

The impact of macro-level socioeconomic interventions on life course risk factors and health outcomes during childhood: a systematic review in high income countries

Work package 9 - Task 9.2 - Subtask 9.2.1-Deliverable 9.2

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Version 01.21

Delivery date: Month 48

Submission date 15th January 2021

Dissemination level: Public

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1. Background

An accumulating body of evidence suggests that exposure to adverse socioeconomic circumstances during fetal life and childhood affects later life health trajectories(1). These socioeconomic inequalities are preventable and unfair, particularly in the case of children who have little control over their health and the factors that influence it(2).

Available evidence largely focuses on behavioural interventions to improve child health, which hold the least potential for population improvement and reduction of health inequalities, with a dearth of research examining macro-level influences. Few experimental and quasi-experimental studies seek to determine whether there is an effect of these macro-level interventions on health(3). There is therefore an *inverse evidence law* by which there is least research on the interventions most likely to have the largest population health impact.

Overall strategies to reduce child poverty and the consequences of child poverty generally involve three key components—early childhood education and care, income redistribution through the benefit and tax systems, and policies to increase the employment chances and wages of families living in poverty(4). While there is evidence that all three components are likely to be effective at reducing child poverty(4), less is known about whether some approaches are more likely to lead to greater health benefits than others, and whom and when is likely to most benefit from these interventions.

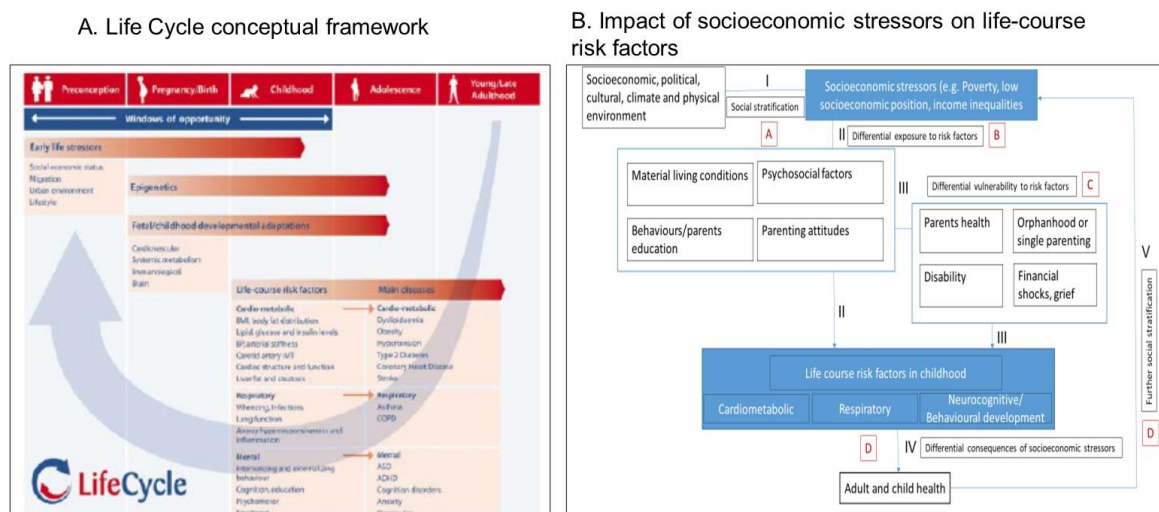
Important knowledge gaps remain also in terms of: a) how these socioeconomic disadvantages *biologically* affect individuals' life course health trajectories; and b) the extent to which and *how* these biological damages can be effectively prevented and/or repaired through structural/macro-level interventions able to address socioeconomic disadvantage during the first 1,000 days of life (from pregnancy to age 2).

Lack of this evidence hampers the development of policy strategies and limit the opportunity of using early life as suitable entry point for interventions able to maximise the human developmental potential.

2. How macro-level socioeconomic interventions may work

According to the LifeCycle conceptual framework (**Figure 1A**), early life socioeconomic stressors can affect life course cardiometabolic, respiratory and mental health outcomes in adolescence/adulthood through epigenetic mechanisms, fetal and childhood development and adaptation, and finally by influencing the differential burden of life course risk factors and health outcomes during childhood. In order to identify entry points for interventions, this framework needs to be further unpacked to elucidate the pathways through which socioeconomic disadvantage arise, operate and is perpetuated (**Figure 1B – see also Appendix 1**).

Figure 1 – LifeCycle conceptual framework and entry points for intervention



Pathways: I = social stratification, II = Differential exposure to risk factors; III = Differential vulnerability to risk factors; IV = Differential consequences of socioeconomic disadvantage. V = Further social stratification. A = interventions affecting social stratification; B= interventions addressing the different exposure to risk factors; C = interventions addressing the differential vulnerability to risk factors; D = Interventions affecting the short- and long-term consequences of socioeconomic disadvantage.

Following from Diderichsen and colleagues conceptual model(2), we can assume that the primer driver of socioeconomic stressors in childhood are positioned at distal level and refer to those structures and constructs that influence the socioeconomic position of individuals in a society (**Fig 1B, Pathway I**). Socioeconomic differential can influence the differential exposure to important material, psychosocial and behavioural risk factors (**Fig 1B, Pathway II**) or can affect the differential vulnerability of children to these risks (**Fig 1B, Pathway III**, e.g. the impact of any given risk factor may be more pronounced in less advantaged groups due to their greater likelihood of being exposed to other important and interacting risk factors). Finally, socioeconomic stressors may influence the clinical and financial consequences of health conditions during childhood (**Fig 1B, Pathway IV**), which ultimately can further exacerbate the disadvantage in early life and adulthood (**Fig 1B, Pathway V**).

Depending on the pathway we can identify different entry points for interventions as outlined in **Box 1**.

3. Objective of the Subtask 9.2

Consistent with LifeCycle Work Package 9 (Task 9.2, Subtask 9.2.2), this review aimed to generate evidence on the impact of interventions able to modify the effect of early-life socioeconomic stressors during the first 1,000 days of life, including poverty, low socioeconomic position, income inequalities, parental education, unemployment, etc.

Box 1 – Examples of entry points for interventions that address socioeconomic stressors in the early life

<i>Pathway</i>	<i>Interventions</i>
<i>I. Creation of social inequalities and disadvantage</i>	A. Policies that influence the process of social stratification through educational system, labour market, taxation and legislation, welfare and poverty-alleviation strategies.
<i>II. Differential exposure to risk factors</i>	B. As above, but also policies that include classic public health interventions that improve housing, working conditions, and access to education and health services.
<i>III. Increased vulnerability to risk factors</i>	C. Policies that include both social and public health intervention in a multisectorial/coordinated fashion to address the amplified health impact among children experiencing multiple risk factors at the same time.
<i>IV. Differential consequences of life course risk factors and health outcome experienced during childhood</i>	D. Policies that may include flexible working agreements and social security systems to mitigate the short and long term consequences of poor child health and health in adulthood.

For the purpose of this review, we focused on Pathway I/Type A interventions, and thus on macro-level measures/poverty-alleviation strategies (i.e. the exposure) able to address socioeconomic stressors during the first 1000 days of life, and evaluated whether these interventions can affect children differential experience of life course risk factors and health outcomes relevant for LifeCycle (i.e. the outcome of interest). Consistent with the LifeCycle population of interest, we focused on high income countries.

