of these allergens is recommended.
- Current methods to reduce house dust mites are not effective in the management of asthma.
- No studies have been identified on the health impact of reduced exposure to mould.

*Temperature and warmth*

Damp cold air and penetrating damp in the structure of a house will contribute to interior cooling. Thermal comfort is determined by a number of environmental, physiological and psychological factors, as well as by personal taste. Although minimum and maximum indoor temperatures have been recommended, it is not possible to predict which temperature limits are hazardous to one's health (14).

Central heating does not automatically result in warmer homes, and health problems associated with cold housing may be more strongly linked to fuel efficiency and affordability (15). Affordability is an essential consideration when installing new heating systems, especially for those with low incomes.

Excess winter deaths have been observed across Europe and are linked to a fall in outdoor temperatures. Those at the extremes of life are particularly vulnerable, i.e. the newborn and the elderly. Influenza epidemics, respiratory illnesses, heart disease and cerebrovascular disease contribute to the seasonal variation in deaths, while deaths from hypothermia account for only a small part of the increase. In countries such as Scotland, Portugal and Spain, the levels of excess winter deaths are higher than in Scandinavia, where winters are more severe (16,17). Recent analyses suggest that seasonal variations are related to indoor rather than outdoor temperatures. Although deprivation is a predictive factor for excess winter deaths, housing conditions and ability to heat one's home may be equally or more important; affluent people living in housing which is difficult to heat are also at an increased risk of winter death (17–19). It may be possible to reduce the annual increase in winter deaths by helping residents protect themselves from cold weather conditions (19–21).

High temperatures during heat-waves may also cause and contribute to deaths, especially among the elderly in urban areas. In a study of mortality rates during the Chicago heat-waves of 1995 and 1999, it was concluded that working air conditioners were the strongest protective factor against heat-related deaths (22).

Energy efficiency measures (e.g. central heating and double glazing) are the main housing improvements that directly affect temperature and dampness, and they may also have a subsequent impact on allergen growth. Four studies of the health impact of energy efficiency have been identified. Actual changes in levels of warmth or dampness were not always assessed, but small improvements in general health and respiratory health among asthmatic children were reported.

**Overall assessment: temperature and warmth**

- The elderly and the very young are particularly at risk from both low and high indoor temperatures.
- Excess winter deaths may be prevented by providing affordable domestic heating.
- Affordability is an essential component of domestic heating provision and may also affect levels of dampness and allergen growth.
- Energy efficiency improvements have led to small improvements in general health and respiratory health among asthmatic children.

### *Lead poisoning*

Domestic exposure to lead is commonly from lead-based paints and drinking water supplied through lead pipes. Many countries have heavily (and successfully) invested in lead reduction (3,23), while in other countries, lead remains a common domestic hazard in the homes of poor people (24–26).

Adverse physical, mental, intellectual and developmental effects have been associated with lead exposure, especially in children. Evaluations of interventions to reduce lead exposure have therefore focused most often on outcomes among children.

Widespread public awareness, governmental initiatives and private action to reduce childhood exposure to lead have led to sharp declines in blood lead concentrations in children (27). There is also increasing evidence of the growing breadth of effective prevention and treatment (28). For example, controlling dust within contaminated homes can significantly reduce blood lead concentrations in children (29). Such measures to reduce or eliminate lead exposure and lead poisoning have excellent cost–benefit ratios. Strict enforcement can result in actual cost savings through reduced medical and educational costs and increased productivity for protected children (30). However, residential lead hazards remains difficult to control in older, poorly maintained rental housing, which is found most often in deprived neighbourhoods (31).

<b>Overall assessment: control of lead exposure in children</b>
<ul style="list-style-type: none"><li>• Lead exposure in children leads to physical, mental and intellectual problems.</li><li>• Lead exposure among children may stem from lead-based paint, which is found mainly in older, poorer housing, and mainly among poor families.</li><li>• Numerous efforts to control childhood exposure have been successful in reducing blood lead concentrations and the adverse health effects of lead hazards.</li><li>• While some treatments of lead poisoning exist, prevention remains the best and most cost-effective alternative.</li></ul>



### *Unintentional injuries, including falls and fires*

The home is a major site of unintentional injuries and deaths, which result most commonly from falls, poisoning and fires; children and the elderly are particularly at risk (32). Targeted interventions to help prevent domestic accidents do exist, but poorly designed architectural features and overcrowding are believed to contribute to over 11% of such injuries among children (33). The use of safety devices and features in the home, particularly child-resistant packaging on poisonous products, can reduce the risk of unintentional injury. Targeted programmes to distribute such devices freely, together with educational outreach and home visits, are recommended in order to achieve the most impact. In the case of smoke alarms, proper installation and maintenance are essential if fire-related injuries are to be prevented (34). The smoke alarms that are most likely to be functioning one year after installation are those that use an ionization sensor and are powered by a 10-year battery (35).

Effective interventions to reduce the risk of falling among the elderly include exercise, balance training and individually tailored interventions for those who take sedative/hypnotic drugs or suffer from postural hypotension (36). Environmental modifications to the home, e.g. removing clutter and electrical cords, securing rugs and installing hand rails, can also help reduce falls in the elderly by up to 60% (37). Programmes to make such environmental modifications or distribute free safety appliances should be accompanied by educational efforts and home visits if injury levels are to be reduced (37,38). In addition, devices that are affordable and easy to use may be likelier to be used and can therefore increase effectiveness (3).

**Overall assessment: unintentional injuries at home, including falls and fires**

- Poisoning, falls and fires in the home are preventable causes of death and injury, particularly among children and the elderly.
- Effective prevention measures include individually tailored safety devices.
- Exercise, balance training and hazard removal help prevent falls among elderly people at risk.
- Educational outreach and home visits are essential if prevention programmes are to result in injury reduction.
- Smoke alarms need to be properly installed and maintained in order to prevent fire-related injury and death.

*Domestic noise*

There is little solid evidence linking environmental noise in residential areas with subsequent health problems (39–41). It is unlikely that outdoor sources of noise, or noise from neighbours in adjoining or nearby buildings, would be capable of causing physical damage to one's hearing (39). Community health surveys have found no direct effect of noise on the prevalence of psychiatric disorders (42–44). Residents exposed to high noise levels from aircraft are more likely to be admitted to psychiatric hospitals (45) and to receive medical treatment for heart trouble and hypertension (46). However, these studies have been challenged on methodological grounds (40,41,47). More commonly, neighbourhood noise is associated with stress, annoyance and sleep disturbance (48–50).

A maximum noise level of 30 dB(A) has been recommended for bedrooms to prevent sleep disturbance, and of 35 dB(A) for indoor dwellings more generally (51,52). Ways to reduce noise include instituting building regulations to ensure more soundproofing, and installing acoustic double-glazed windows and mechanical ventilation in homes subject to high outside noise. Disturbance from traffic noise can also be managed at the local planning level, while statutory controls and public education may help change the behaviour of noisy neighbours (39). No studies have been identified that evaluate the health effects of interventions to reduce domestic noise (39).

**Overall assessment: domestic noise**

- Domestic noise may result in sleep disturbance and stress but is unlikely to result in psychiatric or physical illness.
- Noise insulation, local planning and promotional work are all recommended to manage noise levels.
- The health impact of noise reduction has not been assessed.

*Housing tenure*

Home ownership has been independently linked to improved health among residents. Home ownership may generate a degree of security and control (53), but home ownership could also be linked to improved housing and neighbourhood quality (54). Implicit links between material factors and tenure will vary by country, depending on the rates of home ownership and the meaning attached to it. However, home ownership might not always promote health; for instance, people living on the margins of home ownership and those at risk for mortgage arrears may suffer increased insecurity and poorer mental health (55).

**Overall assessment: housing tenure**

- The financially secure home ownership has been linked to improved health, which may be due to better housing quality and feelings of security.
- This link may vary from country to country according to the rates of home ownership and the meaning attached to it.
- No studies have been identified that link changes in housing tenure to health.

*Housing design*

Living in a flat, particularly a high-rise flat, has been linked to living conditions regarded as stressful, such as increased social isolation, crime, reduced privacy and fewer opportunities for children to play safely (56). A recent review of epidemiological surveys (57) showed a consistent pattern of poor mental health associated with high and multi-unit dwellings, although the quality of research reviewed was poor. There are many factors related to flat dwelling that may confound survey findings, and there are no conclusive data demonstrating that the height of a home from ground level is associated with reduced health or housing satisfaction (58–60).

Specially designed houses are required for those with impaired physical mobility. In some countries, residents with particular medical needs are re-housed when their mobility levels limit their use of their house. Improvements in self-reported physical and mental health have been reported following such “medical priority rehousing” (61–65). However, there has been no research assessing the health effects of changes in housing design that are not specifically aimed at those with identified medical needs.

**Overall assessment: housing design**

- Housing design features may affect mental health, accessibility and risk of domestic injury.
- Rehousing individuals on health grounds is linked to improvements in both physical and mental health.
- No studies have been identified that describe the health effects of changes in housing design for the general population.

*Housing satisfaction*

Poor quality housing, flat housing and overcrowded housing are all linked to poor mental health, particularly among women and children (56,66–72). However, the direction of causality remains unknown. Neighbourhood satisfaction is most strongly influenced by satisfaction with housing and private space (73–77) and has been used as a proxy for life satisfaction (75) and one's general affect influencing mental health (77). Increased satisfaction with housing following housing improvement is strongly linked to improvements in mental health (78).

**Overall assessment: housing satisfaction**

- Housing satisfaction may be linked to life satisfaction and mental health.
- Increased housing satisfaction following housing improvement is strongly linked to improvements in mental health.

### *Infestation*

There are many sources of domestic pest infestation. The most common sources that may pose a health hazard inside the home are lice, bedbugs, fleas, cockroaches, mites (scabies and house dust mites), rats and mice. The health hazard of a pest infestation may arise through it being a direct parasite (e.g. bedbugs feeding on human blood), a disease vector (e.g. the large number of diseases transmitted by rats), a hygiene hazard (e.g. cockroaches and houseflies that carry harmful micro-organisms quickly among food sources) or the source of an allergen (e.g. house dust mite droppings). Control of these hazards is best achieved by prevention and includes careful food and waste storage and good hygiene to reduce the home's attractiveness to pests. In the event of an infestation, a series of measures may be required, including chemical treatments (79).

#### **Overall assessment: infestation**

- The most common sources of infestation that pose a health hazard inside the home are lice, bedbugs, fleas, cockroaches, mites, rats and mice.
- Infestation can be prevented through careful food and waste storage and good hygiene, which reduce the home's attractiveness to pests.

