



A systematic review of economic analyses of the health impact of structural housing interventions: Protocol

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Background

The World Health Organization's global Commission on Social Determinants of Health in its final report published in 2008 noted that housing is an important social determinant of health (Commission on Social Determinants of Health 2008). The Commission further noted that addressing housing may improve individual and population health and health equity, both within and across countries (Commission on Social Determinants of Health 2008).

A recently up-dated systematic review of the effectiveness of interventions for improving the quality of housing concluded that several housing interventions can effectively improve health and associated socio-economic outcomes (Thomson, Thomas et al. 2009, Thomson, Thomas et al. 2013). Therefore, the effectiveness in increasing health of some interventions that address the quality of housing is thus fairly evidence-based (Commission on Social Determinants of Health 2008, Thomson, Thomas et al. 2009, Thomson, Thomas et al. 2013).

The cost-effectiveness of such interventions, however, remains unknown. The only prior systematic review of economic analyses of the health impact of structural housing interventions that we know of found insufficient evidence to conclude whether housing interventions were cost-effective for improving health (Fenwick, Macdonald et al. 2013). Similarly, the World Health Organization recently called for additional economic analyses on interventions that address the social determinants of health, including interventions that improve the quality of housing (World Health Organization 2013).

Why it is important to do this review

There is a lack of systematic review evidence on economic analyses of the health impact of structural housing interventions. The only previous systematic review of economic analyses of the health impact of structural housing interventions that we are aware of included four such studies (Fenwick, Macdonald et al. 2013). Only two of these studies were of community-dwelling, healthy populations. This review concluded that there was a near-absence of economic analyses of structural housing interventions. The review may have been limited in scope by: (i) including only economic analyses conducted alongside intervention studies and excluding studies that used decision analytic modelling; (ii) including only economic analyses published before 2008 and excluding studies published between 2008 and 2014; and (iii) not searching dedicated health economic databases that index economic analyses. Thus, the existing systematic review evidence suggests that it is currently unknown whether and which structural housing interventions are cost-saving, cost-effective or not cost-effective, and it may have some methodological limitations. An updated systematic review of structural housing interventions is therefore required.

International organizations, national governments, research institutions and communities have an intense interest in knowing the cost-effectiveness of structural housing interventions. For example, as noted above, the World Health Organization has recently called on researchers to produce additional economic evidence on interventions for addressing the social determinants of health, including structural housing interventions (World Health Organization 2013). These stakeholders will be interested in up-dated systematic review evidence as the basis for international, national and local decision-making and policy development.

Review objective

To synthesise the existing evidence from economic analyses of the health impact of structural housing interventions in community-dwelling, healthy populations.

Methods

Eligibility criteria

The study type, study population, intervention and outcome will be reported in the *Characteristics of studies* table in the systematic review.

Study types

This review will include all three types of health economic analyses:

- cost-utility analyses
- cost-effectiveness analyses
- cost-benefit analyses

It will exclude health economic studies of costs only. Any other study type will also be excluded.

The review will include comparisons: (i) of an eligible structural housing intervention with standard practice and (ii) of an eligible structural housing intervention with one or more other eligible structural housing interventions. Comparisons of a structural housing intervention with other interventions that are not eligible for inclusion in the review will be excluded (e.g., structural housing intervention compared with educational intervention), as will be any other comparators.

Study population

This review will include: community-dwelling, healthy populations (any age) in any country setting. Community-dwelling populations are defined as all people residing in the community in public and private dwellings other than institutions (e.g., hospitals, supported living, half-way houses and military dwellings). Homeless populations will be excluded, because housing interventions may have a different cost-effectiveness in these populations. Healthy populations are defined as all people without major pre-existing conditions (e.g., moderate or major asthma, moderate or major visual impairment, and major infectious diseases such as HIV). Populations with minor pre-existing conditions such as minor asthma or minor cognitive impairment will be included. If a study population includes people with major or minor pre-existing conditions as part of a general population sample, then it will also be included in the review.

Intervention

This review will include structural housing interventions, defined as structural, physical changes to housing infrastructure and/or content. It will include interventions that provide health-promoting equipment (e.g., added handrails on stairs or in the bathroom, added smoke-alarms, added insecticide-treated bed nets) and which removed health-hazards (e.g., removed tripping hazards, removed open-fire cooking stoves). It will include interventions that remove poisonous substances contained in physical aspects of the home (e.g., removed windows or window sills painted with paint containing lead). Interventions removing naturally occurring poisonous substances (e.g., radon) will be excluded.