Specific objectives of this review included:

1. To quantify the impact of macro-level socioeconomic interventions/poverty alleviation strategies during the first 1,000 days of life specifically on cardiometabolic, respiratory and mental health life course risk factors from birth to childhood.
2. To describe the mechanisms/the underlying causal pathway through which this impact is postulated to happen.
3. To identify evidence gaps and methodological challenges in the available literature.

4. Methods

The methods used in this review largely followed the recommendations of Waddington et al on the review of international development interventions(5). With the exception of the search strategy definition and roll out, all steps were undertaken in parallel from at least two authors of this report.

4.1. Search strategy and databases

Electronic searches have covered key bibliographic databases including:

1. Multidisciplinary ones, such as SCOPUS, Web of Science and Google Scholar;
2. Specific to social sciences, both general and discipline-specific, such as Social Science Research Network (SSRN), and Econlit for economics, PsycInfo for behavioural studies.
3. Specific to biomedical research, including Pubmed/Medline, EMBASE;
4. the Cochrane Library Central for both trials and reviews registry.

Consistent with existing recommendations(5), we adopted a 'snowballing' approach: starting from important primary studies and already existing review we further increased the body of references both by bibliographic back-referencing and citation tracking (i.e. reviewing references in which the included study has been cited.).

In terms of search strategy, we focused on two groups of key terms to begin with:

GROUP 1- Social welfare OR Social protection OR Cash/food/in-kind transfers OR child grants OR child benefits OR child allowances OR Tax benefits OR Child tax credit or Work-based programmes;

GROUP 2 – child health;

Each term in GROUP 1 was tabulated with all terms in GROUP 2. Given the broad scope of the review, we adopted an iterative process and refined the search strategy as we progressed. Key papers were also searched for in databases to identify subject headings or descriptors applied to them, which were then used to further refine the search strategy. The approaches above returned a final search strategy which is illustrated in **Figure 2**. For all searches, high-income countries and RCT, experimental and quasi-experimental studies, filters were used.

4.2. Eligibility criteria

Overall, only studies (both published and unpublished) from high income countries providing impact evidence of macro-level interventions on the outcomes of interest were included in the review. In particular:

1. Macro-level interventions of interest included:
 - Social protection strategies (based on social assistance and safety nets, such as: conditional or unconditional cash transfers; food-based programmes such as supplementary feeding programmes and food stamps, vouchers, and coupons; in-kind transfers such as school supplies and uniforms; price subsidies for food, electricity, or public transport; public works programmes),
 - Taxation policies and benefits (i.e. fee waivers and exemptions for health care, schooling, tax credits, and utilities); and
 - Referral to social services and/or strategies to facilitate/enhance access to targeted social services.

Interventions addressing differential exposure to risk factors (i.e. housing) and differential vulnerability to risk factors in disadvantaged groups (i.e. support for disabled people in the household) were *not* included. We did *not* include either school feeding programs as they were considered to be a separate type of intervention typically delivered beyond the window period of interest (i.e. first 1,000 days of life).

2. Outcomes of interest included all childhood life course risk factors and health outcomes relevant for the LifeCycle project, including cardiometabolic, respiratory and mental health outcomes (**Figure 1A**). Studies including impact on generic, self-reported measures of health were not included.
3. Only studies reporting impact evidence from randomised controlled trials (RCTs) and Quasi-experimental design studies were included.
4. No time or language restriction was applied.

Figure 2 - Final search strategy adopted in this review

Search		Terms
#1	Interventions	social programmes OR social protection OR government programmes OR government transfers OR cash OR food OR in-kind transfers
#2		child grants OR child benefits OR child allowances
#3		Tax benefits OR Tax exemptions OR Tax credit OR Fiscal
#4		Work-based programs
#5		OR #1 to #4
#6	Health outcome	Health OR Resp* Health OR Wheezing OR Resp* Infections OR Mental OR Behav* OR Psycho* OR Cardio* OR BMI OR Weight OR Obesity OR Blood Pressure OR Lipid* OR Glycem*
#7	Population	Prenatal OR Antenatal OR Perinatal OR pregnancy OR pregnant OR mother* OR parent*
#8		Postnatal OR Perinatal OR Postpartum
#9		"Infant" OR "Newborn" OR "Child, preschool" OR "childhood" OR "children"
#10		OR #7 to #9
#11		#5 AND #6 AND #10

4.3. Data extraction, appraisal and synthesis

Data extraction forms were created to gather relevant information from the selected papers. (Appendix 2). Given the anticipated heterogeneity of studies we did not conduct a meta-analysis. Instead we summarised the principal findings of each study and combined them together via a narrative synthesis.

4.4. Risk of bias assessment

Despite the existence of several tools for the critical appraisal of the quality of studies, we chose to use the approach suggested by Waddington et al based on the simple identification of a number of selected biases (whether explicitly stated in the papers or identified by the authors of this report)(5). Biases identified were simply listed and described. Consistent with Waddington recommendations, we did not apply any bias score-based approach to determine the overall risk of bias of the eligible papers(5). In this report we will not present the results of the critical appraisal exercise as still ongoing.

4.5. Review protocol registration

The review protocol can be provided upon request. The review protocol has been successfully registered within PROSPERO in June 2020 with the registration number CRD42020178543 (6).

5. Results

5.1. Studies selection

The search strategy returned a total of 11, 658 papers. After removing duplicates and titles of no relevance, we obtained 358 papers to submit for abstract screening. Of them 95 were considered suitable for the eligibility assessment and 11 of them met the review requirements (Figure 3).

Reasons for exclusion of the 84 papers are provided in **Figure 3**. A full list of included and excluded papers is available respectively in Appendix 3 and Appendix 4 of this report. Among the 11 eligible papers, nine referred to independent studies whereas two were respectively a meta-analysis(7) of 12 different randomised controlled trials and a pooled of analysis of 5 different Welfare-to-Work interventions(8). Studies included in these two reviews are listed in Appendix 5.