### **The effectiveness of housing improvements in improving health**

This section presents a systematic review of all the available evaluative and intervention studies that have monitored health changes following housing improvement. The evaluative studies identified covered three main types of housing improvement: medical priority rehousing, general rehousing or refurbishment, and energy efficiency measures (e.g. installation of central heating or insulation).

Housing improvement programmes, especially those featuring rehousing or major refurbishment, may involve a variety of housing improvements that change residents' exposure to some of the hazards and characteristics associated with poor health that were described in section 1. In slum clearance programmes, it may be assumed that all or most of the hazards described in section 1 will improve. However, very few studies of housing improvement and health have been carried out; despite extensive searching, only 19 studies were identified which had assessed the health impacts following housing improvement (80) (see Annex 2 for full details of the review methods and the studies included). Only a few of these studies reported on actual changes in the specific housing hazards, i.e. dampness reduction or temperature increase, subsequent to the improvements. It is impossible, therefore, to know whether health impacts reported were due to reductions in exposure to specific housing hazards. In addition, because of the lack of evaluative studies of housing improvement, there are insufficient data to attribute specific health impacts to a particular type of housing improvement. The review below is therefore presented according to type of health impact, with some more detail about types of housing improvement where appropriate.

#### *General well-being, physical health and episodes of illness*

The impacts on physical health and illness following housing improvement vary from study to study, making it difficult to draw a clear conclusion about whether the general trend is positive, negative or equivocal. It appears that small improvements in general health and illness will be observed following housing improvement, but such results cannot always be assumed.

Three studies of rehousing and community regeneration reported adverse effects on general health (81–83). One study found increases in reported illness episodes (+56%) (82), though this was attributed in part to a flu epidemic. In a further study, age-standardized mortality rates increased for all age groups except infants five years after rehousing from a slum area (81).

### *Mental health*

Improvements to mental health have been consistently reported following housing improvements, regardless of whether they involved medical priority rehousing, energy efficiency improvements, refurbishment, or rehousing and area regeneration (63,65,82–90). In addition, the degree of mental health improvement was directly related to the extent of the housing improvement and was sustained for up to five years (87).

### *Respiratory health*

Improvements in children's respiratory symptoms and reductions in days lost from school due to asthma have been observed three months after installation of central heating (91), suggesting that energy efficiency measures may have a positive impact on respiratory health. However, the impact of more general housing improvement and neighbourhood regeneration on respiratory health is not clear. In one study, chronic respiratory conditions increased by 12% among adults five years after the move to better neighbourhoods (83), while in another study, bronchial and asthmatic symptoms fell by 11% when measured one to four years after housing and neighbourhood improvements (82). A third study that reported on the rates of respiratory prescriptions in the local area found no significant changes after a regeneration programme that focused on housing.

### *Unintentional injuries, including falls and fires*

The incidence of unintentional injuries was not reported in any evaluative studies of general housing improvement. See Findings “*Housing-related health determinants and available interventions for limiting exposure, Unintentional injuries, including falls and fires*” on page 9 for a review of targeted interventions to reduce injuries in the home caused by poisoning, falls and fires.

<b>Overall assessment: the health effects of housing improvement</b>
<ul style="list-style-type: none"><li>• It is unclear whether reducing specific housing hazards leads to health improvements.</li><li>• The small number of evaluative studies of housing improvement makes it difficult to know which types of housing improvement are most likely to improve health.</li><li>• General housing improvements may result in small improvements in physical health and general well-being.</li><li>• Improvements in mental health are consistently reported following housing improvements. The degree of mental health improvement may be linked to the extent of the housing improvement.</li><li>• Improved energy efficiency may alleviate respiratory symptoms.</li><li>• Housing improvements may also result in adverse health impacts; for example, rent increases that follow housing improvements have been linked to poorer diet, reduced employment opportunities and increased mortality rates.</li></ul>



## **Effects of housing improvement and regeneration that may have an indirect impact on health**

Housing improvement rarely occurs in isolation. This section presents a literature review of other important changes that are often integral to housing improvement programmes. As mentioned at the beginning of this synthesis, it is essential to recognize interactions among such changes in the socioeconomic context in order to help explain both the negative and positive health consequences of housing improvements.

### *Increased rents*

Housing improvement is often accompanied by rent increases that may increase the financial strain on the householder. For example, one study has reported increases in standardized mortality rates of rehoused residents. The increases were attributed to a doubling in rents, which in turn affected the

households' ability to provide themselves with an adequate diet (81). With welfare, it is unlikely that such dramatic rises in rent would be passed on to tenants these days. However, recent work in the United Kingdom reported that rents in new houses increased by an average of 14.8%. The increased rents necessitated economizing on food purchases and resulted in a welfare benefit trap and a barrier to employment opportunities, since the higher wages needed to meet the increased rent result in withdrawal of welfare benefits and a subsequent reduction in household income (82).

#### *Effects on the social context and local area*

Housing improvement may lead to other changes in the local area, including a reduced sense of isolation, reduced fear of actual or perceived crime, an increased sense of belonging and feeling of security, increased involvement in community affairs, greater interaction with neighbours and an improved attitude toward the area as a place to live (82,83,88,92). These changes may also affect residents' satisfaction with their homes, though it is not known if they translate into health improvements.

#### *Neighbourhood effects: relocating to a new area*

The socioeconomic characteristics of a neighbourhood can affect health (93). Residents relocated from deprived areas to improved housing in middle-income areas have reported sustained increases in employment opportunities, improved educational possibilities and better social integration (94,95), as well as some health improvements (96).

#### *Relocation and the process of moving*

Although moving to an improved house may be a positive experience in the long term, the process of moving house may be a stressful, health-damaging life event (97–99), sometimes due to a lack of opportunity to negotiate with the housing authority regarding the move (100). Housing relocation has also been associated with loss of community, uprooting of social networks (101) and unsatisfied social aspirations (102). It is important to consult with residents involved in proposed housing changes and general regeneration projects.

#### *Displacement*

Some area and housing regeneration projects can lead to the displacement of the original residents (84). That may in turn result in shifts in routine social and health statistics that obscure any impacts on the original residents. It is necessary to identify the reasons and potential for displacement in advance. If the health impact of housing improvement is to be predicted, it must be clear who the recipients of the improved housing will be and where existing residents will be relocated.

#### *Social exclusion and community division*

A review of regeneration and health has highlighted the potential for regeneration to increase exclusion and divisions within an area. For those living on the margins of a regenerated area, feelings of exclusion can exacerbate levels of stress and depression (82, 98). Some studies have reported that regeneration can create divisions within local areas (98), though the subsequent impacts on health are unclear.

#### *Gentrification*

Neighbourhoods undergoing regeneration may also undergo gentrification, in which traditionally working-class areas are transformed into middle-class areas (103). A systematic review of the benefits and harms associated with this process reported a range of conflicting findings that involved changes in housing demand, housing prices, social mix, crime, occupancy rates, private and local investment, and the population of other areas (104). Few studies have followed the impact of gentrification on an area's original residents, and fewer still have followed the health impact.

**Overall assessment: the social impact of housing improvement and area regeneration**

- Housing improvements are often accompanied by changes in neighbourhood and social context, as well as changes in housing costs.
- The positive impacts reported include improved perceptions of safety, greater community involvement and more area satisfaction.
- The negative impacts include increased housing costs, the displacement of original residents, social exclusion and community division (for those in neighbouring areas not benefiting from the improvements), disruption, uncertainty and lack of control with respect to moving.
- Only some of these impacts have been linked to subsequent health impacts. Most notably, the negative impact of increased housing costs can lead to poorer diets and reduced employment opportunities.

## Conclusions

This review seeks to answer the question, “Is housing improvement a potential health improvement strategy?” Housing improvement may indeed result in improved health, particularly mental health. However, adverse health impacts can also arise. The positive health impacts of housing improvement are likely to be minor, and the potential for health gains may vary depending on individual vulnerability to the harmful effects of poor housing. The greatest potential for health gain will be among those with poor health, the elderly and the very young. There is not enough evidence about which types of housing improvement are likely to generate the greatest health gains, nor about which offer the most health improvement for the money. In addition, priorities for specific improvements will depend on local factors such as climate and the quality of existing housing stock.

The impact of housing on health is also influenced by the socioeconomic circumstances of residents and the surrounding neighbourhoods, circumstances that also may change during a housing improvement programme. In particular, increased housing costs can add financial strain and indirectly affect health by reducing the money available to spend on adequate heat, food and other necessities (81,105). Identifying potential changes associated with housing improvement (e.g. rent increases, relocation and the disruption of social connections) and their potential to affect health, whether positively or negatively, may help minimize some adverse effects while maximizing health gains.

A further unanswered question of interest to policy-makers is whether health improvement can be achieved more rapidly by centralized policy, i.e. government intervention to upgrade housing and neighbourhood conditions for low-income people, or by raising incomes of poor people and thus enabling them access to better housing. Unfortunately, research evidence on increasing access to affordable housing and improved neighbourhoods is also lacking. A systematic review of United States housing initiatives that provide rental vouchers to low-income families and promote moving to less deprived neighbourhoods suggests that such initiatives may improve household safety, but a lack of evidence prevents conclusions from being drawn on other possible health impacts (106).



## **Critique: using research to inform housing investment as a health improvement strategy<sup>1</sup>**

It is clear that existing research is limited in its ability to answer the question of whether housing investment is an effective health improvement strategy. The lack of research evidence is disappointing, and it raises the question of how much health improvement can be assumed to follow housing improvement. However, it must be remembered that a lack of evidence points to a knowledge gap and must not be interpreted as contrary evidence – i.e. it does not mean that the housing improvements have no effect on health, nor that housing investments are not worth making. Other grounds for housing improvement include social justice, improved access, global energy conservation and general comfort. Besides, the links between poor housing and poor health are sufficiently well established to argue for housing improvements on health grounds. (See Boxes 1 and 2 in Annex 1 for a ranking of health hazards that suggest priority areas.) However, such improvements need to be carefully evaluated if the potential for health gain is to be realized more fully.

The lack of conclusive research evidence in this field is partly explained by the difficulties in eliciting a clear relationship between poor housing and poor health that is independent of individual, local and societal factors. At the beginning of this review, it was mentioned that not only was attributing health effects to specific physical housing characteristics difficult, but that such an approach also ignored the importance of socioeconomic context, which is inextricably linked to housing conditions and health status. To address this oversight, it has been suggested that an ecological approach be adopted that incorporates assessments of the broader relationship between social circumstances and housing. Such an approach would help explain why some people are more adversely affected by poor housing than others (2), and help identify which circumstances are needed to maximize the positive health impact of housing improvement. Pathways that set out how improved housing might lead to health gains could be mapped and then incorporated and tested in future evaluations. Studies of housing improvement that have taken a broader ecological approach are now underway. It is our hope that these studies will enable a more comprehensive understanding of the potential for housing investment to generate health gains.

