The effect of conditional cash transfers on the control of neglected tropical disease: a systematic review

Aaminah Ahmed, Dagfinn Aune, Paolo Vineis, Julia M Pescarini, Christopher Millett, Thomas Hone

Summary

Background Neglected tropical diseases (NTDs) are diseases of poverty and affect 1·5 billion people globally. Conditional cash transfer (CCTs) programmes alleviate poverty in many countries, potentially contributing to improved NTD outcomes. This systematic review examines the relationship between CCTs and screening, incidence, or treatment outcomes of NTDs.

Methods In this systematic review we searched MEDLINE, Embase, Lilacs, EconLit, Global Health, and grey literature websites on Sept 17, 2020, with no date or language restrictions. Controlled quantitative studies including randomised controlled trials (RCTs) and observational studies evaluating CCT interventions in low-income and middle-income countries were included. Any outcome measures related to WHO's 20 diseases classified as NTDs were included. Studies from high-income countries were excluded. Two authors (AA and TH) extracted data from published studies and appraised risk of biases using the Risk of Bias in Non-Randomised Studies of Interventions and Risk of Bias 2 tools. Results were analysed narratively. This study is registered with PROSPERO, CRD42020202480.

Findings From the search, 5165 records were identified; of these, 11 studies were eligible for inclusion covering four CCTs in Brazil, the Philippines, Mexico, and Zambia. Most studies were either RCTs or quasi-experimental studies and ten were assessed to be of moderate quality. Seven studies reported improved NTD outcomes associated with CCTs, in particular, reduced incidence of leprosy and increased uptake of deworming treatments. There was some evidence of greater benefit of CCTS in lower socioeconomic groups but subgroup analysis was scarce. Methodological weaknesses include self-reported outcomes, missing data, improper randomisation, and differences between CCT and comparator populations in observational studies. The available evidence is currently limited, covering a small proportion of CCTs and NTDs.

Interpretation CCTs can be associated with improved NTD outcomes, and could be driven by both improvements in living standards from cash benefits and direct health effects from conditionalities related to health-care use. This evidence adds to the knowledge of health-improving effects from CCTs in poor and vulnerable populations.

Funding None.

Lancet Glob Health 2022; 10: e640–48

See **Comment** page e588

Imperial College School of Medicine (A Ahmed BSc), **Imperial College London, London, UK; Department of Epidemiology and Biostatistics** (D Aune PhD), **MRC Centre for Environment and Health** (P Vineis MPH), **and Public Health Policy Evaluation Unit** (C Millett PhD, T Hone PhD), **School of Public Health, Imperial College London, London, UK; Department of Nutrition, Oslo New University College, Oslo, Norway** (D Aune); **Department of Endocrinology, Morbid Obesity and Preventive Medicine, Oslo University Hospital, Oslo, Norway** (D Aune); **Unit of Cardiovascular and Nutritional Epidemiology, Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden** (D Aune); **Italian Institute of Technology, Genoa, Italy** (P Vineis); **Center of Data and Knowledge Integration for Health, Instituto Gonçalo Moniz, Fundação Oswaldo Cruz, Salvador, Brazil** (J M Pescarini PhD, C Millett); **Department of Infectious Disease Epidemiology, London School of Hygiene & Tropical Medicine, London, UK** (J M Pescarini); **Comprehensive Health Research Centre, NOVA National School of Public Health, NOVA University of Lisbon, Portugal** (C Millett)

Correspondence to:
Dr Thomas Hone, Public Health Policy Evaluation Unit, School of Public Health, Imperial College London, London W6 8RP, UK
thomas.hone12@imperial.ac.uk

Introduction

Neglected tropical diseases (NTDs) affect over 1·5 billion people globally, accounting for over 530 000 deaths each year.[1,2] Populations experiencing poverty in tropical and subtropical areas shoulder most of this burden.[3] Target 3.3 of Sustainable Development Goal (SDG) 3 (health) aims to end the epidemics of NTDs by 2030, but accelerated action is needed to meet this aim. In January, 2021, WHO renewed global efforts to address NTDs with a new roadmap focussing on cross-sector synergies, poverty alleviation, and country ownership.[4]

Poverty is deeply interlinked with NTDs, it drives social and environmental determinants of NTDs including water, sanitation, hygiene, education, housing, and health-care accessibility.[5–8] Poverty affects access to important control strategies such as preventive chemotherapy and vector management.[9] The economic burden from NTDs can impoverish people, further fuelling cycles of poverty and increased NTD burdens. Children are particularly at risk of poverty-NTDs cycles as NTDs can contribute to cognitive impairment, malnutrition, and lifelong disability and stigmatisation.[10] Comprehensive and pro-poor health-system initiatives are essential in achieving effective NTD control,[11] but there is also a need to address underlying socioeconomic barriers and drivers of poverty.[12]

Conditional cash transfer (CCT) programmes are important social assistance programmes which aim to improve social determinants of health through poverty reduction.[13,14] CCTs mandate that particular obligations or conditionalities are fulfilled before beneficiaries receive funds. These conditionalities encourage investment in human capital, for example by mandating school attendance or medical check-ups for children, or health and nutrition education workshops for adults. Funds are often distributed to recipient households in the form

Research in context

Evidence before this study

Evidence demonstrates conditional cash transfer programmes (CCTs) can reduce poverty and improve health outcomes. Systematic reviews on CCTs show that they improve maternal and child health outcomes, as well as improve outcomes relating to infectious diseases such as HIV and tuberculosis. CCTs might deliver these gains through both poverty alleviation and conditionalities that require attendance to health-care clinics and increased opportunities for health education or promotion. Neglected tropical diseases (NTDs) are a major burden globally, predominantly affecting the world's poorest populations who are frequently targeted under CCTs. We searched MEDLINE, Embase, Lilacs, EconLit, Global Health, and grey literature websites on Sept 17, 2020, for any existing systematic reviews on the topic of CCTs and NTDs. Terms included "cash transfer", "neglected tropical disease", and "systematic review", but no relevant systematic reviews were found.