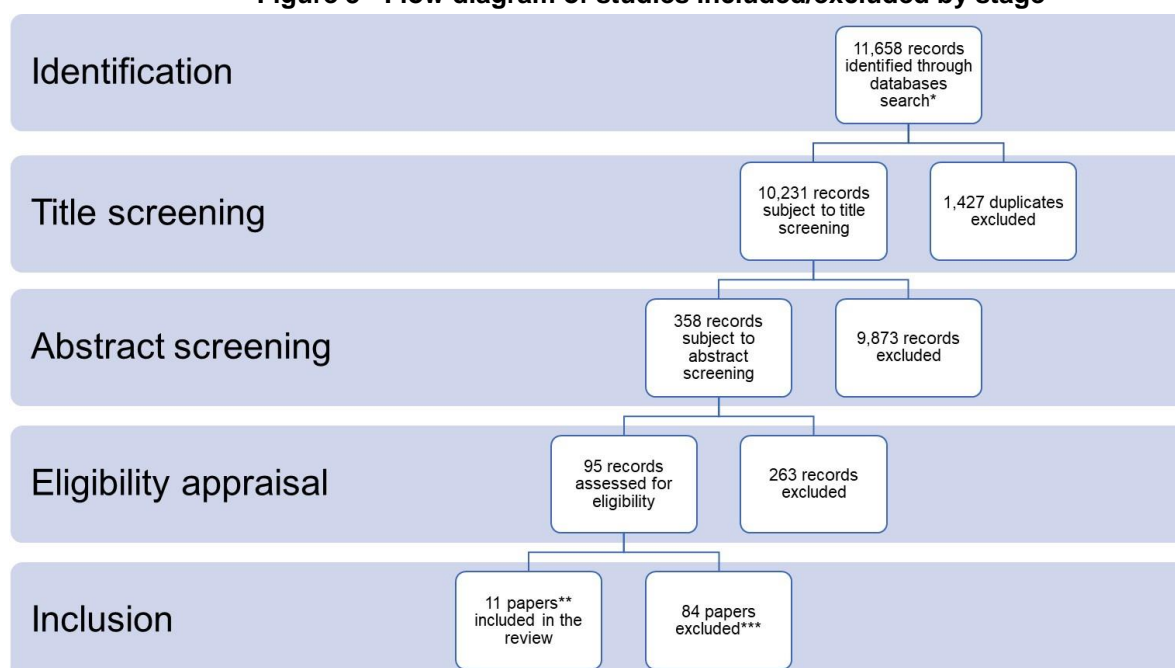
5.2. Studies description

Table 1 provides an overview of the main features of the studies included in this review. With the exception of Dundas et al(9) and Gibson et al(7) , providing evidence from the United Kingdom, all the other studies were from North America, and largely from the United States

and in three cases from Canada(8) (10, 11). Type of interventions included health insurance in one study (12), two unconditional cash transfer interventions (9, 11, 13), two conditional cash transfers(10, 14), four earned income tax credit(15-18).

In terms of child health outcome (Table 1), the vast majority of studies focused on birth outcomes and especially birth and low birth weight. In one study(18), authors also examined other birth outcomes including weight-for-gestational-age. In five cases, authors focused on child mental health both as reported measure of health from parents or through standard mental health scales including the Behavior Problem Index (BPI)(7, 8, 16), the Positive Behaviour Scale (PBS)(8), or a modified version of them(10) and the Scale assessing anxiety and physical and indirect aggression(11).

Figure 3 - Flow diagram of studies included/excluded by stage



*SCOPUS, Google Scholar; Web of Science, Social Science Research Network (SSRN), Social Science and Policy, Econlit, PsycInfo, Pubmed/Medline, EMBASE, Cochrane Library.

**11 papers of which 9 refer to independent studies, one to a meta-analysis of 12 RCTs and one to a pooled analysis of 5 RCTS.

***Papers were excluded because they did not meet one or more inclusion criteria as follows: Study design (N.58 papers); Intervention (N.38 papers); Health outcome (N. 63 papers); Study population (N.29 papers); Country (N.9 papers).

Studies have largely relied on quasi-experimental study designs, whereas randomized control trials have been only considered in the meta-analysis and pooled-analysis included in this report(7, 8) and in one conditional cash transfer from Canada(10) (Table 1) . Quasi-experimental studies adopted a range of impact evaluation methodologies of different rigor and complexity going from before and after analysis(12, 18), difference in difference(11, 17), interrupted time series analysis (Dundas) and instrumental variable analysis(15, 16).

The meta-analysis and the pooled analysis(7, 8) were both summarizing evidence on Welfare-to-Work interventions: these interventions have been defined as all ranges of interventions involving financial sanctions and incentives, training, childcare subsidies and lifetime limits on benefit receipt that are used to support or mandate employment among parents(7). Table 2 provides a detailed description of the interventions included in this review both in terms of benefits provided and beneficiaries (i.e. target population).

With one exception(12), all papers included in this review explicitly mentioned a theory of change or logic model either informing their study hypotheses or guiding their results interpretation: for example, Dundas et al(13) all speculated that maternal nutrition and smoking were key mediating behaviors that could be influenced both through the antenatal advice offered and through the money provided through the HiP grant(13). Same was also speculated by Hoynes et al(18) and Rosenthal, who evaluated possible mechanisms for the changes in infant health by examining impacts on maternal health behaviours (smoking and drinking during pregnancy), underlying co-morbidities and maternal health utilization behaviours (prenatal care).

Maternal depression and parental warm were both identified as potential mediators of the welfare programs' impact in most studies(7, 8, 10, 15, 17, 18).

In all studies looking a earned income tax credit and welfare-to-work programs, income and employment were hypothesised to affect maternal mental health of parents (whether married or lone), which in turn affects child physical and mental health.

Multiple pathways were speculated through which maternal socioeconomic disadvantage during pregnancy could impact perinatal health. Women with lower household income, for example, suffer from higher rates of malnutrition, exhibit disproportionately high rates of risky health behaviours such as smoking and alcohol use, and demonstrate heightened psychological stress associated with neuroendocrine dysfunction(15). They are also less likely to have access to adequate prenatal care services, and less likely to breastfeed their children(15).

In some studies(10, 15-18), authors mentioned the "family process" conceptual model, suggesting that the extra income provided by child benefits may improve long-run outcomes not only through direct investments but also by improving the emotional environment in which the children grow (8).

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Table 1 – Synopsis of studies included in the review

<i>Author</i>	<i>Year of intervention implementation</i>	<i>Country</i>	<i>Type of intervention</i>	<i>Health Outcome</i>	<i>Study design</i>
<i>DUBAY ET AL(12)</i>	Reforms occurred in 1985, 1986, 1987, 1988 with Medicare Catastrophic act and	United States	Health Insurance	Birth weight ¹	Natural experiment - Before and after analysis
<i>LEYLAND ET AL(13)</i>	From April 2009 to January 2011	Scotland	Universal Unconditional Cash transfer	Birth weight ¹	Natural experiment – Interrupted time-series analysis
<i>GIBSON ET AL(7)</i>	Not applicable	North America and UK	Welfare-to-work' (WtW) interventions to support employment among lone parents	Child mental health ²	Meta-analysis of 12 RCTs
<i>HAMAD ET AL 2015(15)</i>	From 1986 to 2000	United States	Earned Income Tax Credit	Birth weight ¹	Panel data with Instrumental Variable strategy
<i>HAMAD ET AL 2016(16)</i>	From 1986 to 2000	United States	Earned Income Tax Credit	Child mental health ²	Panel data with Instrumental Variable strategy
<i>HILL ET AL(8)</i>	Mid to late 1990s	United States and Canada	Welfare to Work interventions (WtW) through income disregards and supplement	Child mental health ²	Pooled analysis of five RCTs
<i>HOYNES ET AL(18)</i>	1993	United States	Earned Income Tax Credit	Birth weight ¹ Weight-for-gestational age ³	Natural experiment- before and after analysis



<i>KOMRO ET AL(17)</i>	From 1994 to 2013	United States	Earned Income Tax Credit	Birth weight ¹	Natural experiment-difference in difference
<i>MORRIS ET AL(10)</i>	From 1992 to 1995	Canada	Conditional cash transfer	Child mental health ²	RCT
<i>MILLIGAN ET AL(11)</i>	2001	Canada	Unconditional cash transfer	Social and motor development Child mental health ²	Natural experiment-difference in difference
<i>ROSENTHAL ET AL(14)</i>	From 1998 to 2001	United States	Conditional cash transfer	Birth weight ¹	Panel data analysis study with Instrumental Variable analysis

1. Measured as birth weight in g or as presence/rate of low birth weight
2. This refers to child mental health as parent -or-child reported or mental health standard measures that varied across studies: Behavior Problems Index (BPI) in (7,8, 16); Positive Behavior Scale (PPS) in (8); BPI-like and PBS-like scales used for National Longitudinal Survey of Children and Youth Canada (NLSCY) in (10); Scales assessing Anxiety and separation anxiety and physical and indirect aggression in (11).
3. Below the tenth percentile of birth weight for gestational age (18).