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<sup>1</sup> The findings of this systematic review were originally compiled as a resource for health impact assessment and a source of accessible research evidence for use in policy and practice [see Thomson et al., 2003 (107) and Douglas et al., 2003 (108)].

## **Annex 1: Identifying links between housing hazards and health**

### **Ranking of housing hazards**

The ranking in Box 1 is based on a comprehensive review by both medical experts and health and safety experts, who assessed the relative risk of housing biohazards according to the strength of evidence, the number of people affected or exposed, and the seriousness of harm, ranging from death through mild heart attack, chronic severe stress, regular serious coughs and colds, and occasional severe discomfort. The identified biohazards listed in Box 1 have often been targeted as part of housing improvement programmes. Other housing characteristics, such as tenure, design and location, can also influence health. The most commonly reported ill health effects linked to housing are listed in Box 2.

#### **Box 1. The most significant housing hazards associated with health effects (1)\***

Poor air quality (particles and fibres that can cause death among the very ill)  
Poor hygrothermal conditions (excessive heat, cold and/or humidity)  
Radon  
Slips, trips and falls  
Noise  
House dust mites  
Ambient tobacco smoke  
Fires

*\*The seriousness of the hazards has been ranked according to the number of people affected, the seriousness of the effects and the strength of evidence.*

#### **Box 2. Types of health effects commonly linked to poor housing**

Respiratory symptoms, asthma, lung cancer  
Depression and anxiety  
Injury/death from accidents and fires  
Hypothermia  
Skin and eye irritation  
General physical symptoms

### **Housing and health: single hazards and the importance of sociocultural context**

This section presents more details and examples of social, cultural, political, economic and climatic factors that can also influence the relationship between housing and health.

As mentioned in the introduction, the identification of single hazards is important, and subsequent development and enforcement of building regulations to limit exposure to single hazards has limited the adverse effects of poor housing in many countries. However, many less wealthy countries do not have or do not enforce strict building regulations; as a result, the adverse effects of specific housing hazards may be more pronounced in these countries, especially among vulnerable groups. Indeed, while certain housing features are considered low or negligible health risks in some countries, due to the enforcement of building controls and other contextual factors, in other countries the same housing features may be considered high health risks. For example, in Turkey the second most common cause of accidental death is falling from a flat roof. Falls are most common there in summer, when people often sleep on their roofs to keep cool (109).

Substandard housing often includes multiple hazards, so that exposure to just a single hazard is rare. Housing exists in a social context, and poor housing is often situated in deprived neighbourhoods, where people are needy and at increased risk for poor health. The unemployed, the sick and the elderly may spend longer periods in the home, resulting in longer exposures to hazards there. Such tendencies can increase individual vulnerability and thus compound the effect of poor housing on residents (2,110).

More general factors in the local social context and the national political and cultural context can also influence housing and housing-related conditions, such as the prevalence of renters or owner-occupiers. For example, there have been significant social, political and economic changes in both eastern and western Europe that have influenced housing environments. The changes may have been the starkest in post-Communist countries, but ageing housing stock, decentralization of government responsibility, pressures on energy reserves and lifestyle shifts have had implications for housing needs across Europe and the rest of the industrialized world (111). Sociopolitical and cultural context can also influence the meaning and value attached to housing conditions, size, design and ownership. Culture and climate can also affect how much time is spent in the home and thus exposed to potential hazards. An ecological approach to housing and health research – one that acknowledges the many influences on health in addition to physical housing conditions – has been recommended (2,3). Such an approach is also essential for those attempting to describe and predict the potential health effects, whether mental or physical, positive or negative, of housing improvement.

### **Research evidence linking health and housing and housing improvement**

As well as the problems of confounding factors outlined above, there are problems in sampling and measuring housing-related health hazards. For example, temperature may vary widely from room to room and day to day. Such issues make it difficult to identify a causal link between poor housing and poor health. Nevertheless, the reports from cross-sectional studies are consistent, and the link between poor housing and poor health is generally accepted (112). The reported links to specific hazards (see Box 1) may suggest what types of housing investment are warranted on health grounds. It seems feasible that targeted housing improvements that reduce exposure to known hazards will be followed by health improvements, and that harm to future generations will be prevented; however, it cannot be assumed. Evidence of association does not confirm, or show the direction of, cause and effect. Evidence from studies that have evaluated the actual health effects of housing improvement is required to shed light on the nature, size and mechanisms of health effects and whether, however counterintuitively, adverse health effects arise.

However, evaluating the health effects of housing improvements is not a straightforward process, and there are further confounding factors that are impossible to control. For example, housing improvement programmes are often part of major neighbourhood improvement programmes, during which original residents may be displaced or move voluntarily. And although the randomized controlled trial may be the ideal experimental model for demonstrating effects, it is difficult to apply to housing improvement programmes, and such trials have rarely been conducted in the field of housing research (113). Other study designs need to be considered as best available research evidence for housing improvement and other complex social interventions. These include prospective, retrospective, controlled and uncontrolled studies, and in the absence of a well-conducted, randomized controlled trial, well-conducted, prospective controlled studies are the most desirable. However, regardless of design, there is a distinct lack of evaluative studies on the health impacts of housing improvement. Therefore, it is still necessary to draw heavily on the wealth of cross-sectional surveys that report associations between housing conditions and health.

## **Annex 2: Methods and research sources used for this review**

### **Review methods and sources**

This paper presents a comprehensive review that draws on the best available evidence on housing and health. To date, housing and health research has focused on identifying direct links between specific physical housing characteristics and health. Although an ecological approach to such research has been recommended, it has rarely been implemented (3,78). and there is very little empirical research to illuminate the complex pathways of how poor housing may impact health. These limitations are reflected in this paper. Where possible, attention has been drawn to important social and economic factors that have been used to explain housing-related health impacts, e.g. housing costs (81,82) and difficult-to-heat homes (17–19). The review findings are divided into three sections based on the methods and sources used:

- 1) The first section on *housing-related determinants of health and available interventions* presents a comprehensive literature review that draws on systematic reviews where available. The literature reviewed is mainly cross-sectional epidemiological surveys that document specific physical housing characteristics and biohazards with strong links to health effects. Also reviewed is qualitative research that reports resident views, satisfaction levels and values associated with specific housing characteristics that can influence mental health and well-being. In rare cases, there have been evaluative studies of the health impacts of housing improvements that target specific health hazards; they have been included when available.
- 2) The second section on the *effectiveness of housing improvements in improving health* presents a systematic review of the types of health impacts that have been observed following housing improvements and includes studies regardless of language, format or location. When this systematic review was conducted in 2000, it identified 14 studies in progress. An update is planned for 2005, when it is hoped that most of the studies under way will have produced publicly available findings<sup>2</sup>. The systematic review only reviews housing intervention studies, but includes both experimental and non-experimental studies (randomized controlled trials and prospective and retrospective observational studies) as well as quantitative and qualitative health outcomes (health, well-being, illness, mortality). Cross-sectional studies that did not investigate the effects of housing improvement before and after the intervention were not included. Housing interventions were defined as rehousing as well as any physical changes to housing infrastructure, for example heating installation, insulation, double glazing and general refurbishment. Studies of interventions to improve the indoor environment by means of furniture or indoor equipment were *excluded* unless such means were part of other housing improvements.

The included studies for this review were identified from searches in 17 clinical, social science and grey literature databases dating back to 1887 (ASSIA, CAB Health, Cochrane Controlled Trials Database, DHSS-DATA, EMBASE, HealthSTAR, IBSS, MEDLINE, PAIS, PsycINFO, SIGLE, Social SciSearch, Sociological Abstracts, Social Sciences Citation Index, SPECTR, Urbanisc and the World Wide Web). Personal collections and the bibliographies of all the reports, papers and textbooks reviewed were hand-searched. In addition, United Kingdom health authorities, housing departments, academic departments, local authorities, housing associations and the subscribers to a national housing studies newsletter were contacted with requests for information on unpublished and ongoing studies.

At least two reviewers independently screened all abstracts identified by the searches. Three reviewers critically appraised the methods and validity of the findings reported in the included

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2 For full details of the systematic review please consult the following sources: Thomson et al., 2001 (78) and Thomson et al., 2002 (80).

studies.

- 3) The third section dealing with the *effects of housing improvement and regeneration that may have an indirect impact on health* is a literature review that draws on individual studies as well as summaries of one systematic and two comprehensive reviews. Important changes that are not directly part of housing improvement, such as rent increases, relocation and neighbourhood improvement, can also accompany housing improvement programmes; research reporting health or social impacts of such changes is also reviewed in this section.

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### **Theme III: Knowledge Transfer**

**Paper X**      **Thomson H**, Jepson R, Hurley F, Douglas M. Assessing the unintended health impacts of road transport policies and interventions: translating research evidence for use in policy and practice. *BMC Public Health* 2008; 8 (339): (<http://www.biomedcentral.com/1471-2458/8/339>).

Research article

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## Assessing the unintended health impacts of road transport policies and interventions: translating research evidence for use in policy and practice

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### Abstract

**Background:** Transport and its links to health and health inequalities suggest that it is important to assess both the direct and unintended indirect health and related impacts of transport initiatives and policies. Health Impact Assessment (HIA) provides a framework to assess the possible health impacts of interventions such as transport. Policymakers and practitioners need access to well conducted research syntheses if research evidence is to be used to inform these assessments. The predictive validity of HIA depends heavily on the use and careful interpretation of supporting empirical evidence. Reviewing and digesting the vast volume and diversity of evidence in a field such as transport is likely to be beyond the scope of most HIAs. Collaborations between HIA practitioners and specialist reviewers to develop syntheses of best available evidence applied specifically to HIA could promote the use of evidence in practice.

**Methods:** Best available research evidence was synthesised using the principles of systematic review. The synthesis was developed to reflect the needs of HIA practitioners and policymakers.

**Results:** Aside from injury reduction measures, there is very little empirical data on the impact of road transport interventions. The possibility of impacts on a diverse range of outcomes and differential impacts across groups, make it difficult to assess overall benefit and harm. In addition, multiple mediating factors in the pathways between transport and hypothesised health impacts further complicate prospective assessment of impacts. Informed by the synthesis, a framework of questions was developed to help HIA practitioners identify the key questions which need to be considered in transport HIA.