The review will include only interventions for improving the quality of housing indoors. It will exclude interventions for changing the physical environment outdoors (e.g., creation of green spaces, creation of play grounds for children); the social environment (e.g., reduction of alcohol and fast food outlets; reduction of neighbourhood crime) or economic environment of the house (e.g., improvement

of housing affordability). It will also exclude rehousing interventions, because such interventions may primarily act by changing social (rather than indoors physical) environment.

Only structural housing interventions that exclusively or predominantly improve housing quality will be included and structural housing interventions conducted alongside or in combination with other, major non-housing interventions will be excluded. For example, a multi-mode intervention that provides home safety assessment and modification in combination with a major education or exercise intervention will be excluded. If an included structural housing intervention is provided alongside or in combination with another, but minor, intervention, then we will report the co-intervention in the review in the *Study characteristics and methods* table.

The review will include all types of static, physical, permanent houses. It will exclude institutionalized housing (e.g., hospitals, supported living, half-way houses and military dwellings). Non-static, (potentially) non-permanent houses (e.g., caravans, house boats) will be excluded, as these houses are comparable to static, permanent houses.

Outcomes

The review will include two outcomes (i.e., cost-effectiveness measures), which we will report in the *Study findings* table, together with an outline of the intervention, comparator(s), and study objective.

The first outcome will be the study author's or authors' conclusion reached regarding the cost-effectiveness of the intervention in terms of health impact. For example, for cost-effectiveness analyses, we will extract the author's or authors' assessments, which will likely be standardized assessments such as: "not cost-effective", "likely cost-effective", "highly cost-effective" or "cost-saving". If we will not find such an assessment, we will assess cost-effectiveness by applying established standard cost-effectiveness thresholds from the World Health Organization's *WHO-CHOICE Guidelines* (World Health Organization 2014). We will assign: "cost-saving" if the intervention was less costly than the value of the health gain it achieved; "highly cost-effective" for costs per disability-adjusted life-year (DALY) averted or quality-adjusted life-year (QALY) gained of <0 and ≤ 1 gross domestic product (GDP); "likely cost-effective" costs per DALY averted or QALY gained of >1 and <3 GDPs; "not cost-effective" for costs per DALY averted or QALY gained of >3 GDPs. If a study does not calculate cost per DALY averted or QALY gained, then we will try to source standard thresholds for the specific country setting of the study, if feasible.

The second outcome will be the cost-effectiveness measure. This is likely to be a measure of the cost per health gain, such as cost per DALY averted. Health gain measures are likely to be one or more of: DALY averted, QALY gained, life-years saved, lives saved (or deaths averted) and other (potentially intermediary) outcomes (e.g., case of injury averted). For the second outcome, if a study reports cost-effectiveness measures for two or more health gain measures (e.g., cost per DALY averted *and* cost per injury averted), then we will prioritise in the review the cost-effectiveness measures for: DALY averted over QALY gained over life-years saved over lives saved (or deaths averted) over other outcomes. We will report the cost-effectiveness measure of a study in the currency or currencies that the study has reported it in, and will not attempt to convert the measure in any way (e.g., to a common currency or base year). We will report information on costs (i.e., base year, source of cost estimation) in the *Study characteristics and methods* table.

Search stage

Academic electronic databases

We will use the search strategy shown in Appendix 1 to search the MEDLINE database for relevant records. We will modify the search syntax of this search strategy to suit the other databases or search machines that we will search.

We will search at a minimum the following electronic academic databases:

- Cochrane Database of Systematic Reviews (*The Cochrane Library* 2014, Current Issue)
- EMBASE
- Health Economic Evaluation Database
- MEDLINE
- NHS Economic Evaluation Database
- PubMed
- Tufts Cost-Effectiveness Analysis Registry

Each search will be conducted by one review author (out of: FP, NW). We will only include recent studies, published between 1st January 2000 and the search date. We will include records written in any language. If the record is written in a language other than those spoken by the review authors (English, French, German), then a translation of the record will be sought.

Grey literature databases

Health economic analyses published in the grey literature are indexed in the Health Economic Evaluation Database, NHS Economic Evaluation Database and Tufts Cost-Effectiveness Analysis Registry. Since we will comprehensively search these specialist databases, we will not search additional grey literature databases.