Table 2 – Intervention description by type, theory of change and target population

AUTHOR	INTERVENTION	DESCRIPTION OF INTERVENTION	POPULATION TARGETED
DUBAY ET AL(12)	Health insurance	Expansion of Medicaid coverage for pregnant women. To evaluate whether the Medicaid expansions achieved the policy objective of increased access to care and improved birth outcomes among poor and near-poor women, authors conducted a before and after analysis using national natality files to compare rates of delayed initiation of prenatal care and rates of low birth weight by race and socioeconomic status for the periods 1980-86 and 1986-93. The impact of expansion of Medicaid coverage was assessed by women race, marital status and education.	All United States women below the poverty line
LEYLAND ET AL(13)	Conditional cash Transfer	The HiP grant was a universal conditional cash transfer of £190 for women reaching 25 weeks of pregnancy if they had sought health advice from a doctor or midwife. It was intended to provide additional financial support in the last months of pregnancy to contribute towards a healthy lifestyle. The grant was introduced for women with a due date on or after 6 April 2009 and subsequently withdrawn for women reaching the 25th week of pregnancy on or after 1 January 2011.	All women in Scotland (but the intervention was delivered through all Great Britain and Northern Ireland from 2009 to 2011) reaching 25 weeks of pregnancy if they had sought health advice from a doctor or midwife.
GIBSON ET AL(7)	Welfare-to-Work	Welfare to work intervention aimed to increase employability with different strategies ranging from earning supplements, to childcare subsidies and employment-related activities	Lone parents and their dependent children residing in countries defined by the world bank as "high income" with established social welfare systems (including US, Canada and UK).
HAMAD ET AL 2015(15)	Earned Income Tax Credit	The Earned Income Tax Credit (EITC) is the largest poverty alleviation program in the US. It involves a tax rebate to low-income families contingent upon their employment, with larger benefits for recipients with children. Individuals with no earned income are not eligible. The size of the credit increases with increasing earned income, eventually plateauing followed by a phase-out of benefits. Initiated in 1975, the program was expanded in 1993, creating substantial variation in the size of the tax credit awarded to recipients. Individual states also offered differing amounts of earned income tax credits that underwent expansions during the study period. The quasi-random nature of these variations – in that	Low income families in the United States contingent upon having an earned income.



they are unassociated with individual characteristics – presents the opportunity to more clearly identify the impacts of the EITC on health.

HAMAD ET AL 2016(16)	Earned Income Tax Credit	See above	See above
HILL ET AL(8)	Welfare-to-Work	<p>The authors examined the effects of welfare programs in the United States and Canada that increased maternal employment and family income on the development of very young children using data from 5 random-assignment experiments. The children were 6 months to 3 years old when their mothers entered the programs; cognitive and behavioral outcomes were measured 2–5 years later. All were implemented in the mid to late 1990s (prior to U.S. federal welfare reforms) as experimental demonstrations of programs designed to increase parental employment and reduce welfare receipt. All programs mixed and matched various components together: all five sought to make work pay by offering income disregards or income supplements (both of which have the effect of decreasing the marginal tax rate on earnings) to employed participants. All but one, mandated employment by conditioning welfare benefits on participation in employment-related activities, such as job searching, job training, and employment. Two programs provided expanded child care assistance, making it easier for parents to purchase child care through some combination of subsidies, direct payment to child care providers, promotion of center-based child care, and access to child care resource and referral services. The generosity of the earning supplement varied by the program. .</p>	Low income parents of children aged 6 months to 3 years
HOYNES ET AL(18)	Earned Income Tax Credit	Same as described by Hamad et al. .	Single mothers aged 18 and older with singleton births
KOMRO ET AL(17)	Earned Income Tax Credit	Same as described by Hamad et al.	Single mothers aged 18 and older with

singleton births

<p>MILLIGAN ET AL(11)</p>	<p>Unconditional cash transfer</p>	<p>Starting in 1998, the core Canada Child Tax Benefit was augmented with a new program called the National Child Benefit. Under the National Child Benefit program, the federal government provided a cash benefit called the National Child Benefit Supplement (NCBS). By 2008, the NCBS reached monthly rates of Canadian \$169 for a first child, \$149 for a second, and \$142 for subsequent children.</p> <p>In 2001, the province of Manitoba changed its approach to the NCBS. Prior to 2001, Manitoba was one of the provinces that reduced welfare checks when a family received the NCBS, dollar for dollar. However, starting in 2001, Manitoba ended this “clawback” for children age zero to five. Furthermore, in 2003, the clawback exemption was extended to all children age zero to eleven. This policy reform implied an increase in income for families. Also the receipt of the NCBS check was not conditional upon parents employment.</p>	<p>Low income families eligible for the NCBS checks. Authors focussed on all children aged 0 to 5 years between the years 1999 and 2005. Years from 2001 onward were coded as as being “after” the policy change</p>
<p>MORRIS ET AL(10)</p>	<p>Conditional cash transfer</p>	<p>The Self-Sufficiency Project (SSP) was a demonstration program designed to make work a viable alternative to welfare for low-income parents, whose skills and experience would likely relegate them to low-paying jobs. SSP’s financial supplement paid parents who left welfare and worked at least 30 hours per week half the difference between their actual earnings and a target level of earnings. The target earnings were set at Can\$30,000 in New Brunswick and Can\$37,000 in British Columbia a year.</p>	<p>Single parents in British Columbia and New Brunswick who had been on welfare for at least a year were selected at random from the welfare rolls between November 1992 and March 1995.</p>
<p>ROSENTHAL ET AL(14)</p>	<p>Conditional Cash Transfer</p>	<p>In November 1999, Las Vegas introduced a program to encourage members to seek prenatal care in the first trimester of pregnancy to complement its traditional high-risk maternity management program. The program offered US\$100 to both the pregnant member and the member’s network obstetrician or midwife after delivery upon verification that the patient entered care during the first trimester and completed regular visits thereafter.</p>	<p>Pregnant women enrolled in the program from 1998 to 2001.</p>

5.3. Impact findings

In this report impact findings are reported both qualitatively and quantitatively. Findings have been labelled as positive, when demonstrating an effect in the expected direction (i.e. health outcome improvement), negative when showing an impact in opposite direction expected (i.e. health outcome worsening) or null, when no effect, with any clear direction was observed. Under the positive impact findings, we included all studies showing a clear direction of the effect, regardless of issues of statistical significance.