**Conclusion:** Principles of systematic review are valuable in producing syntheses of best available evidence for use in HIA practice. Assessment of the health impacts of transport interventions is characterised by much uncertainty, competing values, and differential or conflicting impacts for different population groups at a local or wider level. These are issues pertinent to the value of HIA generally. While uncertainty needs explicit acknowledgement in HIA, there is still scope for best available evidence to inform the development of healthy public policy.

## Background

Transport is often cited as an important determinant of health [1] and health inequalities, [2] and as such transport policies and interventions should be assessed for their potential to impact positively or negatively on health [2]. Physical injury and death are the most direct health impacts of motorised transport. However, other links between transport and health determinants need to be considered if the full potential for healthy transport policy is to be realised [1,3]. The possible impacts cover a range of important public health interests. These include physical activity and obesity, mental health, air quality and cardio-respiratory health, social exclusion and inequalities, and environmental impacts related to fuel emissions and climate change.

Health Impact Assessment (HIA) provides a helpful framework with which to assess the intended and unintended health impacts of policies or interventions. However, the validity of HIA depends substantially on the careful use and interpretation of supporting evidence. Shaping policies or interventions to maximise the potential health benefits and minimise adverse health impacts needs to be supported by empirical evidence, [4-6] but fresh comprehensive reviews of up-to-date evidence are beyond the scope of most individual projects and HIAs. Reviews of research, including systematic reviews, have previously summarised evidence of the health impacts of public policies such as transport and housing; but it cannot be assumed that their findings, often published in academic journals, will be transferred into practice. Well conducted syntheses of best available evidence informed by the needs of potential evidence users may facilitate knowledge transfer from research to practice [7]. Such syntheses need to draw on best available evidence from both intervention studies and epidemiological studies, [8] and to minimise author bias it may be valuable to apply the principles of systematic review, i.e. an explicit search strategy and assessment of the weight of evidence [9]. In addition, to promote the use of evidence in HIA practice, the relevance of the evidence to HIA needs to be made clear.

In 2003 we produced a synthesis of housing research in response to a request from a group of potential evidence users, the Scottish Health Impact Assessment Network (SHIAN-a multi-disciplinary group which consists of policy makers and practitioners from local and national government, and local health boards) [10,11]. This work drew on a systematic review of housing improvement and health as well as summarising the epidemiological links between housing and health. Following dissemination of the housing report, [11] the network identified transport as a priority area for a similar synthesis. This paper presents a summary of the research included in the syn-

thesis of transport research and, informed by the synthesis, a list of key questions which need to be addressed when conducting an HIA of transport interventions. The synthesis is presented here as a demonstration of knowledge transfer to promote the use of evidence in HIA. We encountered a number of wider issues, e.g. lack of evidence, conflicting values, multiple outcomes, and differential impacts, throughout this work and we have used our experience to reflect on the implications for the development of evidence informed healthy public policy and HIAs of complex social interventions such as transport.

## Methods

### **Communication with evidence users & scope of research synthesis**

SHIAN members were consulted to identify topic areas and key questions to be covered in the synthesis [Appendix 1]. This informed the scope of the synthesis, which was then agreed in discussion with a sub-group of SHIAN. The review covered all major transport modes, road and non-road. [Table 1] For the purposes of this paper the expression 'transport intervention' denotes any transport policy, programme, or project. The health impacts of predicted climate change attributed to increased transport fuel use, transport policies for freight movement, or the health impacts of leisure or sport pursuits which use transport modes e.g. mountain biking, rally driving, were not included. The synthesis aimed to reflect SHIAN's key interest in the possible unintended health impacts of transport interventions rather than focus on the primary effectiveness of measures for reducing injuries. Outcomes included in the synthesis were identified by SHIAN [Table 1]. Specific health outcomes included were; injury and death, general health and illness, physical fitness and physical activity, and mental health (including stress). Factors considered by SHIAN to be possible determinants of health included air and noise pollution, personal safety, community severance (defined as reduced access to local amenities and disruption of social networks caused by a road running through the community) and social exclusion.

### **Search strategy & study inclusion/exclusion**

Searches were carried out in 2006. We used a systematic review of systematic reviews (1960–2001) on transport and health [12] as a baseline resource and updated searches for systematic reviews published since 2001 (2001–2006). We searched ten bibliographic databases (Cochrane Library, DARE, SIGLE, PsycINFO, Medline, EmBase, SPORTDiscus, Cinahl, TRIS, and TRANSPORT) and the internet (Google) for systematic reviews of transport and health. Where no systematic reviews of an intervention were located, primary studies were searched for. Cross-sectional data on the associations between transport and health were identified from the above searches

**Table 1: Scope of and outcomes included in transport and health research synthesis**

<b>Transport modes included</b>	All (N.B. Very little research evidence is available on the health impacts of non-road transport. This paper only reports on road transport)
<b>Topics not included</b>	Climate change attributed to increased motorised transport Transport policies for freight movement Health impacts of leisure or sport pursuits which use transport modes e.g. mountain biking, rally driving
<b>Health outcomes included in synthesis</b>	Injury & death General health & illness Mental health & stress Physical fitness & physical activity
<b>Non-health outcomes included in synthesis</b>	Air pollution Noise pollution Community severance Personal safety Social exclusion

and an additional search on Web of Knowledge. All empirical studies identified were included (for a full list of studies see [13]) and the final synthesis reflects the relative strength of evidence of the identified studies [14,15]. Expert reviews were the main source of evidence on the health impacts of transport-related air pollution.

Since 2006 key journals have been hand-searched for relevant studies and reviews, in addition a final search for relevant systematic reviews was conducted in July 2008 in TRIS and the Cochrane Library (Issue 3).

### **Synthesis and appraisal**

A narrative and tabular summary of the research reviewed was prepared in light of the strength of evidence [see Additional files 1, 2, 3, 4]. An indication of the strength of evidence [Appendix 2] based on quality criteria for systematic reviews [14] and/or primary studies where appropriate was included in the summary tables (see Additional files) [15].

### **Results**

The following presents a summary of the full synthesis [13]. In this paper we are not able to report on every study included in the full synthesis, however, the key findings are presented in light of the quantity and quality of available data. Data on all included outcomes are presented where available. Very few studies of the health impacts of non-road transport were identified, but all identified studies of road and non-road transport were included in the final synthesis presented [13]. This paper reports on road transport and where available evidence on all transport modes using roads, for example trams, cycles, has been included.

### **The Health Impacts of Road Transport Interventions**

This first section summarises evidence on the health impacts of road transport interventions. The evidence draws on intervention studies, and the scope of interventions covered reflect the data identified by the searches.

#### **Interventions to reduce road transport injury**

Injury reduction dominates transport and health research [12]. All but three of the systematic reviews we identified reported on injury reduction interventions.

#### *Impact on injuries*

A wide range of legislative, environmental, and safety equipment measures have been shown to lead to reductions in road injuries [see Additional file 2] [12,16,17]. Educational campaigns among the general population to promote the use of safety equipment, such as bicycle and motorcycle helmet, and children's car seats typically include education, incentives and/or distribution of free equipment. These campaigns have led to increased use of equipment such as cycle helmets and car seats, but little is known about subsequent impacts on injuries or other health outcomes [12,18,19]. Driver improvement and education courses may improve knowledge and safety behaviour, and may reduce crash involvement in some groups [20]. However, educational programmes to rehabilitate convicted drivers and high school driver education programmes are associated with increases in crash involvement and violations [12].

#### *Other health impacts*

One study of injury reduction measures had assessed a health related outcome which was unrelated to injury or accident outcomes. In this uncontrolled study a small improvement in physical health, but not mental health



(SF-36), was reported and pedestrian activity was greater 6 months after the neighbourhood traffic calming measures were introduced [21].

**Interventions to promote physically active road transport: Promoting walking and cycling as an alternative to car use**

Two systematic reviews related to this topic were found. They reviewed studies which had assessed the effectiveness of interventions to promote a modal shift from car use to walking and cycling, (a summary of reported impacts is provided in Additional file 3) [22,23].

*Impact on physical activity (walking and cycling) & physical fitness*

Programmes which target already motivated individuals may be effective at shifting up to 5% of trips from cars to walking and/or cycling. However, effects of similar programmes on the general, less motivated, population are unclear [22,23].

Other interventions which have been evaluated are: publicity and education aimed at the general population; financial incentives (road tolls, work subsidy for not driving to work); improved public transport; and car pools. From the research evidence available, there is very little to suggest that these interventions lead to a shift from car use to more active forms of transport.

It cannot be assumed that a shift from car use to more physically active forms of transport will automatically lead to an increase in overall levels of physical fitness or activity. For example, gym exercise may be replaced by cycling to work. However, one study assessed changes in fitness among those who changed from driving to walking or cycling to work; levels of fitness and walking speed improved [24,25].

*Impact on general health & wellbeing*

One study assessed the effects on general health for those who switched from driving to walking or cycling to work; there were significant improvements in general and mental health (SF-36) [26].

*Other impacts: Injury, noise & air pollution*

We found no available data on the injury or pollution impacts of interventions to promote a switch from car use to more physically active forms of transport. However, given the unclear effects of these interventions to achieve a significant modal shift, impacts on injury, noise and air pollution at a population level are likely to be minor.

**New road transport infrastructure: new or improved/ upgraded roads**

One systematic review was identified which had assessed the health impacts of new or improved roads (a summary of reported impacts is provided in Additional file 4) [27].

No research was identified which had assessed the health or health related impacts of other types of new road transport infrastructure, such as a tram network, or a new bus terminus.

*Impact on injury*

Provision of new or improved roads is likely to increase traffic volume. Nevertheless, nine of the 10 evaluation studies identified reported a fall in overall numbers of accidents and related injury [22]. Building by-passes to relieve traffic from urban areas may displace injury accidents from the old route to other secondary roads if smaller side roads are used as popular short-cuts, though the overall level of injury accident is still likely to fall.

*Impact on respiratory health*

One study assessed changes in respiratory symptoms after the opening of a bypass and an associated fall in pollutant levels in the by-passed street. While reports of rhinitis and rhino-conjunctivitis fell, there was little change in lower respiratory symptoms when compared to changes in a similar near-by street [28]. However, a small-scale intervention study such as this is unable to detect the main relationships between traffic-related air pollution and health.

*Impacts on other possible determinants of health: noise, vibrations, fumes and dirt*

New major urban roads are likely to result in increased levels of noise in the immediate vicinity. In some cases perceived traffic disturbance will improve as residents adapt to the changes, but this cannot be assumed. Conversely, where the new road diverts traffic from one road to another, those living in the area with reduced traffic are likely to experience fewer disturbances from noise, vibrations, fumes and dirt.

