Artículo de revisión / Review

Pan American Journal of Public Health

Energy interventions that facilitate sustainable development and impact health: an overview of systematic reviews

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Suggested citation Haby MM, Chapman E, Clark R, Galvão LAC. Energy interventions that facilitate sustainable development and impact health: an overview of systematic reviews. Rev Panam Salud Publica. 2016; 39(4):200–07.

ABSTRACT

Objective. *To inform policy by providing an overview of systematic reviews on interventions that facilitate sustainable energy use and have a positive impact on health.*

Methods. *Systematic review methods were used to synthesize evidence from multiple systematic reviews and economic evaluations through a comprehensive search of 13 databases and nine websites based on a pre-defined protocol, including clear inclusion criteria. Both grey and peer-reviewed literature published in English, Spanish, and Portuguese during the 17 years from January 1997 – January 2014 was included. To classify as "sustainable," interventions needed to aim to positively impact at least two dimensions of the integrated framework for sustainable development and include measures of health impact.*

Results. *Five systematic reviews and one economic evaluation met the inclusion criteria. The most promising interventions that impacted health were electricity for lighting and other uses (developing countries); improved stoves for cooking and health and/or cleaner fuels for cooking (developing countries); and household energy efficiency measures (developed countries). These interventions also had potential environmental and economic impacts. Their cost-effectiveness is not known, nor is their impact on health inequalities.*

Conclusions. *What is needed now is careful implementation of interventions where the impacts are likely to be positive but their implementation needs to be rigorously evaluated, including possible adverse impacts. Care needs to be taken not to exacerbate health inequalities and to consider context, human behavior and cultural factors so that the potential health benefits are realized in real-life implementation. Possible impact on health inequalities needs to be considered and measured in future primary studies and systematic reviews.*

Keywords Sustainable development; renewable energy; review, systematic; Sustainable Development Goals; United Nations.

The Brundtland Report, "Our Common Future," published in 1987, was the first to identify the need for integrating economic development, natural resources management and protection, and social equity and inclusion (1). The report defined sustainable development (SD) as, "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (1). Though this definition is ambiguous, as have been all subsequent alternative definitions, it is widely accepted and used (2).

More recently, an integrated SD framework was proposed by the United Nations (UN) System Task Team on the Post-2015 UN Development Agenda (3). This framework informed Agenda 2030 and the 17 Sustainable Development Goals (SDGs) set by the UN in September 2015 (4). The framework includes the core values of human rights, equality, and sustainability, and four key dimensions: inclusive social development; inclusive economic development;

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environmental sustainability; and peace and security. Health is both an outcome of, and precondition for, all four dimensions of sustainable development.

Sustainable energy use can be seen as representing the "environmental sustainability" dimension of the integrated framework for sustainable development. Providing sustainable energy for all is also an "enabler" in the framework. "Enablers" are indicative of each of the four dimensions, yet supportive to all (3). Improving access to low-emission, renewable, and modern energy technologies, in the home and the community, can contribute to the long term goals of sustainability, while also benefitting health (5). Notably, the inefficient combustion of fossil fuels and biomass (wood, crop residues, animal dung, and charcoal) for energy purposes is the major cause of climate change. Air pollution, often due to inefficient modes of energy production, distribution, and consumption, is a large and growing cause of environmental health risks (5). Some 3.5 million deaths per year and 4.3% of global disability adjusted life years (DALYs) in 2010 may be due to household air pollution from rudimentary biomass and coal stoves (6). Another 3.3 million deaths per year may be due to outdoor air pollution (6), with highest exposure levels in developing cities. Thus, it is clear that sustainable energy use has both environmental and health impacts.

This overview of the systematic review and economic evaluation literature (along with three related overviews) was developed by the Pan American Health Organization (PAHO) to inform the development of the new SDGs, and particularly, to provide Member States with evidence for the possible impact that policies and programs in other sectors (e.g., agriculture, environment, international development, economic) might have on health.