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Overall, the 11 papers included in the review do not allow to draw a clear conclusion about the impact of these interventions: as shown in **Table 3, 4 and 5**, positive and null findings seem to be equally distributed across studies, with six papers providing evidence of a positive impact (whether or not statistically significant)(11, 12, 16-18) and seven papers documenting no effect(7, 8, 10, 12, 13, 15). In two cases(8, 12) authors documented a negative impact of the intervention. In particular Dubai et al(12) observed a marginally significant increase in low birth weight among unmarried African American women with less than 12 years of educations. In Hill et al(8), the positive behaviour among children in age group 12-23 months was negatively affected by mothers assignment to the treatment group. It is worth noticing that in both instances(8, 12) negative results were paralleled with positive or null findings in the same status in other subgroup analyses

In **Table 3** we provide a distribution of the impact findings by type of interventions and study design. Data do not seem to suggest a clear trend with impact findings apparently randomly distributed across the categories of interest. In particular, randomized controlled trials seems to yield consistently a null effect(7, 8, 10).

In terms of type of intervention, the Earned Income Tax credit in the United States seems to produce almost consistently a positive impact on child health(16-18) and this irrespective from the impact evaluation method adopted; on the other hand, welfare-to-work intervention seem to be unable to produce a detectable improvement in child health. However, it is unclear whether this is linked to the type of intervention or to the study design of these interventions (only randomized control trials).

The direction of impact does not seem to be affected by the child outcome of interest under study. **Table 4** shows a mixed picture with positive and null effect results equally represented between studies looking at birth weight and child mental health. Hoynes et al found a positive effect in all birth outcomes, including weight-for-gestational age (18).

In terms of magnitude of positive impact findings (**Table 5**), evidence seems to suggest a general modest effect in all studies, whose translation in public health terms is not obvious. In one case(17), authors attempted to extrapolate the observed effect into actual negative outcomes averted and concluded that a 12% reduction in low birth weight translates into 3760 fewer low birth weight babies born from black mothers and 8364 fewer low birth weight babies born from white mothers per year across the United States. Hispanic and non-Hispanic mothers display relatively similar effects. Given the high heterogeneity of studies involved, a comparison of the magnitude of impact across different interventions is of limited meaning.

Table 3 – Impact findings by study design and type of intervention

<i>Intervention</i>	<i>Study design</i>	<i>Positive impact (1)</i>	<i>Negative impact (2)</i>	<i>Null effect</i>
Health insurance				
<i>Dubay et al(12)</i>	Natural experiment – Before and After study	• ^a	• ^b	• ^c
Unconditional cash transfer				
<i>Leyland et al(13)</i>	Natural experiment – Interrupted Time Series analysis			•
<i>Milligan et al(11)</i>	Natural experiment – Difference in Difference	•		
Conditional cash transfer				
<i>Morris et al(10)</i>	RCT			•
<i>Rosenthal et al(14)</i>	Natural experiment – IV analysis	•		
Welfare – to – Work				
<i>Gibson et al(7)</i>	RCTs			•
<i>Hill et al(8)</i>	RCTs		• ^d	•
Earned income tax credit				
<i>Hamad et al 2015(15)</i>	Natural experiment - IV analysis			•
<i>Hamad et al 2016(16)</i>	Natural experiment - IV analysis	•		
<i>Komro et al(17)</i>	Natural experiment – Difference in Difference	•		
<i>Hoynes et al(18)</i>	Natural experiment – Before and After	•		

1. Effect in the expected direction (whether statistically significant or not). Magnitude and statistical significance of impact are outlined in Table 5.
2. Effect in the opposite direction expected (i.e. health outcome worsened after the intervention)
 - a. Decreases in the rate of low birth weight limited primarily to primarily to white women with less than 12 years of schooling.
 - b. For unmarried African American women with less than 12 years of schooling, the difference-in-differences estimate yields a relative increase of low birth weight that is marginally significant. Positive behaviour of children age 1 (12–23 months) was negatively affected by mother's assignment to the treatment group.
 - c. No meaningful improvement in the rate of low birth weight among Black African women irrespectively of education and marital status.
 - d. Positive behaviour of children age 1 (12–23 months) was negatively affected by mother's assignment to the treatment group.

Table 4 – Impact findings by child health outcome

<i>Child outcome</i>	<i>Intervention</i>	<i>Positive impact (1)</i>	<i>Negative impact (2)</i>	<i>Null effect</i>
Birth weight				
<i>Dubay et al(12)</i>	Health insurance	• ^a	• ^b	• ^c
<i>Leyland et al(13)</i>	Unconditional cash transfer			•
<i>Hamad et al 2015(15)</i>	Earned Income Tax Credit			•
<i>Hoynes et al(18)</i>	Earned Income Tax Credit	•		
<i>Komro et a(17)l</i>	Earned income Tax Credit	•		
<i>Rosenthal et al(14)</i>	Conditional Cash Transfer	•		
Child mental health				
<i>Gibson et al(7)</i>	Welfare-to-Work			•
<i>Hill et al(8)</i>	Welfare-to-Work		• ^d	•
<i>Hamad et al 2016(16)</i>	Earned Income Tax Credit	•		
<i>Morris et al(10)</i>	Conditional cash Transfer			•
<i>Milligan et al(11)</i>	Unconditional cash transfer	•		

1. Effect in the expected direction (whether statistically significant or not). Magnitude and statistical significance of impact are outlined in Table 5.
2. Effect in the opposite direction expected (i.e. health outcome worsened after the intervention)
 - a. Decreases in the rate of low birth weight limited primarily to primarily to white women with less than 12 years of schooling.
 - b. For unmarried African American women with less than 12 years of schooling, the difference-in-differences estimate yields a relative increase of low birth weight that is marginally significant.
 - c. No meaningful improvement in the rate of low birth weight among Black African women irrespectively of education and marital status.
 - d. Positive behaviour of children age 1 (12–23 months) was negatively affected by mother's assignment to the treatment group.

Table 5 – Magnitude of positive effect and results interpretation^a

Child outcome	Intervention	Outcome description	Measure of impact	Effect estimate	Results interpretation
Birth weight					
Dubay et al(12)	Health insurance	Low birth weight percentage, stratified by race, years of education and marital status	Percentage point difference ¹	<u>White women</u> ² Unmarried with less than 12 years of education -0.38 (95% C.I. -0.73; -0.02) Married with less than 12 years of education -0.29 (95% C.I. -0.54; -0.06) <u>African American women</u> ² Unmarried with 12-15 years of education -0.11 (95% C.I. -0.50; 0.27)	<p>More info on LIFECYCLE online: lifecycleproject.eu</p> <p>These large discrepancies in infant health by race and socioeconomic status reflect complex and deeply rooted interactions among poverty, race, parents' behavior, and access to high quality health services. The ability of health care to offset these other deficits, however, may be limited. The emerging lesson from the health insurance eligibility expansions is that increased access to prenatal care is not enough, if the goal is to narrow the gap in health between poor and nonpoor populations.</p>