*Impacts on other possible determinants of health: community severance*

There is very little research evidence on the impacts of new roads on community severance. One US study reported a reduction in the number of people crossing a new road running through a neighbourhood and that this effect was still observable 30 years later [29]. Where a new road leads to reduced traffic on by-passed roads, the severance effect will be reduced [27].

*Impact displacement and volume*

Although a new road may reduce traffic volume on some roads, e.g. through a town centre, it is unlikely that overall traffic volume will be reduced indeed improved road provision may lead to increased traffic overall (i.e. induced traffic). In the case of bypasses, traffic and its associated impacts, i.e. air pollution, will likely be displaced and increase on other roads, in particular the bypass area itself.

Some studies have looked at the overall impacts of new roads on injuries reporting an overall decrease but there is little detailed reporting of the distribution of impacts. Even if the overall impact is clear e.g. reduced injuries, there may be small pockets which experience increased traffic due to motorists detouring through quieter, often residential, streets to avoid congestion or traffic control measures, also known as 'rat-running'.

#### **The health impacts of reducing road transport noise pollution**

Interventions to reduce road noise include eliminating noisy vehicles, reducing traffic speed, and developing quieter road surfaces e.g. porous asphalt [30]. There is little research evidence about the health impacts of effective measures to reduce traffic noise, but reduced traffic noise may reduce sleep disturbance.

#### **The health impact of interventions to reduce road transport related air pollution**

Interventions to reduce air pollution from motor vehicles in the UK include unleaded petrol, low sulphur fuels, and various European directives to control emissions of particles and oxides of nitrogen. These measures have led to clear reductions in air pollution; impacts on health however have been inferred rather than studied directly [31]. A review of interventions that reduced air pollution identified two studies which had assessed the health effects of policies specifically designed to reduce transport-related air pollution [32].

#### *Impact on air pollution*

High-sulphur fuels were banned in Hong Kong in 1990, leading to an immediate, marked and sustained decrease in ambient SO<sub>2</sub>, with changes also to the surface characteristics of fine particles [33]. Short term traffic restriction measures were introduced over a 17-day period during the Atlanta (US) Summer Olympic Games of 1996, with significant reductions in levels of carbon monoxide, particulate matter (PM<sub>10</sub>) and ozone within the affected area [34].

#### *Impact on cardio-respiratory health & mortality*

Prior to the banning of high sulphur fuels in Hong Kong, monthly deaths were rising by 3.5% per year due to demographic changes. The five years following the intervention showed a clear, immediate and sustained reduction in the rate of increase in mortality. The change was greatest for pollution-related causes, i.e. cardio-respiratory, and occurred in the high SO<sub>2</sub> reduction areas; the low SO<sub>2</sub> reduction areas showed a higher increase in mortality after the intervention than before [33]. Following the traffic restrictions in Atlanta there was a small reduction in the number of asthma events requiring hospital attention among children, when compared with 4 week period

before and after the games. There was no change in the number of children requiring acute care due to other causes [34].

#### **Interventions to reduce road traffic: Congestion charging**

Two studies of traffic restriction measures were identified: one study of the London Congestion Charging (LCC) scheme; [35] the second study was of short-term traffic restrictions scheme during the Atlanta Olympic games which partly aimed to reduce air pollution and is reviewed above (section I (e)) [34].

#### *Impacts on injuries*

There is no evidence of an increase in serious road injuries and it is estimated that between 40–70 crashes per year have been prevented in the zone area [35].

#### *Impacts on air & noise pollution*

While there is some suggestion that air quality has improved in the LCC zone, the monitoring programme of the LCC scheme reports that it has not been possible to detect a 'congestion charging effect' in measures of air quality [35]. There are no reports of changes in traffic noise.

#### *Other impacts: local congestion & economy*

Two years after the introduction of the LCC scheme traffic entering the zone is reduced by 18%, and traffic speeds increased due to reduced congestion. Those living within the charging zone report little change in their car use [35].

There does not appear to have been any impact on local economic outcomes such as business performance, employment, property prices and retail sales [35].

#### **The health impacts of improving negative psycho-social impacts of public road transport**

We were unable to identify much research in this area. One systematic review of the crime prevention effects of closed circuit television (CCTV) included four evaluations of CCTV on public transport. Results were mixed and the pooled effect, a 6% reduction in crime, was not significant [36].

#### **Associational Evidence Supporting Links Between Road Transport and Health and Possible Determinants of Health**

In addition to synthesizing data on the health impact of interventions, we searched for research evidence to support the hypothesized links between different modes of transport to health and other health related factors specified by SHIAN. While these data report associations between transport and health, the direction of the relationship is rarely clear, and evidence of an association does not imply a causal relationship. A summary of the

data, with an indication of the strength of the association, is presented in Additional file 1.

#### *General health*

Car ownership and access has been associated with better health and fewer long term health problems [37]. This association may be explained by the relationship between car ownership and socio-economic status, but two studies report that the association persists even when income, social class and self-esteem are controlled for [38,39].

#### *Mental health & stress*

Access to a car has been associated with improved mental health in two studies in Scotland. This association was shown to be independent of social class, income, and self-esteem [38,39].

Physically active forms of transport may lead to increased overall levels of physical activity. For individuals who achieve significant increases in physical activity there may be small mental health benefits [40,41].

Commuting to work, by road and by train, is associated with increased stress and short term elevations in blood pressure. Shorter, familiar, and convenient (i.e. direct route) journeys may be less likely to cause increased stress. The long term health impact of frequent commuting is not known [42,43].

#### *Physical injury & death*

Despite massive increases in motorized road traffic, in most industrialized countries (UK data 1980–2004 +80% [44]) the rates of road casualties and absolute numbers of fatalities have been falling for the past 50 years [45,46]. Motorised road traffic exposes more vulnerable road users, namely cyclists and pedestrians, to a hugely increased risk of injury. However, this risk may vary between countries; the risk to cyclists appears to be inversely related to the proportion of cyclists on the road. Evidence from Holland, Denmark, and Germany suggest that a critical mass of cyclists on the roads leads to a reduced risk of cyclist injury despite an increase in cyclist miles travelled [47,48]. In addition, countries where cyclists are accepted as co-road users a wide range of measures, education and engineering measures, are implemented to promote cyclist safety [49].

Trams were an area of interest to SHIAN, but we were unable to locate much research around the health impacts of tram systems. Two identified studies suggest that cyclists are most at risk from trams, [50,51] in one study the most common scenario being where cycle wheels become trapped in the tram tracks [50].

#### *Physical activity & fitness*

Clearly certain forms of transport involve more physical activity than others, but this cannot be assumed to affect overall levels of physical activity or indeed levels of physical and cardiac fitness. Very little data are available at an individual level to link car use and overall physical activity levels. While there are some data to suggest that children in families who are 'highly car dependent' may be less physically active, [52] another study reports that car ownership is associated with increased levels of physically active leisure independent of socio-economic status [53]. A further study reported a link between time spent in cars and obesity [54].

Physical characteristics of the local environment have been associated with levels of physical activity and physically active transport [55,56]. For example, physically active transport (i.e. walking or cycling) has been directly related to increased residential density, street connectivity, mixed land use and amenities within a walkable distance [57]. Where using public transport involves walking to and from a transit point this may help otherwise inactive groups to increase their levels of walking [58]. An economic analysis has suggested that the potential increase in energy expenditure could lead to significant savings on obesity related medical costs in the long term [59].

#### *Air pollution*

Transport fuel emissions contribute directly to air pollution which has a direct impact on cardio-respiratory health [60] and methodologies for including air pollution effects in HIA are well developed [31]. The most significant public health effect is an increased risk of mortality from long-term exposure to fine ambient particles (PM<sub>2.5</sub>) [61]. There is specific evidence of increased risk of mortality [62] and morbidity [63] in people living near major roads; the Dutch mortality study [62], for example, found that deaths from cardio-respiratory causes were almost twice as likely (relative risk 1.95; CI 1.09–3.52) in people who had lived within 50 metres of a major road for 10 years or more. Factors other than transport-related air pollution may have contributed to the increases in risk. The health effects of transport-related air pollution were reviewed recently by the WHO [64].

Reports from the UK Air Quality Expert Group (AQEG) imply that traffic is responsible for about half of the overall PM<sub>2.5</sub> in the UK [65,66]. On that basis, transport-related air pollution (PM<sub>2.5</sub>) is estimated to reduce life expectancy by a few months, an effect similar to, or a little greater than, the estimated effect of passive smoking [67].

#### *Noise pollution*

Noise from road intersections above 50–60 dB(A) is insufficient to lead to hearing loss but has been reported

to cause annoyance and sleep disturbance; impacts on other long term health outcomes including blood pressure are less clear [68].

#### *Community severance*

No empirical data reporting a link between community severance and health were identified and the possible health impacts of remain unknown.

#### **Other Considerations**

Predictions of health impacts need to be considered in light of the broader aim of transport and different transport needs which may vary by country, local area, population sub-group, and individual.

#### *Transport & access as a health determinant*

The primary function of transport is the movement of people and goods between places, enabling access to employment, economic, and social opportunities as well as to essential services. Transport needs will depend on many local contextual factors e.g. existing public transport, rurality, as well as individual factors, e.g. mobility. But transport which is affordable and accessible may be viewed as an important determinant of health by facilitating access to key socio-economic opportunities.

#### *Transport & social exclusion/inequalities*

Inadequate transport provision may add to social exclusion among already vulnerable groups, i.e. those who are unemployed, elderly, sick, on low incomes, and women, presenting a barrier to jobs, health services, education, shops and other services [69,70].

Lack of access to a car may contribute to transport related social exclusion [70-72]. In the UK, car ownership is strongly associated with income, yet the association between car ownership and improved health is independent of income and social class. This may be explained by the improved access that a car provides [38,39].

Disadvantaged groups are least likely to own a car, compounding disadvantage in a car-dominated society. Yet, ironically, the same groups experience a disproportionate amount of the harmful effects of cars. Children from the poorest households are between four and five times more likely to be killed in a road traffic accident than their counterparts from the most affluent households [73].

#### *Determinants of transport mode*

When considering the potential for a shift in transport behaviour it is essential to consider the reasons, other than health, for choosing different modes of transport. In particular, the considerable positive benefits (convenience, time, comfort, personal safety, carrying loads, and

costs (for existing car owners)) reported to be linked to car use compared to all other transport modes [74].

#### *Health impacts of road transport related climate change*

It is estimated that transport-related fuel use accounts for around 22% of CO<sub>2</sub> fuel emissions [75]. Although individual fuel use may have a negligible impact, an accumulation of increased fuel emissions may have significant environmental, economic and health impacts at a global level.

The balance of health impacts related to climate change is likely to be adverse, particularly in the developing world. The WHO estimates that climate change has already caused 150,000 deaths [76].