The objective of this overview was to use the best available evidence to inform policy on interventions that facilitate sustainable energy use and have a positive impact on health. Sub-questions considered were: What is their impact on health inequalities? What evidence is there for their cost-effectiveness? Which dimensions of the integrated framework are affected by the intervention and how? Health measures eligible for inclusion in the overview were: measures of disease incidence, prevalence, and/or burden; mortality; morbidity; symptoms and signs of disease; indoor and outdoor air pollution—as these have a strong link with health (7); health service use; health-related costs; and health-inequalities.

MATERIALS AND METHODS

This overview used systematic review methodology to locate and evaluate published systematic reviews of interventions. It adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (8). A systematic review protocol was written and registered prior to undertaking the searches (9).

Inclusion criteria for studies

Studies were selected based on the following inclusion criteria:

Types of studies. Systematic reviews of studies of effectiveness, including reviews of randomized controlled trials (individuals or clusters), quasi-randomized controlled trials, controlled before-and-after studies, interrupted time series, and analytic observational studies (cohort, case-control, cross-sectional studies). Economic evaluations (cost-effectiveness, cost-utility, and/or cost-benefit) and systematic reviews of economic evaluations were included.

Types of participants. Studies of individuals, groups, communities, countries or regions from both developed and developing countries were included.

Types of interventions. Interventions include programs, policies, strategies, courses of action and legislation to facilitate sustainable energy use. To classify as "sustainable," interventions need to aim (explicitly or implicitly) to positively impact on at least two dimensions of the integrated framework, e.g., inclusive economic development and inclusive social development (which includes health) or environmental sustainability and inclusive economic development (but where impact on health is also measured).

Types of comparisons. No intervention, another intervention, or current practice were included.

Types of outcome measures. Primary outcomes included: health measures at the group, community, country, region, and/or global level, regarding disease incidence, prevalence, or burden; mortality; morbidity; symptoms and signs of disease; indoor and outdoor air pollution; health service use; health-related costs; and health-inequalities, by gender, age, socioeconomic status, area of residence, etc.

Language and study period. Publications in English, Spanish, and Portuguese published during the 17 years from January 1997 – January 2014 were included. Both grey and peer-reviewed literature was sought and included.

Sources of systematic reviews and economic evaluations

A comprehensive search of 13 databases and nine websites was conducted. The databases searched for systematic reviews were: PubMed, EMBASE,® GreenFILE, ASSIA, ScienceDirect, LILACS, SciELO, CAB Abstracts, The Cochrane Library (including Cochrane Reviews, the Database of Abstracts of Reviews of Effectiveness, and the Health Technology Assessment database), The Campbell Library, and Health-evidence.™

The websites searched were either sources that specialize in systematic reviews or relevant topics: Effective Public Health Practice Project, the Evidence for Policy and Practice Information and Coordinating Centre, the Community Guide, 3ie—International Initiative for Impact Evaluation, the World Health Organization (including WHOLIS and IRIS), National Institute of Environmental Health Sciences, Centre for Sustainable Energy, Sustainable Energy of the United Nations Development Program, and Google. The bibliographies of all included systematic reviews were also searched.

For economic evaluations, three specialized databases were searched: Paediatric Economic Database Evaluation, EconLit, and NHS Economic Evaluation Database.

Search strategy

Searches were conducted from 9–11 January 2014. Databases were searched using the keywords listed in Table 1, in the title and/or abstract, except where otherwise stated. Keyword areas were joined using "AND." Searches were limited to humans, and publication dates between 1 January 1997 and the day of the search. An example search strategy for Greenfile using the EBSCOHost interface is shown in Table 1. Results were downloaded into EndNote, version X7 (Thomson Reuters, New York, NY, United States). Duplicates were removed.