Added value of this study

This is the first systematic review on CCTs and NTDs. Included studies were of moderate quality, employed mainly randomised controlled trial or quasi-experimental study designs, and concentrated on leprosy, schistosomiasis, and soil-transmitted helminthiasis. The overall evidence from the studies demonstrates that CCTs might contribute to improved NTD outcomes, particularly the incidence of leprosy and reported use of deworming treatments. Benefits were concentrated in vulnerable populations suggesting health inequalities from NTDs can be reduced with CCTs. There is a need for more studies on objective and clinically-relevant outcomes such as incidence, treatment adherence, and cure rates, in addition to other NTDs.

Implications of all the available evidence

CCTs remain an important tool for poverty alleviation and improving health and well-being of the world's poorest. There are benefits of CCTs on NTD related outcomes, such as reduced incidence and improved treatment outcomes with some evidence they reduce health inequalities. Enhanced design of CCT programmes could increase their effectiveness for improved NTD outcomes among vulnerable populations globally.

of non-contributory pensions, child grants, or cash.[15] Originally pioneered in Mexico and Brazil in the late 1990s and early 2000s (with world-renowned programmes including Progresa and Bolsa Família), CCTs have now become widespread across low-income and middle-income countries (LMICs) throughout Latin America, Asia, and Africa. CCTs have expanded to target a range of populations and health outcomes including maternal health and communicable diseases such as HIV and tuberculosis.[16–20] Although CCT programmes have been criticised due to unintended effects such as increasing high body-mass index and blood pressure,[21] they have become a key policy tool for poverty reduction in LMICs.

See Online for appendix

There is a wealth of evidence on the health effects of CCTs. Systematic reviews have shown CCTs can contribute to better maternal and child health,[22–28] and infectious disease outcomes such as HIV[29–31] and tuberculosis.[32] CCTs impart health benefits through both the cash benefits received and conditionalities.[33] Cash benefits contribute to poverty alleviation, improve recipients' quality of life, and deliver health gains by providing the opportunity to invest in better nutrition, engage with local economic markets, and access medicines and health-care facilities.[34–36] Conditionalities improve health outcomes directly by improving health knowledge, promoting enrolment in education, and increasing health-care service use.[15] Given this knowledge it is plausible that CCTs might deliver important positive effects on NTDs, but there has been no comprehensive synthesis of the evidence. This systematic review aims to assess the evidence base on the effects of CCTs on screening, incidence, or treatment outcomes of NTDs in LMICs.

Methods

Search strategy and selection criteria

In this systematic review, MEDLINE, Embase, Lilacs, EconLit, and Global Health were searched in Sept 17, 2020, to find relevant publications evaluating the relationship between CCTs and screening, incidence or treatment outcomes of NTDs. The search strategy was built around key terms such as "cash transfer", "social protection", "monetary incentive", and "neglected tropical disease", a full search strategy is in the appendix (pp 1–7). Lilacs was searched using terms in Spanish and Portuguese and MEDLINE, Embase, EconLit, and Global Health were searched in English. The World Bank, UNICEF, WHO, Save the Children, the Cash Learning Partnership, and the International Food Policy Research Institute websites were also searched for studies and grey literature. The references of relevant publications were screened for potential studies.

Population, interventions, comparators, outcomes, and studies criteria were used to structure inclusion and exclusion criteria. Population: populations in LMICs were included. Studies in high-income countries were excluded. There were no other population exclusion criteria (eg, age or sex), and study populations could be measured at the individual-level or aggregated geographical areas. Interventions: any programme or policies addressing socioeconomic disadvantage through the provision of cash transfers to recipients with attached conditionalities (eg, visits to health-care facilities) were eligible for inclusion. Microcredit interventions, in-kind transfers, food vouchers, and unconditional transfers were excluded. CCTs from both governmental and non-governmental

providers were eligible for inclusion. Comparators: only studies with suitable comparators were included, with uncontrolled or studies without comparators excluded. Eligible comparators were non-CCT recipients, time periods before CCT receipt, or populations or areas exposed to varying levels of CCT programme coverage. Outcomes: any outcomes related to WHO's 20 diseases classified as NTDs were eligible for inclusion (appendix p 8).[37] Eligible outcomes could be related to screening (ie, attendance at screening clinics), incidence, treatment, or cure of NTDs.[31] Broad, non-specific outcomes that might be related to non-NTD effects of CCTs such as anthropometric status and cognitive development were excluded. Studies: studies in all languages were considered for inclusion. Randomised controlled trials, cohort studies, longitudinal studies, case-control studies, cross-sectional studies, ecological studies, and quasi-experimental studies were all considered for inclusion. Case-reports, commentaries, editorials, qualitative studies, report summaries, and media briefings were excluded.

Titles and abstracts were screened by two researchers (AA and TH) using Covidence software. The full text of potentially eligible studies were then screened; disagreements between reviewers were resolved by a third reviewer (CM). Data collection was done by two researchers (AA and TH); data extracted from eligible studies included information on study design, study population, intervention, setting, outcomes, and effect estimates. In studies considering multiple outcomes or variables, all eligible outcomes were extracted. In studies whereby authors presented different empirical models, we selected those the authors presented as their main findings or the models with the most robust specifications. In cases of discrepant or missing data, the lead authors were contacted for further clarification. Values of benefits were converted to US$ for comparability.

To assess the risk of bias of included studies, the Risk of Bias in Non-Randomised Studies of Interventions tool was used for non-randomised studies and the Risk of Bias 2 tool was used for randomised studies.[38] Studies were classified as either low, moderate, or severe risk of bias.