#### *Applying evidence to policy & practice*

Informed by the synthesis, we produced a list of questions [Table 2] which may be used as a guide to shape assessments of the potential health impacts of a planned transport intervention or policy. In addition to questions directing assessors to consider the empirical support for predicted impacts, Table 2 includes questions central to defining the scope of the HIA and the actual intervention and population being included.

## **Discussion**

This evidence synthesis aims to provide a digest of the best available evidence within the transport and health field for use by public health policymakers and practitioners. Where available we endeavoured to meet the evidence needs of SHIAN [Table 2], but for many of their questions there was no evidence available. While drawing heavily on systematic reviews, other types of research, including single intervention and cross-sectional studies, have also been reviewed [77]. The principles of systematic review were applied to the synthesis in order to minimise bias in the data selected and so that the digest of research reflected the relative strength of evidence with respect to study quality. The list of questions [Table 2] aims to assist discussion and assessment of the health impacts of transport interventions, and the figure in Additional file 5 demonstrates how the evidence synthesis might be used to populate theoretical pathways for predicted impacts of specific interventions. Far from presenting a clear map of health impacts, many of the impacts included in this review are characterised by uncertainty. This has important implications for the potential value of transport HIA [Table 3] and highlights the need for accurate assessment and representation of uncertainty within transport HIAs.

#### **Wide range of possible impacts**

The links between transport and health cover a vast literature on diverse transport modes, and a variety of issues important to public health. However, while there is a con-

**Table 2: Questions to help shape HIAs of road transport interventions**

<p><i>Define nature and extent of intervention or policy being assessed</i></p> <hr/> <ul style="list-style-type: none"> <li>• What are the specific transport-related changes proposed?</li> <li>• What is/are the overall aim(s) and objectives of the transport changes proposed?</li> <li>• How will the changes be implemented?</li> <li>• What phases of implementation are there, e.g. consultation, implementation/construction, maintenance?</li> </ul> <hr/> <p><b>Research evidence about health impacts of the intervention</b></p> <hr/> <ul style="list-style-type: none"> <li>• What is the research evidence that this intervention is effective in achieving its stated aims e.g. reducing speed?</li> <li>• What is the research evidence that this intervention will have the intended health impacts (positive or negative)? Include any stated health objectives of the intervention.</li> <li>• What is the research evidence that this intervention has unintended health related impacts (positive or negative)?</li> </ul> <hr/> <p><b>Define features of the local area</b></p> <hr/> <ul style="list-style-type: none"> <li>• What is/are the geographical area(s) covered by the intervention?</li> <li>• What are the key features of the area: <ul style="list-style-type: none"> <li>• Is it urban or rural?</li> </ul> </li> <li>• What transport infrastructure currently exists?</li> <li>• What facilities and amenities are there that people need to access?</li> </ul> <hr/> <p><b>Define populations</b></p> <hr/> <ul style="list-style-type: none"> <li>• What populations will be affected by the changes?</li> <li>• Note any vulnerable population groups.</li> <li>• For each impact identified who will be affected positively.</li> <li>• For each impact identified who will be affected negatively.</li> <li>• Will the impacts be distributed equally in difference socio-economic groups? <i>If not this may have implications for health and social inequalities.</i></li> </ul> <hr/> <p><b>Economic implications</b></p> <hr/> <ul style="list-style-type: none"> <li>• What are the predicted effects of the proposal on the local economy?</li> <li>• How will travel costs be affected for individuals?</li> </ul> <hr/> <p><b>Changes in travel and traffic patterns</b></p> <hr/> <ul style="list-style-type: none"> <li>• How will traffic levels or speed change? If appropriate, consider different parts of the affected area separately.</li> <li>• Where relevant, will improved provision lead to increases in overall Vehicle Miles Travelled (VMT) i.e. induced traffic?</li> <li>• Will there be any part of the affected area where traffic levels, speed, or infrastructure, will change to the extent that severance effects may occur?</li> <li>• How will these changes affect access to essential services and amenities for those living in or travelling through the affected area?</li> <li>• What will be the effect on individuals' travel patterns? Consider levels of driving, walking, cycling, and public transport use. Consider travel patterns of those both living in and travelling through the affected area(s).</li> <li>• How will the expected changes affect safety for vehicle drivers or other transport users?</li> <li>• How will the expected changes affect safety for other vulnerable road users, e.g. pedestrians?</li> <li>• How will the expected changes affect air quality in the affected area?</li> <li>• How will the expected changes affect noise levels in the affected area?</li> <li>• Will there be a shift to more or less physically active forms of transport? (Walking, cycling or public transport use)</li> <li>• Will this shift affect individuals' levels of physical activity overall?</li> <li>• Will this change in physical activity be sufficient to affect health?</li> <li>• Will changed levels of physical activity be seen in the general population of the affected area or in a minority of motivated individuals?</li> <li>• How will safety, and perceptions of safety, among vulnerable road users and public transport users be affected?</li> </ul> <hr/> <p><b>Traffic and impact displacement</b></p> <hr/> <ul style="list-style-type: none"> <li>• Will there be displacement of traffic and related impacts to or from surrounding areas? For example, traffic calming may lead to less traffic in one area but displace traffic to a peripheral area. <i>If displacement is expected a Health Impact Assessment should consider impacts on both areas.</i></li> </ul> <hr/>
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**Table 3: Some key issues affecting the predictive value of transport HIA**

- 
- Multiple outcomes present conflicting overall benefit and harm at different levels
  - Lack of empirical support for plausibility of links to actual health impacts
  - Numerous steps and mediating factors influence links between transport and health
  - Defining a transport intervention and affected area and population not always straightforward
- 

siderable literature on the direct impacts of transport on injury there is far less to forecast other unintended health impacts which are central to HIA.

This wide range of possible impacts means that policies may be beneficial in some respects and harmful in others. There may also be differential and conflicting impacts depending on the level (individual v population), location, and timescale of measurement. This adds further to the potential for conflict between impacts and also increases uncertainty around overall benefits and harms. Supplemental Figure 1 (see Additional file 5) illustrates some mediating factors and conflicting benefits and harms which might follow a modal shift to active commuting. This mix of benefits and harms requires difficult decisions about which outcomes and population groups to prioritise [78]. This may be partly resolved by using a common metric to represent diverse health outcomes, for example Quality-Adjusted Life Years (QALYs) [79] or monetary valuation, [31] however such an approach may conceal differential impacts.

#### **Empirical support for plausibility of predicted impacts & their pathways**

The value of HIA depends largely on the accuracy with which it can correctly predict future impacts. While it is increasingly accepted that predictive validity, based on empirical data from intervention studies, is unlikely to be available to HIA, plausibility and formal validity supported by best available scientific evidence is desirable [77]. This involves setting out plausible pathways for predicted impacts (e.g. Figure S1-see Additional file 5) and gathering empirical support for each step in the pathway. For the types of interventions subject to an HIA the best available evidence is likely to come from both intervention and cross-sectional studies. Indeed, data from cross-sectional studies may in some cases be superior in terms of both quality and quantity, such as when modelling the health impacts of transport-related air pollution.

While each of the hypothesised impacts and pathways in this synthesis was regarded as plausible it is disappointing that we found so little empirical support. Much of this uncertainty owes to lack of evidence rather than evidence of no effect, either from intervention or cross-sectional studies.

The hypothesised pathways linking a transport intervention to a possible health impact will often involve more than one step; between each step there are numerous mediating factors. For example, at an individual level there are many influences on transport choices, such as cost, time, weather, safety, passengers [74]. At a wider level, large-scale transport interventions cannot be separated from the local and political context within which they occur [80]. Even with stronger empirical support for specific impacts, these numerous mediating factors introduce an inevitable and substantial amount of uncertainty to the development of health-related transport policy; uncertainty which should be clearly acknowledged in transport HIAs.

#### **Defining transport interventions, affected area(s), and affected population(s)**

Further challenges lie in defining the intervention(s), identifying the geographical areas and population(s) affected (a helpful description of attempts to define a motorway extension and a congestion charging scheme is presented by Ogilvie et al 2006) [80]. Structural transport interventions may lead to traffic displacement. For example, a bypass will reduce traffic through a town but may increase traffic around the bypass and may result in 'rat-running' on residential roads by drivers trying to find short-cuts. There may also be differential impacts across areas and population groups. For example, noise effects are necessarily close to source, whereas transport air-pollution may have long-range effects. Differential impacts across socio-economic groups raise further issues of equity. For example, in a context of growing car dependence, financial incentives to reduce car use will be disproportionately harsh on low-income groups, and may increase social exclusion and subsequent health inequalities. Conversely, subsidies to promote a modal shift from private car to public transport may be of great benefit to those on low incomes. Highlighting differential impacts, including unintended consequences, is a central element of HIA [81].

#### **Conclusion**

When compared to a similar synthesis of the health impacts of housing improvement, [10] the uncertainty and complexity in attributing health impacts to transport interventions appears to be much greater. Injuries and deaths caused by motor-vehicles are indisputable and already closely monitored with many effective interven-

tions in place to minimise this harm. The strength of evidence about other indirect health related impacts varies according to the pathways concerned, from strong quantifiable evidence of air pollution effects, to much weaker evidence on the health effects of transport noise and community severance. This leads to considerable uncertainty in assessing the overall benefits and harms of transport interventions.

However, few decisions, in policy or elsewhere, are supported by thorough knowledge or conclusive outcome evaluations. And lack of conclusive evidence does not preclude the possibility for small increases in risks across a large population to have significant public health impacts. It remains that transport interventions have important potential impacts on health and health inequalities. While HIA practitioners need to make the inevitable uncertainties explicit in their assessments, HIA has a valuable role to play in raising awareness of the potential impacts, and to inform the development of healthy public policy.

#### List of abbreviations

SHIAN: Scottish Health Impact Assessment Network; US: United States (of America); UK: United Kingdom; SF-36: Short Form 36 item questionnaire; CCTV: Closed Circuit Television; LCC: London Congestion Charging

#### Competing interests

The authors declare that they have no competing interests.

#### Authors' contributions

RJ & HT led on the evidence synthesis: FH contributed a synthesis of evidence on transport related air pollutants; MD prepared the section on transport related climate change; RJ & HT prepared all other sections of the synthesis. HT developed the questions in Table 2. HT prepared the first draft of the paper and all authors contributed to subsequent drafts.

#### Appendix 1: Questions to be addressed by research synthesis (as proposed by SHIAN)

- What is the evidence that transport policies and initiatives can affect physical activity levels overall? (taking account of, eg, substitution effects)?
- What is the evidence that transport policies and initiatives can affect road safety for car drivers, passengers and pedestrians?
- What is the evidence of health effects from air and noise pollution from different modes of transport? What population subgroups are affected?