Screening, data collection, and analysis

Searches were conducted and screened according to the selection criteria, by one review author (MH). The full text of any potentially relevant papers was retrieved for closer examination. The inclusion criteria were applied against these papers independently by two reviewers (MH and RC). Disagreements regarding eligibility of studies were resolved by discussion and consensus. All studies that initially appeared to meet the inclusion criteria, but on inspection of the full text paper did not, are detailed in Supplemental File 1, "Characteristics of excluded systematic reviews," along with the reasons for exclusion. One reviewer extracted all relevant data from included papers (MH) using a standard form. A second reviewer verified the extracted data (RC). Differences were resolved by discussion and consensus. Data extracted from systematic reviews included: objectives, inclusion criteria for the systematic review, date of search, number of studies included, country or region of included studies, details of interventions studied, the dimensions of the integrated framework that the individual studies attempted to impact (implicitly or explicitly), summary of findings in relation to health, impact on any of the key dimensions of sustainable development, impact on health inequalities, impact on secondary outcomes, impact on human rights, limitations of the systematic review, research gaps, and critical success factors for the interventions.

Findings from the included publications and their methodological quality were synthesized using tables and a narrative summary. Meta-analysis was not possible because included studies were heterogeneous in terms of the type of intervention studied and outcomes measured.

Assessment of methodological quality

The methodological quality of included systematic reviews was assessed independently by two reviewers using AMSTAR: A MeaSurement Tool to Assess Reviews (10). For this overview, reviews that achieved AMSTAR scores of 8–11 were considered high quality; scores of 4–7 medium quality; and scores of 0–3 low quality. These cut-offs are commonly used in Cochrane Collaboration overviews. The review quality assessment was used to interpret the results synthesized in this overview and to form this study's conclusions.

RESULTS

Five systematic reviews (11–15) and one economic evaluation (16) met the inclusion criteria for this overview. The selection process for systematic reviews and the numbers at each stage are shown in Figure 1. Three papers were excluded at full text stage because they did not measure (or aim to measure) health outcomes or air pollution (Table A1a, Supplemental File 1). An additional two systematic reviews were located through the search of the bibliographies of included systematic reviews (17, 18); four were found by the funders; and one through email contact with the author of an included review. When the full text of these seven articles was assessed, they were all excluded for reasons given in Table A1a (Supplemental File 1).

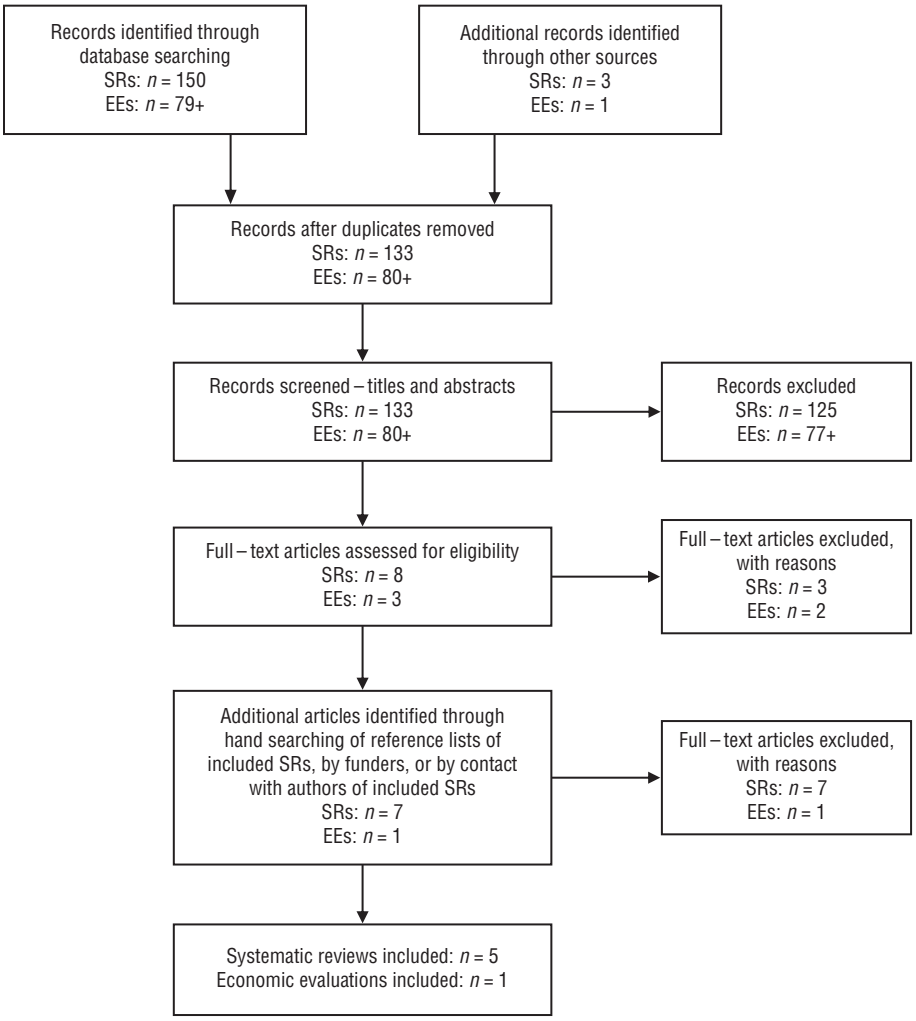
The selection process for economic evaluations and the numbers at each stage are also shown in Figure 1. After examination of the full text, two papers were excluded for the reasons given in Table A1b (Supplemental File 1). An additional economic evaluation found by the funders