Targeted Internet searches

We will search the google search machine and screen the first 30 hits.

Hand searching reference lists of previous reviews and included records

Two review authors will independently hand search for any additional eligible studies or records the reference lists of any relevant prior reviews that we already know of (i.e., (Fenwick, Macdonald et al. 2013)) or will learn of during the conduct of the review. Similarly, we will also hand search the reference lists of all included records for additional studies or records.

Screening stage

Title and abstract screening

The search will produce an Endnote library with all records identified from all databases or search machines, respectively. We will first remove all duplicates. One author (FP;) will then screen the title of each record for potentially relevant records. One author (FP) will then screen the abstracts of potentially relevant records. Any records with potentially relevant titles that do not have an abstract will proceed to full-text screening.

Full-text screening

Records still considered potentially relevant after abstract screening will proceed to full-text screening. Two review authors (FP, NW) will independently screen all of these full text articles in depth for the eligibility criteria of the review described above. Any disagreements between the review

authors about the inclusion of a study or record will be discussed until resolution is reached. Study records that fulfil the inclusion criteria will be included in the review.

We will produce and include a flow-chart of the selection of studies in the review, adhering with the standard *PRISMA Guidelines* (Moher, Liberati et al. 2009). We will document reasons for the exclusion of records that proceeded to in-depth, full-text screening in the flow-chart.

Data extraction stage

One review author (out of: FP, NW) will extract data from the studies included in the review. The second review author will double-check the extracted data.

Study characteristics and methods

We will extract data on the characteristics of the included studies. More specifically, we will extract at a minimum: country setting, base year (of costing), the study population and the outcome. We will also extract data on the methods of the included studies, including: type of economic analysis (differentiating cost-utility, perspective (health sector, society), cost-effectiveness and cost-benefit analysis), base year of cost data, source of effectiveness estimates, source of cost estimates, effectiveness outcome measure, discounting rates, and sensitivity analyses. If a study will value non-health benefits of structural housing interventions such as saving from reduced energy consumption, then we will document the domains of the covered non-health benefits (e.g., energy or climate change).

The World Health Organization guidelines for economic analyses of the health impact of housing (and other social determinants of health-focused) interventions suggest that such studies should explicitly consider health equity issues (World Health Organization 2013). Therefore, we will also extract whether and how health equity was considered in each included study.

We will report the characteristics and methods of included studies in the *Study characteristics and methods* table in the review.

Study findings

We will extract data on the study findings. More specifically, we will extract at a minimum: the comparison (e.g., Intervention A compared with Comparator A or Intervention A compared with Intervention B), study objective and study findings (i.e., both cost-effectiveness outcome measures). We will report the study findings in the *Study findings* table in the review.

Quality assessment

Assessment of risk of bias

Risk of bias assessment is central in systematic reviews of the effectiveness of interventions (Higgins and Green 2011). However, for systematic reviews of economic analyses, either the methodology for assessing risk of bias is currently underdeveloped or it is not meaningful to conduct such assessments. We are not aware of best practice guidelines or standard tools for such assessments. Such assessments have not been conducted in the systematic reviews of economic analyses that we are aware of. Therefore, this review will not assess risk of bias in the included studies.

Assessment of study quality

The best practice in systematic reviews of economic analyses appears to be to exclusively assess the quality of included studies. We will follow the approach taken by Zelle and Balthussen in their systematic review of economic analyses (Zelle and Balthussen 2013). Two review authors (FP, NW) will independently apply Drummond and Jefferson's *Checklist for quality of economic evaluations* (Drummond and Jefferson 1996) (as modified by Zelle and Balthussen (Zelle and Balthussen 2013)) presented in Appendix 2 to assess the quality of each included study, both for each of five assessment categories () and overall. This checklist includes 29 items over five assessment categories, namely (i) study design; (ii) effectiveness estimation; (iii) cost estimation; (iv) analysis; and (v) interpretation of results. We will independently assess, for each study, each checklist item along a three-point grading scale: fully considered - 2 points, partially considered - 1 point or not considered - 0 points. If a checklist item is not applicable, then we will exclude the item from the assessment. Any disagreements between the study authors in their assessment will be discussed until resolution is reached.

To provide a mean quality score, we will sum scores and compare the summary score to the maximum attainable score. Such mean quality scores will be produced, for each included study, for each of the five assessment categories and across all five categories. We will report these scores in the *Quality assessment* table in the review.