- What is the evidence of links between stress and mode of travel?
- What is the evidence of impacts of transport policies and initiatives on community severance, and resulting impacts on health? This would include, eg, new roads, crossings, how busy roads are.
- What is the evidence of links between social inclusion and transport policies and initiatives?
- What is the evidence of health impacts of initiatives intended to effect modal shift?
- What is the evidence of the direct and indirect health impacts of measures to promote availability and use of public transport?
- What are the most effective interventions for:
  - reducing drink driving?
  - reducing speed?
  - increasing seat belt use?
  - increasing helmet use?

#### Appendix 2: Classification used for Strength of Evidence (SoE)(adapted from Weightman et al 2005 [15])

1++ High quality meta-analysis, systematic review(s) of RCTs (including cluster RCTs) or RCTs with a very low risk.

1+ Well conducted meta-analysis, systematic review of RCTs, or RCTs with a low risk of bias.

1- Meta-analysis, systematic reviews of RCTs, or RCTs with a high risk of bias.

2++ High quality systematic reviews of, or individual high quality non-randomised intervention studies (controlled non-randomised trial, controlled before-and-after, interrupted time series) comparative cohort and correlation studies with a low risk of confounding, bias or chance.

2+ Well conducted, non-randomised intervention studies (controlled non-randomised trial, controlled before-and-after, interrupted time series), comparative cohort and correlation studies with a low risk of confounding, bias or chance.

2- Systematic review (Oxman & Guyatt score < 5: moderate to poor quality)[14] of non-randomised intervention

studies with high risk of confounding, bias or chance. Non-randomised intervention studies (controlled non-randomised trial, controlled before-and-after, interrupted time series), comparative cohort and correlation studies with a high risk of confounding, bias or chance.

3 Non-analytical studies (e.g. case reports, case series), single cross-sectional study or single small non-randomised intervention study (controlled non-randomised trial, controlled before-and-after, interrupted time series), comparative cohort and correlation studies with a high risk of confounding, bias or chance.

4 Expert opinion, formal consensus

## Additional material

### Additional file 1

**Table S1.** Summary of hypothesised links between road transport and health with Strength of Evidence (SoE).

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[<http://www.biomedcentral.com/content/supplementary/1471-2458-8-339-S1.doc>]

### Additional file 2

**Table S2.** Overview of health impacts of interventions which aim to reduce transport related injury with Strength of Evidence (SoE).

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[<http://www.biomedcentral.com/content/supplementary/1471-2458-8-339-S2.doc>]

### Additional file 3

**Table S3.** Summary of health and environmental impacts of initiatives promoting physically active forms of transport with indication of Strength of Evidence (SoE).

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[<http://www.biomedcentral.com/content/supplementary/1471-2458-8-339-S3.doc>]

### Additional file 4

**Table S4.** Summary of the health and related impacts of new roads with indication of strength of research evidence (SoE).

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[<http://www.biomedcentral.com/content/supplementary/1471-2458-8-339-S4.doc>]

### Additional file 5

**Figure S1.** Some possible pathways to health and related impacts following modal shift from driving to cycling to work.

Click here for file

[<http://www.biomedcentral.com/content/supplementary/1471-2458-8-339-S5.doc>]

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**Table 1: Summary of hypothesised links between road transport and health with Strength of Evidence (SoE) <sup>[1]</sup> see Appendix 2**

Transport factor	General health	SoE	Mental health & stress	SoE	Physical injury/death	SoE	Physical activity	SoE
<b>Mode of transport</b>								
<b>Car</b>	Very little research investigating links between use of different transport modes and general health		Very little research investigating links between use of different transport modes and mental health		3.7 KSI* per million kilometres travelled <sup>[2]</sup>		Sedentary form of transport	
<b>Pedal bike/motorcycle</b>					53.3/119 KSI* per million kilometres travelled <sup>[2]</sup>		Physically active form of transport	
<b>Foot</b>					1.4 KSI* per million kilometres travelled <sup>[2]</sup>		Physically active form of transport	
<b>Public transport-Bus/Coach</b>					7.2 KSI* per million kilometres travelled <sup>[2]</sup>		May require short walk to pick-up point <sup>[3]</sup> (mean time from home to bus-stop= 6 minutes in Scotland) <sup>[4]</sup>	
<b>Car ownership/ Access</b>	Improved health independent of social class, income, self-esteem <sup>[5, 6]</sup>	2-	Improved mental health: independent of income and self-esteem <sup>[5, 6]</sup>	2-			High levels of car use may be linked to lower levels of physical activity <sup>[7]</sup> Those with access to a car are more likely to participate in physically active leisure, independent of socio-economic status <sup>[8]</sup>	2-  2-
<b>Road transport factors/impacts and hypothesised links to health or related social outcomes</b>								
	<b>Links to health and related social outcomes supported by research evidence</b>							<b>SoE</b>
<b>Physical activity</b>	Moderate physical activity, such as brisk walking, accumulating to 30 minutes on 5 days per week is recommended for adults to benefit health. Regular moderate activity may lead to reduced risk of chronic disease and death from any cause and may help control weight and prevent obesity. <sup>[9]</sup> Physical activity may have a protective effect on mental health. <sup>[10]</sup>							2++  2++
<b>Community severance</b>	May disrupt local social networks and access to local services but potential for impact will vary substantially by area geography. Health impacts are unknown. <sup>[11]</sup>							3
<b>Air pollution</b>	Traffic contributes to outdoor air pollution. Both short-term and longer-term exposure to ambient particulate matter (PM) increases the risks of death and disease from cardio-respiratory causes. Some effects are more-or-less immediate and affect vulnerable groups in particular whereas the effects of long-term exposure are more widespread. <sup>[12, 13]</sup> In Britain, long-term exposure to transport-related air pollution measured as PM <sub>2.5</sub> is estimated to reduce life expectancy by a few months, an effect similar to the estimated effect of passive smoking. <sup>[14]</sup>							3
<b>Noise pollution</b>	Not sufficient to lead to hearing loss, but is likely to cause sleep disturbance for those living in the immediate vicinity of a busy street or motorway. Other health effects are unknown. <sup>[15]</sup>							3
<b>Personal safety</b>	May affect decisions to walk, cycle or use public transport but health effects are not known <sup>[16][17]</sup>							3
<b>Stress</b>	Traffic congestion may cause short term elevations in stress markers but possible long term effects are not known <sup>[18][19]</sup>							2-

\* KSI: Killed/seriously injured. Vehicle kilometres travelled (UK data 2005) Figures will vary by country factors and varying proportions of different transport modes e.g. cyclists <sup>[2]</sup>

**Table 2: Overview of health impacts of interventions which aim to reduce transport related injury with Strength of Evidence (SoE)<sup>[1]</sup> see Appendix 2**

Intervention	Impact on accidents in affected area	Effect on fatal and serious injury from accidents	Effect on less serious injury from accidents	Other health related effects	Other unintended effects/comments
<b>Environmental and engineering:</b> separating pedestrians from vehicles and increasing pedestrian visibility					
Exclusive pedestrian signalling (traffic light pedestrian crossings) <sup>[20]</sup>	Decreased (2-)				Effectiveness will depend on use which will depend on perceived safety and convenience for pedestrian users
Pedestrian overpasses and underpasses <sup>[20]</sup>	Decreased (2-)				
Median/refuge islands in multi-lane roads <sup>[20]</sup>	Decreased (2-)				
Pavements <sup>[20]</sup>	Decreased (2-)				
Advance stopping lines (indicating vehicles to stop a few feet from crossing) <sup>[20]</sup>	Decreased (2-)				
Street lighting <sup>[21]</sup>	Decreased (2-)	Decreased (2-)			
Diagonal on-street car parking <sup>[20]</sup>					Reduces number of pedestrians entering road in front of a parked vehicle (2-)
<b>Environmental and engineering:</b> managing vehicle speeds					
Speed limit zones, e.g. twenty's plenty <sup>[22]</sup>			Decreased (2-)		Speed limit zones in quiet peripheral roads also lead to reduced amount of material damage
Changes to speed limits- slower in built up areas and faster on peripheral roads <sup>[22]</sup>	May increase accidents on peripheral roads where speed limit is increased (2-)				
Roundabouts <sup>[20]</sup>	Decreased (2-)				Largest decreases in accidents observed when the intersection was previously controlled by a Give Way sign rather than by traffic lights
Road humps <sup>[22]</sup>	Unclear (2-)				May displace accidents to alternative local roads
Raised crossroads <sup>[22]</sup>	Small increase (2-)				
Rumble strips <sup>[22]</sup>			Decreased (2-)		Reduced levels of material damage from traffic accidents (2-)
Area-wide traffic calming <sup>[22]</sup>	Decreased (2+)			Possible increase in walking in local area (2-)	Impact on noise levels will vary depending on type of traffic

<b>Environmental and engineering: separating vehicles from other vehicles, pedestrians and local area (i.e. motorways running through an area)</b>					
Guard rails <sup>[22]</sup>	Decreased (2-)	Decreased (2-)	Decreased (2-)		
Crash cushions <sup>[22]</sup>	Decreased (2-)	Possible decrease (2-)	Possible decrease (2-)		
Central reservation crash barriers <sup>[22]</sup>	Increased (2-)	Decreased (2-)	No change (2-)		
<b>Legal strategies</b>					
Blood alcohol concentration (0.08g/dl or 0.08%) <sup>[23] [22]</sup>	Decreased * (2+)		Decreased * (2+)		UK legal limit is 0.08%
Lower blood alcohol concentration for teenage drivers (0.02g/dl or 0.02%) <sup>[24] [23]</sup>	Decreased * (2+)	Decreased * & ** (2+)			
Minimum legal drinking age <sup>[23]</sup>		Decreased * (2+)			Reduces drink driving among younger drivers
Random breath testing <sup>[23] [22]</sup>	Decreased * (2+)	Decreased * (2+)			
Red light cameras <sup>[25]</sup>	Unclear (2++)	Decreased (2++)	Decreased (2++)		Reduces red light running
Speed cameras <sup>[26]</sup>	Decreased (2++)	Decreased (2++)	Decreased (2++)		Reduces speed at affected area (2++)
Motorcycle helmet legislation <sup>[27] [28]</sup>		Decreased (2-)	Unclear effect on facial & neck injuries		
Bicycle helmet legislation <sup>[29]</sup>	Decreased (2++)			Increased helmet use (2++)	Unknown impact on cycle use (2++)
Graduated licensing laws <sup>[30]</sup>	Decreased (2+)	Decreased (2+)	Decreased (2+)		<i>Not used in the UK</i>
Seatbelt legislation (primary) <sup>[31]</sup>		Decreased (2-)		Increases seat belt use	
Licence ban/suspension for problem drivers <sup>[32]</sup>	Small decrease (2+)				May also reduce rates of violation among problem drivers
<b>Safety equipment for individuals</b>					
Motorcycle helmets <sup>[33] [28]</sup>		Decreased head injury. Unclear effect on neck and facial injury. (2+)			Impact dependent on speed and driving habits of helmet wearers
Bicycle helmets (pedal cycle) <sup>[27] [34]</sup>		Decreased (2+)	Decreased (2+)		May not prevent lower facial injuries.
Visibility aids for pedestrians <sup>[35]</sup>					Improves drivers ability to identify and respond to vulnerable road users
Daytime running lights <sup>[22]</sup>	Decreased (2-)				<i>Not commonly used in the UK</i>
Studded tyres <sup>[22]</sup>	Unclear (2-)				
Seatbelts <sup>[36] [37] [38]</sup>		Decreased (2++)			Potential for benefit depends on use of seatbelt
<b>Educational interventions</b>					
Post-license driver educational courses <sup>[39]</sup>	Mixed effects (2++)				