Statistical analysis

For comparability, effect sizes were converted to relative effect sizes (ie, odds ratios, rate ratios, risk ratios, prevalence ratios, and probability ratios) by expressing absolute changes relative to baseline risks, proportions, or prevalence (appendix p 8). A narrative synthesis of findings was performed and the results were displayed graphically; no data synthesis was planned. Due to the variability in the included studies, no formal process was undertaken to assess heterogeneity. This systematic review was registered with PROSPERO (CRD42020202480).

Role of the funding source

There was no funding source for this study.

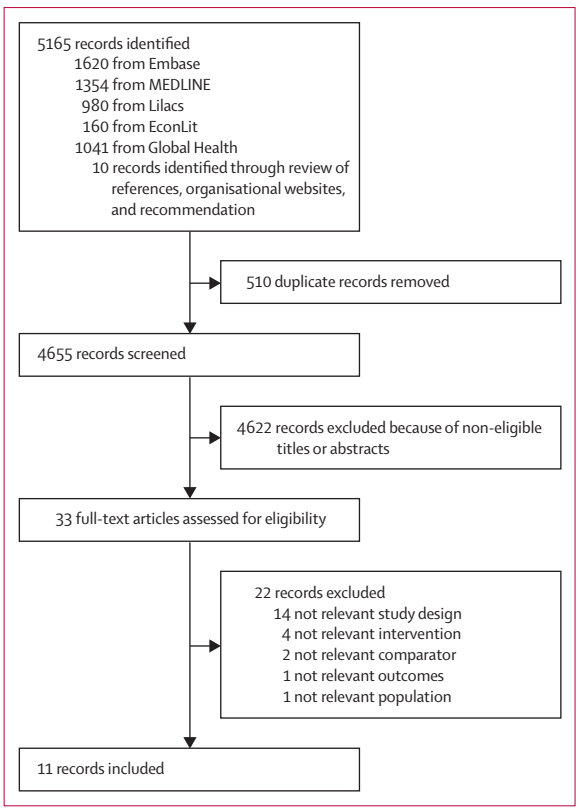

Figure 1: **Study inclusion and exclusion flow diagram**

Results

There were 5165 records identified and after removal of 510 duplicates, 4655 titles and abstracts were screened (figure 1). The full text of 33 articles were assessed for eligibility, of which 11 studies were eligible for inclusion. The 11 included studies comprised four randomised controlled trials,[39–42] six quasi-experimental studies,[43–48] and one cross-sectional study,[49] and assessed CCT interventions between 1997 and 2015 (table 1; appendix pp 9–11). The studies came from four countries. Five papers evaluated the Bolsa Família Program (BFP) in Brazil,[43–47] one study examined Progresa in Mexico,[40] four papers covered the Pantawid Pamilyang programme in the Philippines,[41,42,48,49] and one study reported on a small-scale randomised trial in Zambia.[44]

Ten of the included studies were judged to be of moderate risk of bias and one study[49] had a serious risk of bias due to no adjustment for confounding factors and selection bias (table 1; appendix pp 15–17). There were a range of quality issues across the studies, which increased the risk of bias. For RCTs, there were potential biases from self-reported outcomes, missing data, or improper randomisation. In the non-randomised studies, potential biases stemmed from differences between CCT and comparator populations (despite the use of methods such as propensity-matched scoring or inverse probability of treatment weighting)[46,47] little adjustment for potential confounding

For more on **Covidence software** see https://www.covidence.org/

For more on the **Risk of Bias in Non-Randomised Studies of Interventions tool** see https://sites.google.com/site/riskofbiastool/welcome/home?authuser=0

For more on the **Risk of Bias 2 tool** see https://sites.google.com/site/riskofbiastool/welcome/rob-2-0-tool?authuser=0

	Years	Study population	Study design	Statistical analysis	Outcomes measured	Risk of bias
Brazil: Bolsa Família Programme						
Andrade et al (2018)[43]	2004–15	1120 high leprosy risk municipalities	Quasi-experimental ecological observational	Longitudinal fixed effects Poisson regression	Leprosy new case detection rate	Moderate
Monteiro et al (2017)[44]	2001–12	139 municipalities from the State of Tocantins	Quasi-experimental ecological observational	Negative binomial log linear regression model	Leprosy new case detection rate	Moderate
Nery et al (2014)[45]	2004–11	1358 municipalities	Quasi-experimental ecological observational	Fixed-effect negative binomial model	Leprosy new case detection rate	Moderate
Pescarini et al (2020)[46]	2007–14	11 456 individuals (2706 beneficiaries; 8750 non-beneficiaries)	Quasi-experimental observational	Propensity score matching	Leprosy treatment adherence and cure rate	Moderate
Pescarini et al (2020)[47]	2007–14	31 613 355 individuals	Quasi-experimental observational	Poisson regression	Leprosy incidence	Moderate
Zambia						
Fink and Rockers (2017)[39]	2010–11	522 parents from 31 urban and rural clusters	Cluster-randomised controlled trial	Principle component analysis	Child health check-up attendance: schistosomiasis screening	Moderate
Philippines: Pantawid Pamilyang						
Kandpal et al (2016)[42]	2008–11	65 control villages and 65 treatment villages, encompassing 1418 households	Randomised controlled trial	Intention-to-treat analysis	Taking deworming pills (self-reported)	Moderate
Onishi et al (2014)[41]	2011–12	3742 households from eight municipalities	Randomised controlled trial	Regression discontinuity	Taking deworming pills (self-reported)	Moderate
Orbeta et al (2014)[48]	2013	3108 households from 175 villages in 30 municipalities	Regression discontinuity (quasi-experimental)	Regression discontinuity	Receipt of deworming pills	Moderate
Liwanag et al (2017)[49]	2015	209 families randomly selected from four rural villages in Leyte	Cross-sectional observational	Generalised mixed linear model	Prevalence of schistosomiasis, helminthiasis, or co-infection	Serious
Mexico: Progresa						
Quiñones (2016)[40]	1997–2000	11 058 control households, 6965 treatment households; randomly selected	Randomised controlled trial	Difference-in-difference	Deworming in household (self-reported)	Moderate

Table 1: **Details of included studies**

variables, and data quality issues. Many studies were limited in the generalisability of their findings beyond their study populations.