Child outcome	Intervention	Outcome description	Measure of impact	Effect estimate	Results interpretation
Birth weight					
Hoynes et al(18)	Earned Income Tax Credit	Low Birth Weight	DD ¹ regression coefficient	Parity 2+ versus Parity 1 ³ : -0.35, $p < 0.01$ Parity 3+ versus Parity 1: -0.53, $p < 0.01$ Parity 3+ versus Parity 2: -0.34, $p < 0.01$ Parity 2 versus Parity 1: -0.16, $p < 0.05$	<p>For single, low-education (12 years or less) mothers, a policy-induced treatment on the treated increase of \$1000 in after-tax income is associated with a 0.17 to 0.31 percentage point decrease in low birth weight status. Given roughly 10.7 percent of treated children were low birth weight, this represents a 1.6 percent to 2.9 percent decline.</p>

Table 5 – Continued

Child outcome	Intervention	Outcome description	Measure of impact	Effect estimate	Results interpretation
Birth weight Komro et al(17)	Earned income Tax Credit	Birth weight in grams LBW percentage All results are stratified by race and shown according to the intervention characteristics ⁴	DD ¹ regression coefficient	<p><u>Birth weight</u> <i>EITC, NR, < 10%</i> Black:16.120, <i>p<0.01</i> White:9.830, <i>p<0.01</i> Hispanic:11.264, <i>p<0.01</i> Non-hispanic:8.667, <i>p<0.05</i></p> <p><i>EITC, R, <10%</i> Black: 19.342, <i>p<0.01</i> White:18.219, <i>p<0.05</i> Hispanic:21.431, <i>p<0.01</i> Non-hispanic: 15.530, <i>p<0.10</i></p> <p><i>EITC, NR, 10%+</i> Black:19.257, <i>p<0.01</i> White:10.462, <i>p<0.01</i> Hispanic:16.561, <i>p<0.01</i> Non-hispanic:11.851, <i>p<0.01</i></p> <p><i>EITC, R, 10%+</i> Black:37.164, <i>p<0.01</i> White:28.400, <i>p<0.01</i> Hispanic:35.613, <i>p<0.10</i> Non-hispanic:28.492, <i>p<0.01</i></p> <p><u>LBW %</u> <i>EITC, NR, < 10%</i> Black:-0.007, <i>p<0.01</i> White:-0.002, <i>p<0.05</i> Hispanic:-0.001, <i>p<0.10</i> Non-hispanic:-0.004, <i>p<0.01</i></p> <p><i>EITC, R, < 10%</i> Black:-0.009, <i>p<0.01</i> White:-0.005, <i>p<0.01</i> Hispanic:- 0.004, <i>p<0.05</i> Non-hispanic:-0.006, <i>p<0.05</i></p> <p><i>EITC NR, 10%+</i> Black:-0.006, <i>p<0.05</i> White:-0.002, <i>p<0.01</i> Hispanic:-0.002, <i>p<0.05</i> Non-hispanic:-0.003, <i>p<0.05</i></p> <p><i>EITC R, 10%+</i> Black:-0.014, <i>p<0.01</i> White:-0.007, <i>p<0.01</i> Hispanic:-0.007, <i>p<0.01</i> Non-hispanic:-0.009, <i>p<0.01</i></p>	In states with the most generous state EITCs, refundable and 10% or more of the federal, they found nearly 12% reductions in LBW births for black and white mothers. Among mothers with a high school education or less, this reduction translates to 3760 fewer babies born LBW with black mothers and 8364 fewer babies with white mothers per year across the United States. Hispanic and non-Hispanic mothers display relatively similar effects.

Table 5 – Continued

Child outcome	Intervention	Outcome description	Measure of impact	Effect estimate	Results interpretation
Birth weight					
Rosenthal et al(14)	Conditional Cash Transfer	LBW rate	Logistic regression coefficient (Odd Ratio) obtained through Instrumental Variable analysis	0.53 (95%CI: 0.23; -1.18)	Despite non-significant, the magnitude of effect is similar to the one obtained through ordinary logistic regression in which the exposure (i.e. intervention enrolment) is the one as reported in the dataset.
Child mental health					
Hamad et al 2016(16)	Earned Income Tax Credit	BPI score ⁵ . The score was measured after 2 and 4 years ⁶	Linear regression coefficient (BPI score difference)	2 year difference -0.46 (95%C.I.: -0.86;-0.091) 4 year difference -0.41 (95% C.I.: -0.91;-0.001)	Results suggest that there were positive effects on children's behavioral problems in the sample overall. The effect magnitudes were approximately 5% of a standard deviation for every \$1,000 of income. Although these associations were modest, it is possible that persistent increases in income might bring about greater cumulative changes in child development
Child mental health					
Milligan et al(11)	Unconditional cash transfer	Social and motor development score ⁷ Physical aggression score Separation anxiety score Indirect aggression score Anxiety score	Regression coefficient	Social/motor development 0.187, $p<0.01$ Physical aggression -0.208, $p<0.01$ Separation anxiety -0.138 Indirect aggression -0.145 Anxiety -0.204, $p<0.10$	

- a. As by reported in the authors of the papers.
1. Estimated through Difference in Difference (DD).
 2. For white woman positive effect were found only for women with less than 12 years of education, stratified for their marital status. For African Americans, results are shown for

unmarried women with 12-15 years of education. For both races, results for other educational levels the effect is null.

3. The study used different models comparing parity of the mothers because EITC treatment corresponds to the number of children prior to the current birth. Model 1 uses women at second or higher pregnancy as intervention group and women at first as control. Model 2 uses separately women at second and third or higher pregnancy as control vs first pregnancy. Model 3 uses mother at third or higher pregnancy vs mother at second.
4. Intervention categories are defined in this way: NR/R (Non-refundable or Refundable amount) and intervention benefit size groups (reported as percentage of the federal amount, i.e. less than 10%, 10% or more). All EITC categories are compared with states with no EITC (reference).
5. Different scales are used as Behavior Problems Index, Behavior Problems Scale, Survey Diagnostic Instrument Conduct Disorder. Result are reported as standard deviation of the scores, normalized
6. In the results BPI score difference was calculated both as 4 years after the intervention vs actual difference and 2 years after the intervention vs actual difference
7. Scales used in this study are Canadian scales of parents reports developed for use in the National Longitudinal Survey of Children and Youth. Results are stratified per age. We took in account the impact on preschoolers at 36 months of follow up.

6. Discussion

This review aimed to provide insights into the impact of macro-level socioeconomic interventions on life-course risk factors as part of Work-package 9 of the LifeCycle Project. To the best of our knowledge this is one of the few attempts available in the literature trying to summarise this effect in a systematic way and – most importantly – in high income countries.

As concluded in similar recent efforts(7, 19), in this review we could not conclusively demonstrate an effect of macro-level social policies on the selected child outcomes. Despite evidence from observational studies strongly support an association with income (or more broadly household socioeconomic position)(20), experimental and quasi-experimental studies targeting specific programs in high income countries seem to show a null or weak positive effect on the health outcomes of interest. This conclusion seems to be robust to the type of intervention and child outcome under observation, whereas quasi-experimental studies seem to return more often evidence of a positive effect, albeit mostly modest.

One could argue that despite the small observed effect, the proportion of people exposed to these policies is quite large which could result overall into a considerable effect in public health terms. Nonetheless, only two studies in this review have tried to extrapolate this effect at population level(17, 18).