Distribution of educational material to problem drivers <sup>[32]</sup>	No change (2++)	No change (2++)	No change		
School based driver education <sup>[22]</sup>	Possible small increase (1+)	No change (1+)	No change (1+)		Leads to earlier licensing among teenagers
Road safety campaigns <sup>[22]</sup>				Improves road safety behaviour among pedestrians (2++)	
Child safety campaigns (road behaviour) <sup>[22][40]</sup>				Fewer children walk onto road from behind a parked car (2++)	Improves children road safety knowledge and behaviour
Promoting use of cycle helmets <sup>[22][41]</sup>				Decrease in hospital admissions for cycle injuries (2++) Increased helmet use	
Counselling on use of child safety seats among general population of parents <sup>[42]</sup>				Increased use of equipment especially provision of free/reduced cost equipment (2++)	
Counselling on use of car seat restraints among general population (children & adults) <sup>[42]</sup>				Unclear effect for adults and children (2++)	
Counselling on drink driving among general population <sup>[42]</sup>					Insufficient evidence
Education +/- incentives/distribution of free child booster seats <sup>[42, 43]</sup>				Increased use of equipment especially provision of free/reduced cost equipment (2++)	
Retraining older drivers <sup>[44]</sup>				Improved safe driving behaviour (2++)	
Promoting seat belt use <sup>[45-47]</sup>		Unclear (2++)	Unclear (2++)	Increased use of seat belts and in-car restraints for children	Community based campaigns with financial incentives may be most effective- especially where seat belt use is already low
Reducing drink driving (mass media campaigns) <sup>[48]</sup>	Decreased* (2++)				
<b>Remediation of drinking and driving offenders</b>					
Alcohol ignition interlock <sup>[49]</sup>					Reduces re-offending while lock fitted to car. (2++) <i>Not used in the UK.</i>
Probation & rehabilitation <sup>[22]</sup>	Decreased (1+)	Decreased (1+)			Probation and rehabilitation together may increase risk of injury (1+)
Treatment of convicted drivers <sup>[22]</sup>	Decreased *				

	Increased ** (1+)				
Licence ban/sanction <sup>[22]</sup>	Increased (light sanctions) (2-) Decreased (severe sanctions) (2-)				

\* alcohol related crashes

\*\* non-alcohol related crashes

NB: Blank cells indicate that there is no available research evidence reporting on this specific impact.

Where the cells for serious and less serious injury are merged this indicates that available data has not distinguished between serious and non-serious injury

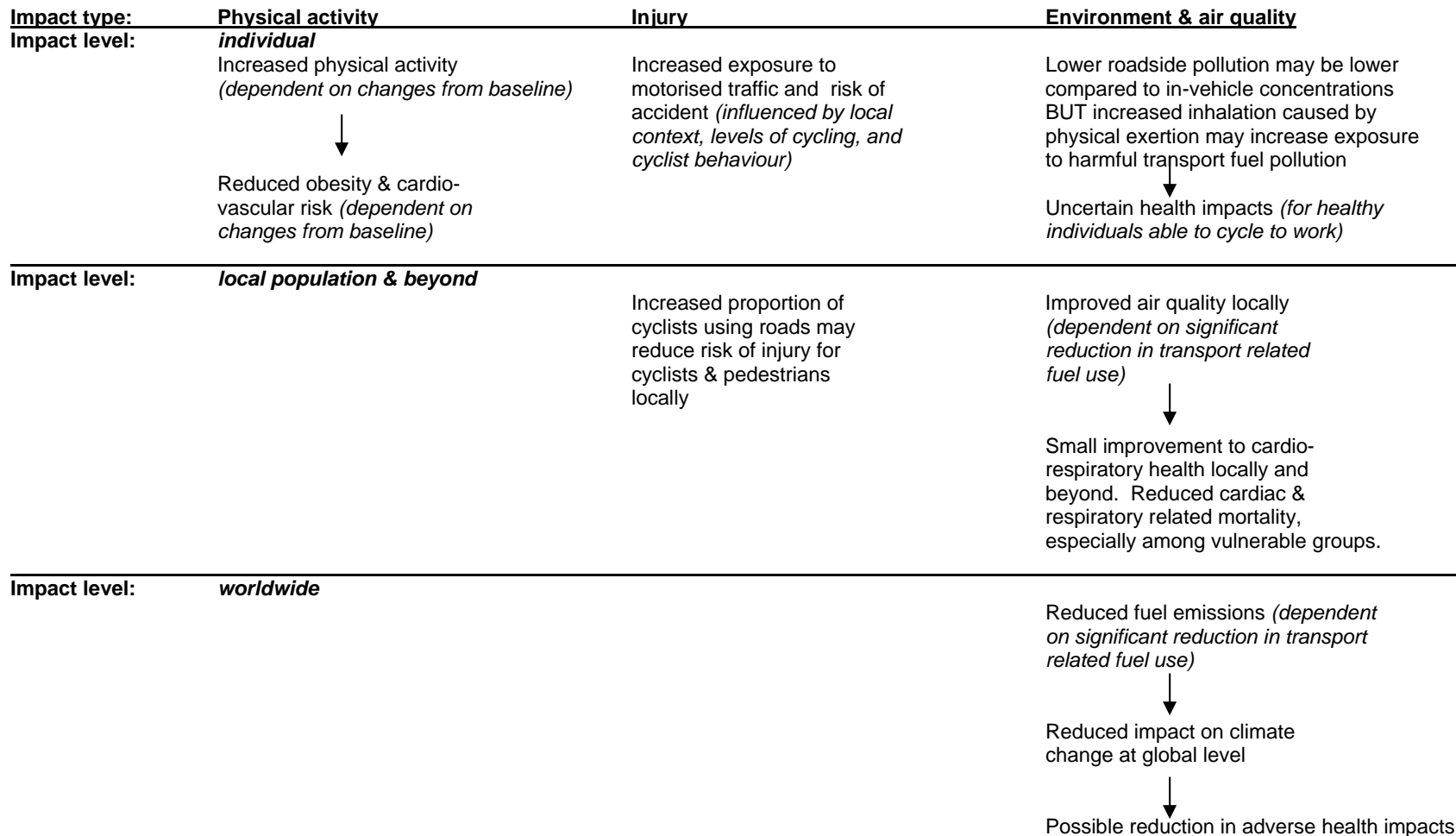
**Table 3: Summary of health and environmental impacts of initiatives promoting physically active forms of transport with indication of Strength of Evidence (SoE) <sup>[1]</sup> see Appendix 2**

	<b>Example of intervention</b>	<b>Walking &amp; Cycling</b>	<b>SoE</b>	<b>Physical fitness &amp; weight</b>	<b>SoE</b>	<b>General wellbeing</b>	<b>SoE</b>	<b>Road traffic crashes &amp; injury</b>	<b>SoE</b>
<b>Engineering measures</b> <sup>[50]</sup>	Road based measures to promote safe walking and cycling, e.g. cycle lanes, speed restrictions	Unclear effect	2+						
<b>Targeted behaviour change</b> <sup>[50]</sup>	Individualised marketing of alternative modes of transport to households showing an interest in using them	May shift up to 5% of car trips among motivated sub-groups Increase in walking as form of transport up to one year later	2+	Small improvement in fitness No change in average weight	2+ 2-	Possibility of small improvements	2+	No changes reported	2-
<b>Agents of change and publicity campaigns</b> <sup>[50]</sup>	Campaign using mass media, community activities and/or travel co-ordinator to promote alternative modes of transport	Unclear effect	2+						
<b>Financial incentives</b> <sup>[50]</sup>	Charging road users, e.g. road tolls, charging for car park space at work	Unclear effect. May depend on specifics of intervention	2+						
<b>Provision of alternative services</b> <sup>[50]</sup>	Neighbourhood-based car-sharing cooperative.	Unclear effect. Possibility of small increase in car use; will depend on specifics of intervention	2-						





**Figure I: Some possible pathways to health and related impacts following modal shift from driving to cycling to work**



Modal shift from driving to cycling to work (suitability of cycling to work will be affected by distance to work, facilities to change into work clothes in the workplace, weather, other business (personal or work) to be carried out on journey to/from work e.g. shopping, taking children to school etc

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### **Appendix III: Definition of key terms**

**Knowledge transfer/knowledge translation:** Knowledge transfer involves providing knowledge available in one organisation/sector to another separate organisation/sector. The differences between the organisations/sectors may often have implications for the way in which information or knowledge is accessed or used. Knowledge translation is the process by which knowledge is made more accessible and appropriate to the needs of other users, most often being translated from its original source, e.g. from an academic paper to an applied report for evidence users.

**Evidence synthesis:** Combining data or evidence on similar outcomes from more than one study to strengthen the ability to comment on the overall strength of evidence on a specific relationship or impact.

**Meta-analysis:** The statistical pooling or synthesis of quantitative data into a single quantitative estimate of effect size. To pool data statistically, the data need to be presented in comparable units e.g. odds ratios, standardised means.

**Narrative synthesis:** The process of pooling data and exploring heterogeneity descriptively rather than statistically.

**Social policy:** For the purposes of this thesis social policy is intended to refer to any government policy that may change the social or living conditions of a population but that is not part of health service provision (either funding or delivery). Key areas of social policy are welfare, housing, education, transport, and employment.

**Systematic review:** A method to synthesis previous research evidence and minimise bias in interpretation of the evidence. Systematic reviews include the comprehensive identification, appraisal, and synthesis of all relevant studies within pre-set parameters.