CCT programmes from the four countries were mainly focused towards poor and disadvantaged groups, pregnant women, or mothers with children (table 2). Of the included programmes, the Progresa and Bolsa Família programmes were introduced in the late 1990s, and Pantawid Pamilyang was established in 2007.[50] There was variation in the benefit packages between CCTs, but most provided monthly stipends of cash, free access to health services, and nutritional supplementation. The trial CCT programme from Zambia provided cash immediately following a health evaluation and was without income eligibility restrictions—eg, high-income parents also received this benefit. The large scale CCT programmes from Brazil, Mexico, and the Philippines included conditionalities such as attendance of health check-ups and school attendance. Mexico and Brazil included nutrition supplement conditionalities, and Mexico and the Philippines included conditionalities on educational workshops. The CCT in Zambia focused on a single behaviour—attendance to child health check-ups. The CCTs in Mexico, the Philippines, and Zambia had specific conditionalities related to NTD control.

Five studies examined outcomes relating to leprosy,[43–47] five examined outcomes relating to soil-transmitted helminthiasis,[40–42,48,49] and two examined outcomes relating to schistosomiasis (figure 2; appendix pp 8–11).[39,49] The NTDs of interest in each study are highly endemic to their regions—eg, Brazil has the second highest burden of leprosy in the world, and schistosomiasis and helminthiasis are endemic in many provinces in the Philippines, Mexico, and Zambia.[51–53] Of the included studies, one study measured screening uptake (attendance at health clinic appointments), one study measured prevalence (through parasites identified in stool samples of the study population), two studies measured new case detection rate (using data from national databases), five studies measured NTD management (through self-reported uptake of deworming medication), two studies considered incidence, and one study measured cure (using data from a national database).

All five studies on leprosy were from the BFP in Brazil. Four studies found that CCTs were associated with improved leprosy outcomes, and one demonstrated mixed results (appendix pp 9–13). Three ecological studies reported a lower new case detection rate for leprosy with higher BFP coverage (figure 2),[43–45] although study populations were either residents of high risk regions or poor households in municipalities with a high risk of leprosy. One of these studies,[45] found a dose-response relationship between increasing BFP coverage and a reduced new case detection rate. Another

	Eligible beneficiaries	Transfer details	Conditions of transfer						
			Primary education	Secondary education	Health visits (mother)	Health visits (child)	Nutrition supplements	Health education workshops	Conditionalities related to neglected tropical diseases
Progresa, Mexico	Poor, rural households	Monthly transfers of US$25 intending to add 20–30% to the household income	Yes	Yes	Yes	Yes	Yes	Yes	Deworming education
Bolsa Família, Brazil	Households earning less than US$35 per month, or households earning $25–70 per month with children (up to 17 years old), or pregnant or breastfeeding mothers	Monthly transfers of US$18–175 per household depending on household size and eligible members	Yes	Yes	Yes	Yes	Yes	No	No
Pantawid, Philippines	Households with children 0–14 years old or a pregnant woman at the time of assessment, or both	Households received up to US$32 per household per month	Yes	Yes	Yes	Yes	No	Yes	Deworming tablets
Pilot trial, Zambia	Parents of low-income, medium-income and high-income groups (across five asset quintiles)	One-off payment with participants randomly allocated into four incentive groups of the following amounts: US$0, $0·41, $1·43, $3·06	No	No	No	Yes	No	No	Schistosomiasis screening

Table 2: **Details of included conditional cash transfer programmes**

quasi-experimental study[46] found mixed results reporting, no statistically significant association between BFP receipt and any outcome relating to leprosy among individuals younger than 15 years, or individuals with paucibacillary leprosy. However, the study did find BFP receipt was associated with increased treatment adherence and cure rates, but only among patients with multibacillary leprosy (appendix pp 9–13; figure 2).[46] One study of 32 million individuals[47] compared BFP beneficiaries to non-beneficiaries and found a lower leprosy incidence among beneficiaries, with larger reductions in incidence for paucibacillary leprosy and associated disabilities, and where BFP receipt was for 2 years or more.

Four studies examined soil-transmitted helminthiasis and reported mixed results (figure 2, appendix pp 9–13). Three studies focused on the Pantawid programme (Philippines) and one on Progresa (Mexico). Two studies found a statistically significant effect of the CCT programmes on outcomes relating to helminthiasis.[40,41] An RCT of Pantawid found the CCT increased uptake of anthelmintics in children,[41] and another study[40] found the CCT in Mexico increased deworming, with greater increases in indigenous populations. Because indigenous populations had lower deworming at baseline, this contributed to reductions in inequalities between indigenous and non-indigenous groups. No statistically significant effect of the Pantawid programme was found on the receipt of anthelmintic medication among children aged 0–36 months.[42] Although CCT was associated with an increase in the uptake of one deworming pill among beneficiaries, there is no impact on the uptake of the recommended two pills per year.[48]

Two studies focused on schistosomiasis (figure 2, appendix pp 9–13); of these, one study[49] considered prevalence and the other study[39] assessed attendance at health check-ups with schistosomiasis screening in Zambia. Liwanag and colleagues reported that, compared to non-CCT beneficiary families, children from CCT beneficiary families were more likely to have schistosomiasis and schistosomiasis or helminthiasis co-infection.[49] However this study had a severe risk of bias due to no adjustment for confounders. Fink and Rockers found that increasing levels of CCT benefits were associated with increased service uptake,[39] and that non-farmers, individuals more than 2 km from health-care facilities, and those in the middle wealth quintiles were more responsive to CCT incentives (appendix p 14).