There are a number of possible explanations for the results of our review:

1. Despite the extensive review of different, multidisciplinary literature browsers, the search strategy returned a limited number of eligible studies. This is consistent with what also concluded in similar reviews(7, 19) claiming that evidence are inconclusive also because very few experimental or quasi-experimental studies have been

undertaken to explore the impact of complex, macro-level socioeconomic interventions on child health and - even less - on specific, well measured child health outcomes. The restriction of the outcomes of interest to the life-course risk factors relevant for the LifeCycle project has further limited the literature to draw upon.

2. If we exclude studies that have used a randomised control study designs(7, 8, 10), results appear less mixed and more convincingly leaning towards an overall positive effect: as argued by other authors(21, 22) it could be that randomised controlled trials are not the elective choice for the evaluation of complex interventions. Quasi-experimental studies seem to be more suitable to this scope and more likely to portray the actual effect of these interventions. Given the limited number of studies, this remains speculative, but there is clearly the need to understand how methodological aspects influence our understanding of the health impact of these policies.
3. It is worth noting that with few exceptions(13, 14), most of the interventions included in the review were *not* originally designed and implemented to evaluate nor achieve an health effect. This implies that some of the potential impact of these programs could have been missed purely for design/implementation reasons. On the other hand, for those interventions that had a quantifiable effect (e.g. the Earned Income Tax credit studies), one could argue how bigger this effect could have been if these programs were designed with the precise intent of improving people health other than just socioeconomic measures.
4. The relative modest or null effect observed in the studies included in this review could be attributed to the size of the benefits provided: this may explain for example why the impact of the Earned Income Tax credit (where the size of cash received can be relatively high(16, 18)) seems almost consistently positive. By contrast, no effect was detected for both the conditional cash transfers included in this review where the overall cash transfer provided to beneficiary women, of respectively 190GBP and 100 USD, appeared fairly small(13, 14). These observations are consistent with what reported in other reviews similar to this one: for example, Lucas et al(19) concluded that the monetary value of many interventions was low. In most studies the total increase in income to intervention families was less than US\$50 per month despite the fact that many parents were compelled to work full-time (8). Authors questioned whether the level of income increase was sufficient to affect living conditions and – we would add – it was big enough to ensure this effect translated into an health effect(19). Similarly the impact of Welfare-to-work interventions on health were considered to be unlikely to have a tangible impact and this largely because of the small effect on the economic outcomes (i.e. income)(7). Authors observed that even where employment and income were higher for lone parents enrolled in these programs, poverty was still high for the majority of them in many of the studies. Perhaps because of this, depression also remained very high for lone parents whether they were enrolled in these programs or not(7).
5. Most of the interventions included in this review focus on indicators of socioeconomic position or - broadly speaking - econometric concepts of disadvantage. While the association between these constructs and child health is widely acknowledged, this relationship is likely to be complex and mediated by a number of underlying known

and unknown pathways: if the effect on income does not translate into a tangible effect on these mediators then the expected impact on child health may not materialise as expected. As in Gibson et al(7), the role of parental depression and in particular maternal mental health has been speculated to be an important mediator. Other studies(11, 18) suggest a 'family process' mediation pathway according to which the extra income provided by the child benefits may improve in the long-run outcomes not only through direct financial investment, but also by improving the emotional environment in which children grow up. Another important mediator is whether the increase of income happens via the mother's employment(8, 18): some authors speculated that some policies that incentivise maternal employment may involuntarily increase maternal stress and add extra pressure on mothers which offsets the benefit of a better income on children(8). Similarly, Morris et al(10) argue that a proper evaluation of the impact of better income and parental employment on child health should account for the moderating role of the developmental period of the child. According to these authors(10), the effect of income and employment on children aged 1 or less may be counterbalanced, if not reverted, via prolonged periods of time of maternal absence which ultimately leads to increased instability of care and reduced parental warmth(10).

Our review presents with a number of limitations: despite our comprehensive search of the literature, the papers included in this review showed a heavy predominance of studies from North America and impact studies about the Earned Income Tax Credit in the United States. This unbalance is probably largely due to the fact that Earned Income Tax Credit is the most important poverty-alleviation strategy in the United States and it is particularly suitable to quasi-experimental impact evaluations because of variation in the distribution of benefits and changes in welfare policy. The results are still relevant; however, their external validity to countries beyond the United States and to different type of interventions remain limited. The evidence we gathered therefore provides at most a partial representation of existing macroeconomic policies.

In several studies, authors documented a differential impact by race and education level. Sometimes the evaluation of impact by race gave conflicting results(12, 17, 18), clearly there is the need to understand better this complex interaction effect and who may most benefit from this type of policies.

Finally, we have not completed yet the formal assessment of the biases and other important quality issues of the papers included in this review. No conclusion can be reached at this stage about the quality of the reviewed literature and how this may have affected our findings.

7. Implications for future research

This review provides a useful contribution to the literature on the health impact of social policies. Through the extensive review of the evidence, this research allowed to speculate about possible mechanisms through which these policies may play an effect and why they seem to fail in other circumstances. Finally, through the identification of persisting

knowledge gaps, it allowed to draw a research agenda for the future that applies within and beyond the LifeCycle project:

- First, there is clearly a scope to invest more in the evaluation of the child health impact of macro-level socioeconomic interventions either by financing more impact evaluations or by advocating for a better design and implementation of these policies to allow their proper health impact assessment.
- Second, the association between income and child health is amply demonstrated. If interventions aiming at improving income do not obtain a commensurate effect on child health outcomes, there is clearly something not working either in the type of intervention provided or in the way we measure this effect. Randomised Controlled trials are considered to be often unfeasible and unethical and unable to capture the complexity of social 'experiments'(22). On the other hand, quasi-experimental studies are often imperfect tools that only allow for comparisons between sub-optimal groups(23). Given the above, there is a mandate to investigate the role of alternative methodologies including observational studies as well as mathematical modelling (i.e. microsimulations) in filling the numerous knowledge gaps still surrounding the impact of socioeconomic interventions on child health.
- Thirdly, the question of 'what works?' should be more correctly replaced by 'what works for whom and why?'. There is an urgent need to unpack the effect of these interventions to understand better the reasons for their failure and success. This could be achieved through the design of impact evaluations complex enough to allow the collection of data on known mediating pathways. Alternatively, and perhaps more conveniently, one could complement reviews like this one, with a "realist" approach, that is a type of literature review in which evidence are mapped against a pre-defined conceptual framework to validate or reject the existence of the speculated underlying pathways linking the interventions with the outcomes of interest(24). This lens could be applied to the subject of this review and provide important additional explanations on the likely impact of these interventions on child health.
- Finally there is scope to expand this literature review by adding the evidence resulting from the grey literature as well as papers referring to generic child health outcomes in children. The paucity of evidence impose to expand the studies eligibility also to those looking at child health and wellbeing in general. It is also worth remembering that the corresponding literature from low and middle income countries is far more rich and – with all the due differences – can still contribute to the understanding of the potential public health impact of these macro-level policies. In other words, there may be merits in creating more connections between low/middle income and high income countries on socioeconomic interventions and explore how lessons can be extrapolated to both environments(25).