TABLE 1. Keyword areas for searching and sample search string for an overview of systematic reviews on energy interventions that facilitate sustainable development and impact health, 1997 – 2014

Keyword areas	Details
Sustainable energy	"renewable energy" [MESH Term] OR "conservation of energy resources" [MESH Term] OR "Climate Change/prevention and control"[MESH Term] OR "Global Warming/prevention and control" [MESH Term] OR "Greenhouse Effect/prevention and control" [MESH Term] OR "renewable energy" OR "wind energy" OR "solar energy" OR "natural gas" OR "biomass" OR biodiesel OR bioethanol OR "bio ethanol" OR biofuel* OR bioenergy OR "efficient light*" OR "hybrid electric" OR "carbon emissions" OR "greenhouse gas*" OR electricity OR "efficient heat*" OR diesel OR "liquefied petroleum gas" OR biogas OR kerosene OR LPG* OR "household energy" OR "improved stove*" OR cookstoves
Outcomes	disease OR injury OR burden OR incidence OR prevalence OR mortality OR morbidity OR health* OR asthma OR "air quality" OR "air pollution" OR particles OR "particulate matter" OR PM OR "carbon monoxide"
Systematic reviews	"systematic review" OR "meta-analysis"
Sample search string for GreenFile (EBSCOHost)	
("biomass energy" or "wind power" or "alternative energy" or "energy conservation" OR "renewable energy" or "wind energy" or "solar energy" or "natural gas" or "biomass" or biodiesel or bioethanol or "bio ethanol" or biofuel* or bioenergy or "efficient light*" or "hybrid electric" or "carbon emissions" or "greenhouse gas*" or electricity or "efficient heat*" or diesel or "liquefied petroleum gas" or biogas OR kerosene OR LPG* OR "household energy" OR "improved stove*" OR cookstoves) – title or abstract	
AND TI ("systematic review" or "meta-analysis") OR AB ("systematic review" or "meta-analysis")	
AND TI (disease OR injury OR burden OR incidence OR prevalence OR mortality OR morbidity OR health* OR asthma OR "air quality" OR "air pollution" OR particles OR "particulate matter" OR PM OR "carbon monoxide") OR AB (disease OR injury OR burden OR incidence OR prevalence OR mortality OR morbidity OR health* OR asthma OR "air quality" OR "air pollution" OR particles OR "particulate matter" OR PM OR "carbon monoxide")	
Limiters - Publication Date: 19970101-20141231	

Source: Developed by the authors.

FIGURE 1. Flow diagram of the number of records identified, included, and excluded in the search for systematic reviews (SRs) and economic evaluations (EEs) on energy interventions that facilitate sustainable development and impact health, 1997 – 2014



Note: For one of the economic evaluation databases (PEDE), keywords needed to be searched one at a time, thus, it is not possible to know the exact number of references found nor the number of duplicates.
Source: Prepared by the authors from the study data. Flow diagram adapted from Moher, *et al*. (8).

of this study was excluded because it was a narrative review of cost-effectiveness analyses, with the outcome being choice of analysis method rather than impact on health or cost (19).