Discussion

This systematic review included 11 studies in four countries, from three major CCT programmes and one piloted trial. Seven studies reported that CCT programmes were associated with improved NTD outcomes including leprosy, schistosomiasis, and soil-transmitted helminthiasis.[39–41,43,44,48,53] Some studies identified greater benefits from CCTs in poorer and lower socioeconomic populations than in higher socioeconomic populations suggesting equity improvements. Ten studies had moderate risk of bias. There was considerable heterogeneity in the outcomes studied and there is a need for more robust studies on clinically relevant outcomes such as prevalence and incidence, timely diagnosis, treatment adherence, cure rates, hospitalisations, and mortality. The longer-term NTD health effects, such as stunting, malnutrition, and disabilities were not well evaluated.

The identified effects appear sizeable enough to offer some clinical benefit, however many studies examined intermediate outcomes. For example, Monteiro and colleagues[44] found a 40% reduction in the detection rate of leprosy where CCT coverage was over 33·9%, which translated into a rate of 63 per 100 000 (compared with 105 per 100 000 where coverage was less than 25%; a rate difference of 42 per 100 000). Pescarini and colleagues[46]

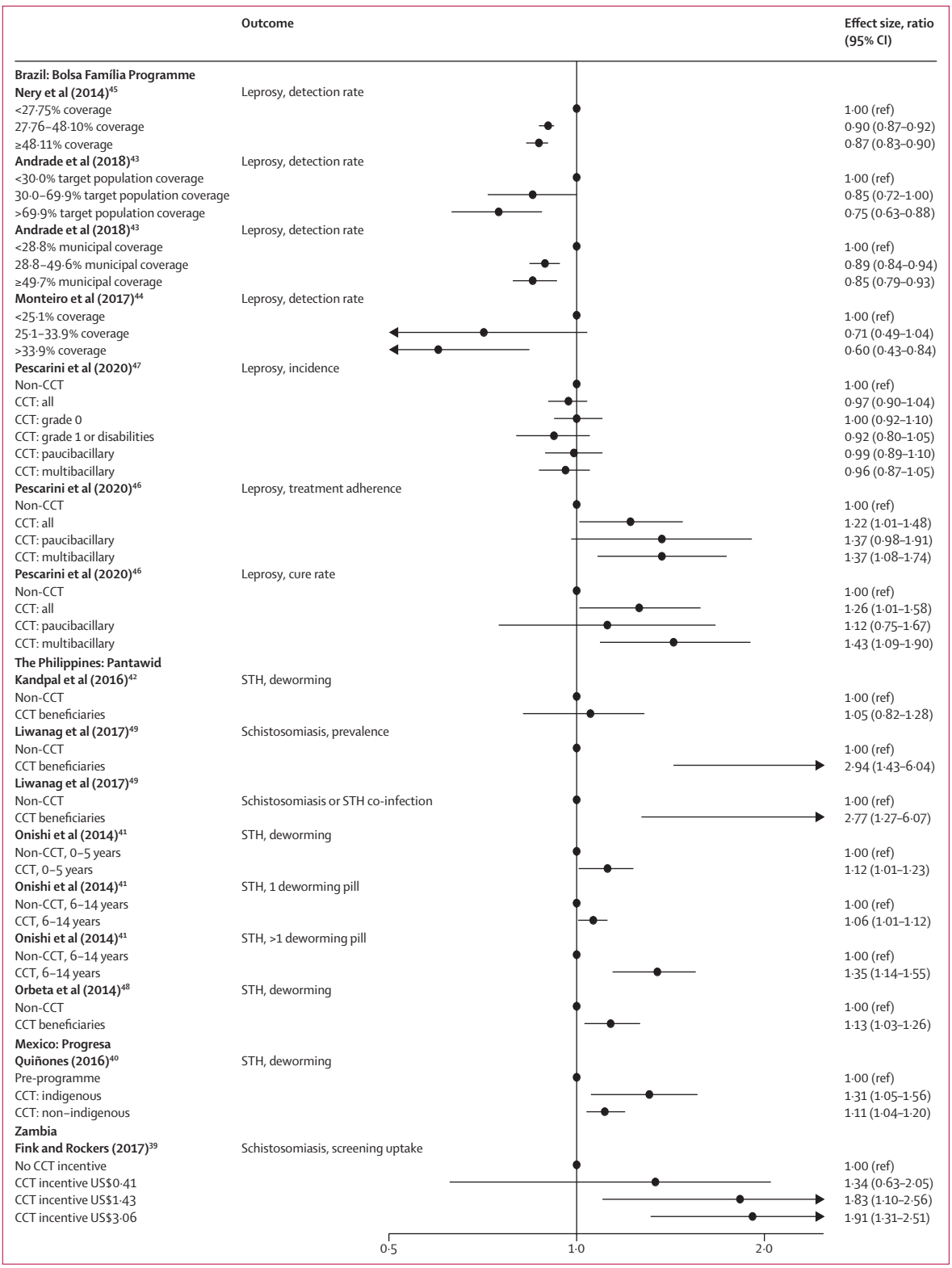

Figure 2: **Overview of effects of included studies**
All effect sizes converted to relative effect sizes (ie, rate ratios, prevalence ratios, and probability ratios) for comparability. CCT=conditional cash transfer. STH=soil-transmitted helminthiasis.

reported a 43% increase in the likelihood of multibacillary leprosy cure for CCT beneficiaries. Onishi and colleagues[41] found 36% of CCT recipients 6–14 year olds reported taking one or more deworming pills compared with 27% of non-beneficiaries (an increase of 9%).

The general finding that CCTs can contribute to improved short-term NTD outcomes aligns with existing knowledge on the impact of CCTs on health outcomes in LMICs.[16,17,31,54] Similar to the evidence of CCTs on HIV[29–31] and tuberculosis,[32] there are multiple mechanisms by which CCT interventions can improve NTDs outcomes. Cash benefits can improve living standards, reducing the risk of contracting NTDs. Evidence shows the socioeconomic development enabled by cash transfers can improve water, sanitation, hygiene, diet, and housing standards,[55,56] which are important risk factors for NTDs. Cash benefits can also improve management of existing NTD infections, facilitating access to health care or medicines for treatment. There are large financial burdens on individuals with infectious diseases such as tuberculosis,[46] and the cash benefits from CCTs may increase long-term treatment adherence and related health outcomes.