8. Conclusions

On the basis of this review we have not been able to establish conclusively whether macro-economic policies delivered in the first 1,000 days of life are able to improve important life-course risk factors and child health outcomes. If we concentrate on quasi-

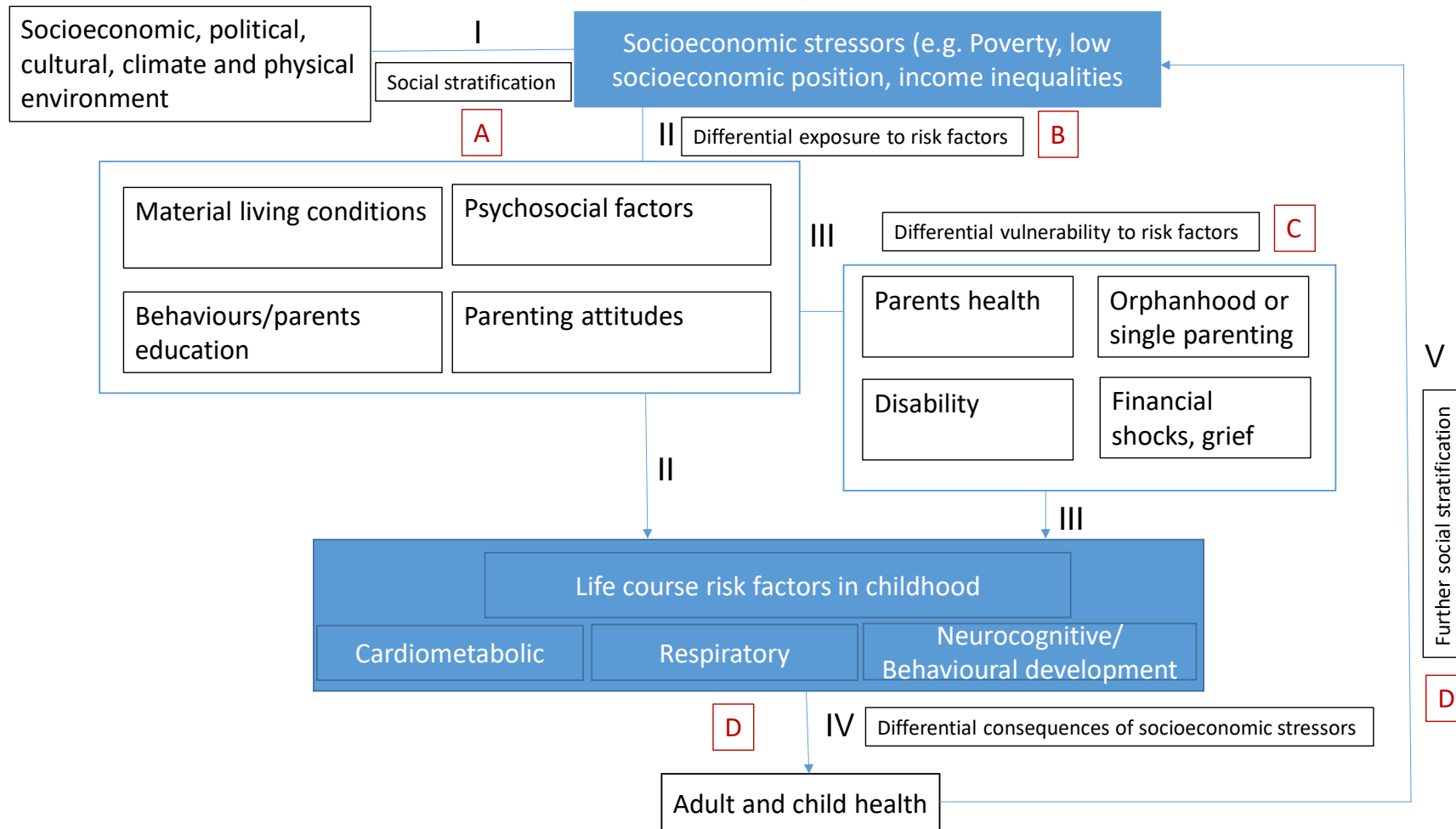
experimental studies only, evidence seem to lean towards a modest, but positive effect of these policies. However, the breath and scope of the literature needs to be enriched with more and more diversified studies (in terms of health outcome, country and intervention of interest) before a definitive conclusion can be reached and the public health potential of these policies is fully understood. The association between lower income and poorer outcome across all dimensions of child health is strong and consistent across countries and time: the fact that a relatively small number of interventions show a small or null effect should be considered as a “research call” to undertake more and better impact evaluations of these policies, able not only to quantify their effect, but also to provide evidence on what works best, for whom, at what development stage and - most importantly - why.

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26. Appendix 1 – Impact of socioeconomic stressors on life course risk factors: the review conceptual framework



Appendix 2 – Data extraction form



For each eligible paper the following information were extracted and copied in the tables below and stored in an excel file.

Table 1: General info	Table 2: Study characteristics	Table 3: Impact and operational findings <small>More info on LIFE CYCLE online: lifecfindings.eu</small>	Table 4: Limitations and biases
Authors	Authors	Authors	Authors
Year of publication	Intervention description (benefit provided: type, size and duration)	Measure of effect (OR, RR, % etc.)	Missing values (yes, no, unknown)
Country	Intervention description (Delivery, frequency of delivery)	Impact- qualitative (positive/negative and statistically significant/ not statistically significant)	Lost to follow up (yes, no, unknown)
Objective	Intervention description (Provider)	Impact- quantitative	Bias 1 (type of bias)
Secondary objective	Intervention description (Recruitment strategy)	Impact after confounding (if applicable)	Bias 2 (type of bias)
Intervention category	Inclusion criteria	Impact after mediation analyses (if applicable)	Bias 3 (type of bias)
Year of intervention implementation	Exclusion criteria	Acceptability of the intervention (yes, no, unknown)	Spill over (yes, no, unknown)
Health outcome 1	Intervention group (N)	Feasibility of the intervention (yes, no, unknown)	Groups equivalence (yes, no, unknown)
Health outcome 2	Intervention group (description)	Reported ethical issues	Fidelity of intervention
Population of interest	Control group (N)		
Subgroup of interest	Control group (description)		
	Design/ evaluation method		
	Randomization (Yes/No)		
	Theory of change/Conceptual framework (Yes/No)		
	N. of measurement in time (1, 2, more than 2)		
	Outcome measurement (tool, unit)		

Appendix 3 – List of references (N.11) included in this review (in alphabetic order)

More info on LIFECYCLE online:
lifecycle-project.eu

1. Dubay L, Joyce T, Kaestner R, Kenney GM. Changes in prenatal care timing and low birth weight by race and socioeconomic status: implications for the Medicaid expansions for pregnant women. *Health Serv Res.* 2001 Jun;36(2):373-98. PMID: 11409818; PMCID: PMC1089229.
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Appendix 4 – List of references (N.84) excluded from this review (in alphabetic order)

More info on LIFECYCLE online:
lifecycle-project.eu

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Appendix 5 – List of studies included in the pooled analysis and meta-analysis included in this review

More info on LIFECYCLE online:
lifecycle-project.eu

Studies included in the pooled analysis(8)

Bloom D, Kemple JJ, Morris P, Scrivener S, Verma N, Hendra R, et al. The Family Transition Program: Final Report on Florida's Initial Time-limited Welfare Program. New York: Manpower Demonstration Research Corporation 2000.

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