Characteristics of included studies and quality assessment

The types of interventions studied and their potential connection with the four key dimensions of the integrated framework for sustainable development are shown in Table 2. Further details of the characteristics of the included systematic reviews and economic evaluations can be found in Supplemental Files 2 and 3, respectively. AMSTAR scores ranged from 3–10. Two systematic reviews were of high quality, scoring from 8–11 (14, 15); two were of medium quality, scoring from 4–7 (11, 13); and one was of low quality, with a score of 3 (12). AMSTAR scores are shown in Table A2a (Supplemental File 2).

Effectiveness

The most promising interventions found by this overview in terms of impact on health were introduction of electricity for lighting and other uses (developing countries); improved stoves for cooking and health and/or cleaner fuels for cooking (developing countries); and household energy efficiency measures (developed countries) (Table 3). No evidence of impact on health was found for energy infrastructure as part of a slum upgrading strategy or energy efficient vehicles (Table 3). The impact of these interventions on health

TABLE 2. Interventions studied and potential connection with the key dimensions of the integrated framework[a] for an overview of systematic reviews on energy interventions that facilitate sustainable development and impact health, 1997 – 2014

Intervention	Number of systematic reviews (SR) and economic evaluations (EE)	Inclusive economic development	Environmental sustainability	Inclusive social development	Peace and security
Introduction of electricity for lighting and other uses	1 SR (11)	✓	✓	✓	✓
Improved stoves for cooking and heating and/or cleaner fuels for cooking	2 SRs (11, 13)	✓	✓	✓	
Energy infrastructure as part of a slum upgrading strategy	1 SR[b] (15)	✓	✓	✓	✓
Household energy efficiency measures, including insulation; central heating; glazing measures; or a combination	2 SRs (12, 14)	✓	✓	✓	
Diesel-electric hybrid technology used to propel urban pickup and delivery vehicles	1 EE (16)	✓	✓	✓	

Source: Prepared by the authors from the study data.
[a] Potential impacts on the key dimensions can be negative or positive.
[b] This SR did not identify any energy infrastructure interventions as part of slum upgrading.

TABLE 3. Details of interventions studied, quality, and results in an overview of systematic reviews on energy interventions that facilitate sustainable development and impact health, 1997 – 2014

Intervention	Level of country development	Quality of systematic reviews (SR)	Impact on health	Cost-effectiveness
Introduction of electricity for lighting and other uses	Developing	1 medium	Minor impact of solar electricity on health, since households initially continue to use traditional (kerosene) lamps next to electricity. Electrification can reduce the 'cold chain' for vaccines, but the impact on immunization rates is not strong. Health facilities with electricity were open longer (≈1 hour per day) (11).	—
Improved stoves for cooking and heating and/or cleaner fuels for cooking	Developing	2 medium	Improved solid fuel stoves (e.g., wood, coal) have a positive impact on some aspects of health – particularly respiratory disease symptoms and eye infections. Health effects are due to less indoor air pollution (11). Solid fuel stoves with chimneys and one clean fuel with sufficient available studies (ethanol) delivered the largest reductions in particulate matter and carbon monoxide (13).	—
Energy infrastructure as part of a slum upgrading strategy	Developing	1 high	No evidence found (15).	—
Household energy efficiency measures, including insulation; central heating; glazing measures; or a combination of measures	Developed	1 high, 1 low	Improvements in general health, respiratory health, and mental health are possible –among adults and children (high quality SR; 14). Studies that targeted those with inadequate warmth and existing chronic respiratory disease (high quality SR; 14) or low incomes (low quality SR; 12) were most likely to report health improvement.	—
Diesel-electric hybrid technology used to propel urban pickup and delivery vehicles	Developed	—	—	Generally not cost-effective from a societal perspective. Better data needed (16).

Source: Prepared by the authors from the study data.

inequalities is not known as no studies directly assessed this.

Cost-effectiveness

The cost-benefit analysis showed that diesel-electric hybrid technology ("green" vehicles) investment does not appear to be justified from a societal perspective at a 7% discount rate, but the probability for positive net returns increases substantially at a 3% discount rate (16). The results vary depending on the perspective taken, i.e., societal; transportation firms; parties benefiting from reduced externality damages; or state and local governments. However, that study (16) had several limitations, including possible conflicts of interest and limited published data to support the analyses (Supplemental File 3).