CCT conditionalities are the other main mechanism of benefit. Promoting education and health-care check attendance can increase awareness of risk, detection and treatment of NTDs. Notably, the CCTs from the Philippines, Mexico, and Zambia included conditionalities related to NTDs (deworming education or screening) with associated improvements in NTD outcomes. However, the evidence from Brazil, where the BFP does not include NTD-specific conditionalities, suggests specific NTD conditionalities are not a prerequisite for improved NTD outcomes.[43–47] In this case, CCTs might deliver benefits for NTDs by reducing poverty and the associated higher risk of NTDs in addition to increasing contacts with health-care services.

NTDs are diseases of poverty, and this was reflected in study populations. Most studies concentrated on high-risk populations or areas. Subgroup analyses from Brazil, where the most deprived individuals have the greatest risk of leprosy, found effect sizes were higher in the poor.[43,53] Similarly, indigenous populations in Mexico, who have higher rates of poverty, poorer health-care access, and greater risk of NTDs disproportionally benefitted from Progresa than non-indigenous populations. These findings suggest CCTs can contribute to reducing inequalities even within the poorest populations, although health equity impacts were not robustly explored in the included studies.

There are key limitations to this systematic review. Studies might have been omitted despite robust searching efforts. Many included studies had methodological weaknesses limiting causal inference and the conclusions that could be drawn. Six studies were ecological with the potential for an ecological fallacy, whereby inferences at the individual-level cannot be made from results at the group-level.[43,44,46–48,53]

Some non-randomised studies did not adequately deal with confounding between CCT treatment and control groups, and in some settings CCT and non-CCT study populations had different characteristics. Different studies also used different comparator populations, making comparability and interpretation of effect sizes difficult. Four studies utilised self-reported outcomes, with the potential for recall bias.[40–42,48] There also needs to be caution over generalisable conclusions due to the economic, social, political, and geographical differences in study contexts. Although there is good reason to believe CCTs in other settings can deliver NTD health benefits, there needs to be attention to the enabling factors. For example, Brazil has expanded the family health strategy alongside the BFP increasing the provision of community-based primary care,[43,44] which provides an accessible and comprehensive health service for BFP recipients to meet health conditionalities. CCT programmes themselves also have key differences (eg, in cash value and types of conditionalities), which limits the generalisability of the findings. Furthermore, of the 20 WHO-recognised NTDs, 17 were not considered in the included studies. Future studies should consider evaluating the effect of CCTs on other NTDs with large health burdens such as lymphatic filariasis, onchocerciasis, and trachoma.

The finding that CCTs can contribute to better NTD outcomes is important for policy-makers and builds on previous evidence of benefit for other disease outcomes. This evidence aligns with WHO's road map to address NTDs providing support for cross-sector synergies and poverty alleviation.[4] Countries with large NTD burdens and without CCT programmes should consider CCT programmes to deliver health gains and make progress towards the SDGs. Policy-maker attention to demand and supply factors is essential, particularly around health-care infrastructure, staffing, and surveillance efforts.[55,57,58] Evidence shows combined demand-side and supply-side incentives have a more enduring impact on outcomes such as child health, nutrition, and education.[59] In high-burden countries, where multiple NTDs coexist, it might be of benefit to tailor CCT conditionalities towards reducing factors associated with multiple NTDs. For example, conditionalities relating to increased engagement with health services, access to water, sanitation and hygiene practices, and housing improvements can contribute to the reduction of multiple NTDs. Knowledge gaps remain. More robust studies including more relevant and objective outcomes such as NTD screening, incidence, management, and cure rates are needed. Further research on the factors which enable CCT benefits on health and the specific pathway of action, as well as the effects of CCTs on health equity would be valuable.[14] Future work should examine the effect of changes to CCTs studied on NTDs, including the planned removal of health conditionalities within the Bolsa Família programme in Brazil. Empirical evidence from highly endemic areas for NTDs such as Bangladesh

or India would be beneficial. Cost-effectiveness, which incorporates costs from CCTs and savings from accrued health benefits, also remains poorly explored and is an important piece of evidence in policy-maker decisions.

In line with the wider knowledge on the health benefits of CCTs, this systematic review finds evidence that CCTs can contribute to improved NTD outcomes in LMICs. CCTs remain important tools for making progress towards the SDGs, reducing poverty, and improving the health of the world's poorest people.

Contributors

AA, DA, PV, and CM contributed to study conceptualisation. AA undertook the data searches with support from JMP and TH. Both AA and TH undertook title and abstract screening, and performed quality assessment. AA wrote the first draft of the manuscript. All authors contributed to further iterations of the manuscript including interpretation, reviewing, and editing. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Declaration of interests

We declare no competing interests.

Data sharing

All data collated and generated in this systematic review is available from the corresponding author upon request.

References

1 WHO. Integrating neglected tropical diseases into global health and development: fourth WHO report on neglected tropical diseases. Geneva: World Health Organization, 2017.

2 Hotez PJ, Molyneux DH, Fenwick A, Ottesen E, Sachs SE, Sachs JD. Incorporating a rapid-impact package for neglected tropical diseases with programs for HIV/AIDS, tuberculosis, and malaria: a comprehensive pro-poor health policy and strategy for the developing world. *PLoS Med* 2006; **3:** e102.

3 Aagaard-Hansen J, Chaignat CL. Neglected tropical diseases: equity and social determinants. 2010. https://www.who.int/neglected_diseases/Social_determinants_NTD.pdf (accessed June 1, 2019).

4 WHO. Ending the neglect to attain the Sustainable Development Goals: a road map for neglected tropical diseases 2021–2030. Geneva: World Health Organization, 2020.