We will also assess all studies for potential disclosed and undisclosed financial conflicts of interest and will note these as part of our quality assessment. If we identify any conflict of interest, we will report it in the *Study characteristics and methods* table in the review.

Assessment of quality of total body of evidence

For each included intervention or broader intervention type, we will assess the overall quality of the total body of evidence. This assessment will include consideration of the quality of the individual studies included in the body of evidence, as well as of the consistency of evidence.

We are not aware of any best practice guidelines for assessing publication bias in systematic review of economic analyses. However, we will assess whether the body of evidence included a plausible range of cost-effectiveness estimates across the included studies.

Assessment of heterogeneity

Best practice guidelines for systematic reviews of economic analyses discourage meta-analysis of cost-effectiveness measures, because such measures are unlikely to be meaningful (Anderson 2010). Therefore, we will not assess heterogeneity in the studies included in the review.

Data synthesis

We will follow the best practice guidelines (Anderson 2010), which discourage meta-analysis of cost-effectiveness measures, and will not conduct meta-analysis in this review. We will synthesise the evidence from the included studies qualitatively. To avoid introducing bias, we will not place emphasis on any one study in the systematic review.

References

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- Zelle, S. G. and R. M. Baltussen (2013). "Economic analyses of breast cancer control in low- and middle-income countries: a systematic review." Syst Rev **2**: 20.

Appendix 1: MEDLINE search strategy

1. Cost Benefit Analysis/
2. (cost* adj5 effect*).mp.
3. (cost* adj5 utilit*).mp.
4. (cost* adj5 benefi*).mp.
5. sensitivity analy*.mp.
6. scenario analy*.mp.
7. (economic adj5 analy*).mp.
8. (economic adj5 evaluat*).mp.
9. or/1-8
10. exp Housing/
11. (home or homes or house or houses).ti. or housing.tw.
12. *Group Homes/ or *Homes for the Aged/ or *Nursing Homes/
13. 11 not 12
14. 10 or 13
15. 9 and 14
16. limit 15 to humans
17. limit 15 to animals
18. 15 not 17
19. 16 or 18

Appendix 2: Checklist for quality of economic evaluations

Item	Fully	Partial	Not at all	Not appropriate
Original checklist	2 points	1 point	0 points	NA
Study design				
1. The research question is stated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. The economic importance of the research question is stated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. The viewpoint(s) of the analysis are clearly stated and justified (relating to a particular decision-making context)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. The rationale(s) for choosing the alternative programs or interventions which are compared is stated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. The alternatives being compared are clearly described	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. All relevant alternatives are included	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. The choice of economic evaluation is justified in relation to the questions addressed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Effectiveness estimation				
8. The primary outcome measure for the economic evaluation is clearly stated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. The source(s) of effectiveness estimates used is clearly stated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Details of the design and results of the effectiveness study are given (if based on a single study)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Details of the methods of synthesis or meta-analysis of estimates are given (if based on multiple studies)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Data and methods used to value health states and other benefits are stated and justified.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost estimation				

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Item	Fully	Partial	Not at all	Not appropriate
13. Indirect non-healthcare costs are included or discussed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Quantities of resources are reported separately from their unit costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Methods for the estimation of quantities and unit costs are described and justified.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Details of currency of price adjustments for inflation or currency conversion are given	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Analysis				
17. Time horizon of costs and benefits are stated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Details of any model used are given	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. The choice of model used and the key parameters on which it is based are justified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. The discount rate(s) is stated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. The choice of rate(s) is justified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Details of statistical tests and confidence intervals are given for stochastic data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Sensitivity analysis is performed: 2) Probabilistic (bootstrap/Monte Carlo) 1) Deterministic (one way /multiple way)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. The choice of variables in sensitivity analysis and the range over which these variables are varied is justified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. Incremental analysis is performed and reported	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interpretation of results				
26. Major outcomes are presented in a disaggregated as well as aggregated form	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. The answer to the study question is given	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Relevant alternatives are compared	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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Item	Fully	Partial	Not at all	Not appropriate
29. Conclusions follow from the data reported	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Conclusions are accompanied by the appropriate caveats such as generalizability, equity, feasibility, and implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Source: Drummond & Jefferson (Drummond and Jefferson 1996) as adapted by Zelle & Baltussen (Zelle and Baltussen 2013).