Dimensions of the integrated framework impacted

Apart from health impacts, two systematic reviews looked at other social impacts of the interventions (11, 14). One medium-quality systematic review looked at other social impacts of introducing electricity (11). The authors stated that programs introducing electricity claimed that light contributed to feelings of safety and enabled children to study at night and adults to be more productive. In addition, electricity allowed use of modern communication and entertainment devices. The authors also noted that evaluations indicated that all these assumptions can be confirmed, but not everywhere and not always (11). A high-quality systematic review reported on social impacts of improved energy efficiency measures (14). Three experimental studies included in the systematic review, which assessed illness-related absences from school and work, reported statistically significant reductions following the warmth improvements. There was a suggestion from one quantitative, though not experimental study that improved temperature (warmer homes) was linked to increased use of the home for hospitality purposes.

Two systematic reviews reported economic outcomes (11, 14). One medium-quality systematic review of the introduction of energy for lighting and improved cooking stoves and/or cleaner fuels for cooking concluded that energy use and income are associated in a two-way direction of causality (11). The higher-middle income "early adopters" of energy innovations incur higher expenditure in the short term; but the investment pays off—over time the income of early adopters increased relatively more than that of late or non-adopting households (11). However, the claim that clean energy is central to poverty reduction in developing countries cannot be corroborated—the poor are either excluded from the direct benefits or are late adopters. Eight evaluations indicate that direct income generation from solar energy installations is restricted to micro home enterprises making use of extended working hours after nightfall. However, the additional earnings are modest, due to market limitations in the rural environment, such as distance and lack of purchasing power (11).

In regards to household energy efficiency measures, one high-quality systematic review reported financial impacts (14). In a controlled before-and-after study, reduced levels of financial difficulty were found compared to the control group (Odds Ratio 0.77, 95% Confidence Interval [95%] = 0.6 – 0.99). One randomized controlled trial also included an economic analysis that examined health services use, days off work or school, and fuel costs. The authors concluded that the cost of the benefits of housing improvement outweighed the intervention costs.

Two systematic reviews reported on environmental impacts (11, 13). The first review (11) found that the environmental impact of introducing electricity and improved cook stoves and/or cleaner

cook fuels was, at best, modest (11). A study conducted in South Africa, measured the impact of rural electrification by using a satellite monitoring system and found that both solar and grid electricity had no verifiable effect on slowing down deforestation (11). In regards to improved stoves and cleaner fuels (such as bio-gas), these installations do reduce firewood consumption in laboratory settings. However, at the household level, proper use of the appliance is crucial to its impact (11). Depending on measurement systems, savings in real kitchen use are 20% – 40%, for both simple portable stoves and larger, fixed ones. Whether real benefits in carbon dioxide emissions can be registered, depends on the household's cooking behavior. If more cooking time is used, the fuel/ wood consumption may remain the same. Also, improved stoves might be so fuel efficient that they can compete with "modern" ethanol or LPG gas stoves, and hence households go back to using firewood (11).

The second systematic review that reported on environmental impacts (13) found that reductions in environmental pollutants were reported for almost all included individual studies, and when grouped, there were large reductions of 38% – 82% in kitchen particulate matter (PM) and carbon monoxide levels—largest for solid fuel chimney stoves and ethanol, least for solid fuel stoves without chimneys (13). For carbon monoxide, many of the interventions, especially chimney stoves and clean fuels, achieve levels below the 24 hour WHO air quality guideline level of 5.7 ppm. However, for small particulate matter (most studies reported PM2.5, a few PM4), none of the interventions, whether solid fuel stoves or clean fuels, reached the actual guideline value of 10 $\mu g/m^3$ (13).

Two of the five interventions were assessed as having a potential impact on peace and security: introduction of electricity for lighting, and energy infrastructure as part of slum upgrading. However, only one systematic review included measures of impact (11). In this systematic review, a cross-sectional study assessed how electric lighting affects feelings of security and concluded that having bright lights inside and around the house contributes to reduced fear.