5 Institute of Medicine (US) Forum on Microbial Threats. The causes and impacts of neglected tropical and zoonotic diseases: opportunities for Integrated Intervention Strategies. Washington, DC: National Academies Press, 2011.

6 United Nations. Report on the world social situation 2010. 2010. https://www.un-ilibrary.org/content/books/9789210545693 (accessed Sept 2, 2021).

7 Coady D. Alleviating structural poverty in developing countries: the approach of Progresa in Mexico. Washington, DC: International Food Policy Research Institute, 2003.

8 United Nations. A new global partnership. 2013. https://www.un-ilibrary.org/content/books/9789210562119 (accessed Sept 2, 2021).

9 Fürst T, Salari P, Llamas LM, Steinmann P, Fitzpatrick C, Tediosi F. Global health policy and neglected tropical diseases: then, now, and in the years to come. *PLoS Negl Trop Dis* 2017; **11:** e0005759.

10 Hamill LC, Haslam D, Abrahamsson S, et al. People are neglected, not diseases: the relationship between disability and neglected tropical diseases. *Trans R Soc Trop Med Hyg* 2019; **113:** 829–34.

11 WHO. Investing to overcome the global impact of neglected tropical diseases. Third WHO report on neglected tropical diseases. Geneva: World Health Organization, 2015.

12 WHO. Controlling and eliminating neglected tropical diseases. https://www.who.int/westernpacific/activities/controlling-and-eliminating-neglected-tropical-diseases (accessed May 6, 2020).

13 Millán TM, Barham T, Macours K, Maluccio JA, Stampini M. Long-term impacts of conditional cash transfers: review of the evidence. *World Bank Res Obs* 2019; **34:** 119–59.

14 Sun S, Huang J, Hudson DL, Sherraden M. Cash transfers and health. *Annu Rev Public Health* 2021; **42:** 363–80.

15 Veras Soares F, Perez Ribas R, Guerreiro Osório R. Cash transfer programs in comparative perspective. *Lat Am Res Rev* 2010; **45:** 173–90.

16 Carter DJ, Daniel R, Torrens AW, et al. The impact of a cash transfer programme on tuberculosis treatment success rate: a quasi-experimental study in Brazil. *BMJ Glob Health* 2019; **4:** e001029.

17 Oliosi JGN, Reis-Santos B, Locatelli RL, et al. Effect of the Bolsa Familia Programme on the outcome of tuberculosis treatment: a prospective cohort study. *Lancet Glob Health* 2019; **7:** e219–26.

18 Kohler H-P, Thornton R. Conditional cash transfers and HIV/AIDS prevention: unconditionally promising? *World Bank Econ Rev* 2012; **26:** 165–90.

19 Yotebieng M, Thirumurthy H, Moracco KE, et al. Conditional cash transfers and uptake of and retention in prevention of mother-to-child HIV transmission care: a randomised controlled trial. *Lancet HIV* 2016; **3:** e85–93.

20 Cluver L, Boyes M, Orkin M, Pantelic M, Molwena T, Sherr L. Child-focused state cash transfers and adolescent risk of HIV infection in South Africa: a propensity-score-matched case-control study. *Lancet Glob Health* 2013; **1:** e362–70.

21 Fernald LCH, Gertler PJ, Hou X. Cash component of conditional cash transfer program is associated with higher body mass index and blood pressure in adults. *J Nutr* 2008; **138:** 2250–57.

22 Hunter BM, Harrison S, Portela A, Bick D. The effects of cash transfers and vouchers on the use and quality of maternity care services: a systematic review. *PLoS One* 2017; **12:** e0173068.

23 Hunter BM, Murray SF. Demand-side financing for maternal and newborn health: what do we know about factors that affect implementation of cash transfers and voucher programmes? *BMC Pregnancy Childbirth* 2017; **17:** 262.

24 Owusu-Addo E, Cross R. The impact of conditional cash transfers on child health in low- and middle-income countries: a systematic review. *Int J Public Health* 2014; **59:** 609–18.

25 Glassman A, Duran D, Fleisher L, et al. Impact of conditional cash transfers on maternal and newborn health. *J Health Popul Nutr* 2013; **31** (suppl 2): 48–66.

26 McQueston K, Silverman R, Glassman A. The efficacy of interventions to reduce adolescent childbearing in low- and middle-income countries: a systematic review. *Stud Fam Plann* 2013; **44:** 369–88.

27 Bassani DG, Arora P, Wazny K, Gaffey MF, Lenters L, Bhutta ZA. Financial incentives and coverage of child health interventions: a systematic review and meta-analysis. *BMC Public Health* 2013; **13** (suppl 3): S30.

28 Siddiqi A, Rajaram A, Miller SP. Do cash transfer programmes yield better health in the first year of life? A systematic review linking low-income/middle-income and high-income contexts. *Arch Dis Child* 2018; **103:** 920–26.

29 Sarkar S, Corso P, Ebrahim-Zadeh S, Kim P, Charania S, Wall K. Cost-effectiveness of HIV prevention interventions in sub-Saharan Africa: a systematic review. *EClinicalMedicine* 2019; **10:** 10–31.

30 Kennedy CE, Yeh PT, Atkins K, et al. Economic compensation interventions to increase uptake of voluntary medical male circumcision for HIV prevention: a systematic review and meta-analysis. *PLoS One* 2020; **15:** e0227623.

31 Galárraga O, Sosa-Rubí SG. Conditional economic incentives to improve HIV prevention and treatment in low-income and middle-income countries. *Lancet HIV* 2019; **6:** e705–14.

32 Richterman A, Steer-Massaro J, Jarolimova J, et al. Cash interventions to improve clinical outcomes for pulmonary tuberculosis: systematic review and meta-analysis. *Bull World Health Organ* 2018; **96:** 471–48.

33 Gaarder MM, Glassman A, Todd JE. Conditional cash transfers and health: unpacking the causal chain. *J Dev Effect* 2010; **2:** 6–50.