DISCUSSION

The most promising interventions in this overview, in terms of impact on health, were: introduction of electricity for lighting and other uses (developing countries); improved stoves for cooking and health and/or cleaner fuels for cooking (developing countries); and household energy efficiency measures (developed countries). These interventions also have potential environmental and economic impacts; however, their cost-effectiveness is not known, nor is their impact on health inequalities.

Implications for policy

Introduction of electricity in developing countries should be done in a way that does not exacerbate health inequalities. There is some evidence that electricity favors the non-poor in the short term, and only when coverage expands over time does it becomes more equitable (11). Thus, financial measures may be necessary to prevent widening health inequalities.

Households in rural areas cope with uncertainties (e.g., temporary fuel scarcity, price increases, lack of supplies, deterioration of family income) by adding sources of energy or energy related appliances to the ones already in use, not by replacing one source with another (11). This is known as energy stacking. The adoption of a new form of energy is not a rational economic behavior; however, equally important are sociocultural considerations, such as feeling modern, aspiring to an urban lifestyle, or simple convenience. Collective choice also plays a role in adopting a new energy source (11).

As well as health impacts, improved stoves and/or cleaner fuels have a positive impact on the environment by significantly reducing indoor particulate matter and carbon monoxide levels (13). However, more effort needs to be directed at developing and testing cleaner combustion solid-fuel stoves, promoting access to clean fuels, and adopting clean household energy across communities (13). Also, more work is needed to ensure that behavioral factors, such as energy stacking, do not counteract these potential impacts when improved stoves and/or cleaner fuels are introduced (11). It is only through all these efforts that maximum health benefits can be achieved by lowering levels of household particulate air pollution to within WHO guidelines.

In regards to developed countries, energy efficiency measures have the potential to reduce health inequalities if targeted at those most in need, e.g., living in inadequately heated homes, of low income, or with chronic respiratory disease (12, 14).

Sectors involved. An original aim of this overview was to determine with which sectors the health sector should engage in order to promote sustainable energy use. Unfortunately, none of the included studies specified which sectors were involved in the interventions. To facilitate policy development, the reviewers deduced which sectors were involved from the researchers' affiliations and any funding organizations. The resulting information is provided in Table 4 to enable discussion, but is

TABLE 4. Sectors involved in sustainable energy interventions according to an overview of systematic reviews on energy interventions that facilitate sustainable development and impact health, 1997 – 2014

Intervention	Energy	Health	Environment	Economic	Housing	Transport	Local government	International development
Introduction of electricity for lighting and other uses	✓	✓	✓	✓			✓	✓
Improved stoves for cooking and heating and/or cleaner fuels for cooking	✓	✓	✓				✓	✓
Energy infrastructure as part of a slum upgrading strategy	✓	✓		✓	✓		✓	✓
Household energy efficiency measures, including insulation; central heating; glazing measures; or a combination	✓	✓			✓		✓	
Diesel-electric hybrid technology used to propel urban pickup and delivery vehicles	✓	✓	✓	✓		✓		

Source: Created by the review authors from the author affiliations and funding organizations of the included systematic reviews and economic evaluations.

open to debate. Collaboration across sectors to design, implement, and evaluate sustainable energy interventions will likely result in greater benefits for all involved.

Implications for research

More research is needed on the intervention types where no systematic reviews or economic evaluations were found. This research needs to be multidisciplinary; leverage partnerships with funders, implementers, and researchers; be rigorous and well designed, including credible control groups; measure, where possible, a range of outcomes, including social, environmental, economic, and peace and security outcomes; measure impact on health inequalities; include a concurrent process evaluation to ensure that the intervention is properly implemented and does not result in any unintended consequences; include a long term follow-up to ensure that the effects are sustained; and assess the cost-effectiveness of the interventions.

Lack of research on the impact that these interventions have had on health does not imply that their effectiveness has not been measured at all. It may be that other outcomes, such as environmental or economic, were measured. Alternatively, health impact may have been measured by primary studies that were not the subject of a systematic review.

Limitations

It should be noted that this overview had key strengths, most notably, the use of high quality systematic review methodology (20). A meta-analysis was not possible due to the heterogeneity of intervention types and populations studied by the included systematic reviews. As a result, publication bias could not be assessed quantitatively in this overview and there are no clear methods available for assessing publication bias qualitatively (21).

All of the systematic reviews included in the overview were published recently (2013 and 2014), so it is likely that most of the relevant literature has been captured. The best quality systematic reviews were the two conducted under the auspices of the Cochrane Collaboration (14, 15).

The lack of economic evaluations is a limitation of this study. The only economic evaluation that met the inclusion criteria relies extensively on expert opinion, could be susceptible to conflict of interests, and is only applicable to the United States (16).

Conclusions

What is needed now is careful implementation of interventions where the impacts are likely to be positive, but implementation must be rigorously evaluated, including possible adverse impacts. Care needs to be taken not to exacerbate health inequalities and to consider context, human behavior, and cultural factors so that the potential health benefits are realized in real-life implementation. Possible impact on health inequalities needs to be considered and measured in future primary studies and systematic reviews. Collaboration across sectors will likely result in greater benefits for all involved.

Acknowledgements. This work was funded by PAHO. Apart from the input of the two PAHO authors (EC, LG), the funder did not influence the study's methods or content. We thank the two reviewers who critically reviewed an earlier and longer version of this manuscript and provided very helpful comments.

Conflict of interests. None declared.

Disclaimer. Authors hold sole responsibility for the views expressed in the manuscript, which may not necessarily reflect the opinion or policy of the RPSP/PAJPH and/or PAHO.

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Manuscript received on 28 August 2015. Revised version accepted for publication on 21 December 2015.

RESUMEN

Intervenciones en materia de energía que facilitan el desarrollo sostenible y tienen un impacto positivo en la salud: visión panorámica de revisiones sistemáticas

Objetivo. Fundamentar la política con una visión panorámica de las revisiones sistemáticas de intervenciones que facilitan el uso de energía sostenible y tienen un impacto positivo en la salud.

Métodos. Se usaron métodos de revisión sistemática para sintetizar los datos probatorios de múltiples revisiones sistemáticas y evaluaciones económicas mediante una amplia búsqueda en 13 bases de datos y nueve sitios web, sobre la base de un protocolo predefinido, que incluyó criterios de inclusión claros. Se incluyó tanto la bibliografía "gris" como la arbitrada, publicada en inglés, español y portugués durante 17 años, de enero de 1997 a enero del 2014. Para ser consideradas "sostenibles," las intervenciones debían estar orientadas a lograr una repercusión positiva en al menos dos dimensiones del marco integrado para el desarrollo sostenible e incluir mediciones de la repercusión en la salud.

Resultados. Cinco revisiones sistemáticas y una evaluación económica cumplieron los criterios de inclusión. Las intervenciones más prometedoras en cuanto al impacto en la salud en esta visión panorámica fueron: la introducción de la electricidad para alumbrado y otros usos (países en desarrollo); las cocinas o estufas mejoradas más saludables o los combustibles más limpios para cocinar (países en desarrollo), y las medidas de eficiencia energética en los hogares (países desarrollados). Estas intervenciones también pueden tener repercusiones ambientales y económicas. No se conoce su costoeficacia ni su efecto en las desigualdades en la salud.

Conclusiones. Hoy es necesaria la ejecución cuidadosa de las intervenciones cuya repercusión pueda ser positiva pero cuya ejecución debe ser rigurosamente evaluada, incluidas las posibles repercusiones adversas. Se debe tener cuidado de no exacerbar las desigualdades en la salud y tomar en cuenta el contexto, el comportamiento humano y los factores culturales, de modo que los posibles beneficios para la salud se concreten en la ejecución en la vida real. En los futuros estudios primarios y revisiones sistemáticas se deben considerar y cuantificar las desigualdades en la salud.

Palabras clave Desarrollo sostenible; energía renovable; revisión sistemática; objetivos de desarrollo sostenible; Naciones Unidas.