34 Soares S, Guerreiro R, Fábio O, Soares V, Medeiros M, Zepeda E. Conditional cash transfers in Brazil, Chile and Mexico: impacts upon inequality. 2007. http://www.ipc-undp.org/pub/IPCWorkingPaper35.pdf (accessed May 6, 2020).

35 Samson M. Promoting pro-poor growth: social protection. 2009 https://europa.eu/capacity4dev/iesf/documents/promoting-pro-poor-growth-social-protection-oecd-2009 (accessed May 6, 2020).

36 Cabral De Mello M, Chisholm D, Durairaj V, et al. Public health agencies and cash transfer programmes: making the case for greater involvement. Geneva: World Health Organization, 2011.

37 WHO. Report of the tenth meeting of the WHO strategic and technical advisory group for neglected tropical diseases. Geneva: World Health Organization, 2017.

38 Higgins JP, Savovic J, Page MJ, Elbers RG, Sterne JA. Chapter 8: assessing risk of bias in a randomized trial. https://training.cochrane.org/handbook/current/chapter-08 (accessed May 6, 2020).

39 Fink G, Rockers PC. Financial incentives, targeting, and utilization of child health services: experimental evidence from Zambia. *Health Econ* 2017; **26:** 1307–21.

40 Quiñones EJ, Roy S. The impact of conditional cash transfer programs on indigenous households in Latin America. 2016. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2752588 (accessed May 7, 2020).

41 Onishi J, Deloria C, Popes M, Villena J, Tardeo K. Philippines conditional cash transfer program impact evaluation. 2014. http://documents.worldbank.org/curated/en/537391468144882935/pdf/755330REVISED000Revised0June0402014.pdf (accessed May 7, 2020).

42 Kandpal E, Alderman H, Friedman J, Filmer D, Onishi J, Avalos J. A conditional cash transfer program in the Philippines reduces severe stunting. *J Nutr* 2016; **146:** 1793–800.

43 Andrade K, Nery J, Penna M, Penna G, Pereira S. Effect of Brazil's conditional cash transfer programme on the new case detection rate of leprosy in children under 15 years old. *Lepr Rev* 2018; **89:** 13–24.

44 Monteiro LD, Mota RMS, Martins-Melo FR, Alencar CH, Heukelbach J. Social determinants of leprosy in a hyperendemic State in North Brazil. *Rev Saude Publica* 2017; **51:** 70.

45 Nery JS, Pereira SM, Rasella D, et al. Effect of the Brazilian conditional cash transfer and primary health care programs on the new case detection rate of leprosy. *PLoS Negl Trop Dis* 2014; **8:** e3357.

46 Pescarini JM, Williamson E, Nery JS, et al. Effect of a conditional cash transfer programme on leprosy treatment adherence and cure in patients from the nationwide 100 Million Brazilian Cohort: a quasi-experimental study. *Lancet Infect Dis* 2020; **20:** 618–27.

47 Pescarini JM, Williamson E, Ichihara MY, et al. Conditional cash transfer program and leprosy incidence: analysis of 12.9 million families from the 100 Million Brazilian Cohort. *Am J Epidemiol* 2020; **189:** 1547–58.

48 Orbeta AC, Abdon A, del Mundo M, Tutor M, Valera MT. Keeping children healthy and in school: evaluating the Pantawid Pamilya using regression discontinuity design second wave impact evaluation results. 2014. https://www.dswd.gov.ph/download/pantawid_pamilya_impact_evaluation/Pantawid%20Pamilya%20Impact%20Evaluation%202014%20Report%20Final.pdf (accessed Oct 15, 2020).

49 Liwanag HJ, Uy J, Bataller R, et al. Soil-transmitted helminthiasis and schistosomiasis in children of poor families in leyte, Philippines: lessons for disease prevention and control. *J Trop Pediatr* 2017; **63:** 335–45.

50 Fiszbein A, Schady N, Ferreira FHG, et al. Conditional cash transfers: reducing present and future poverty. World Bank policy research report. Washington, DC: World Bank, 2009.

51 Soares Magalhães RJ, Salamat MS, Leonardo L, et al. Mapping the risk of soil-transmitted helminthic infections in the Philippines. *PLoS Negl Trop Dis* 2015; **9:** e0003915.

52 Soares Magalhães RJ, Salamat MS, Leonardo L, et al. Geographical distribution of human *Schistosoma japonicum* infection in the Philippines: tools to support disease control and further elimination. *Int J Parasitol* 2014; **44:** 977–84.

53 Nery JS, Ramond A, Pescarini JM, et al. Socioeconomic determinants of leprosy new case detection in the 100 Million Brazilian Cohort: a population-based linkage study. *Lancet Glob Health* 2019; **7:** e1226–36.

54 Manley J, Gitter S, Slavchevska V. How effective are cash transfers at improving nutritional status? *World Dev* 2013; **48:** 133–55.

55 Freitas LRS, Duarte EC, Garcia LP. Leprosy in Brazil and its association with characteristics of municipalities: ecological study, 2009-2011. *Trop Med Int Heal* 2014; **19:** 1216–25.

56 Owusu-Addo E, Renzaho AMN, Smith BJ. Cash transfers and the social determinants of health: a conceptual framework. *Health Promot Int* 2019; **34:** e106–18.

57 Samuels F, Pose RR. Why neglected tropical diseases matter in reducing poverty. 2013. https://www.odi.org/publications/7606-neglected-tropical-diseases-matter-reducing-poverty (accessed May 11, 2020).

58 Cruz-Cruz C, López-Hernández D, Hernández-Shilón JA, Luna-Cazáres LM, Vidal JE, Gutiérrez-Jiménez J. Stunting and intestinal parasites in school children from high marginalized localities at the Mexican southeast. *J Infect Dev Ctries* 2018; **12:** 1026–33.

59 Ham A, Michelson HC. Does the form of delivering incentives in conditional cash transfers matter over a decade later? *J Dev Econ* 2018; **134:** 96–108.